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8.1 Readers' Guide

4 Chapter 8, *Water Quality*, describes the environmental setting and potential impacts of the BDCP on
5 water quality in and upstream of the Sacramento-San Joaquin Delta. The chapter provides the
6 results of the evaluation of the effects of implementing the BDCP conservation measures on water
7 quality constituents under a no action alternative and 15 different project alternatives. This guide is
8 intended to help the reader understand the organization of the chapter and the impact analysis of
9 the constituent of interest.

10

8.1.1 Overview

11 Chapter 8 is organized much like the other chapters in this document, but because of the chapter's
12 greater scope, this guide is provided to help the reader navigate through the various components of
13 the chapter.

14 The chapter is divided into three main sections.

- 15
- 16 • 8.1 *Environmental Setting/Affected Environment*
 - 17 • 8.2 *Regulatory Setting*
 - 18 • 8.3 *Environmental Consequences*

18 These sections parallel the same sections in other resource chapters.

19

8.1.2 Environmental Setting/Affected Environment

20 The first part of the chapter is the Environmental Setting and Affected Environment section. This
21 section provides a general description of the existing environment, including the following:

- 22
- 23 • Overview of the Sacramento and San Joaquin River Watersheds
 - 24 • Water Management and the State Water Project and Central Valley Project Systems
 - 25 • Primary Factors Affecting Water Quality
 - 26 • Beneficial Uses
 - 27 • Water Quality Objectives and Criteria
 - 28 • Water Quality Impairments
 - 29 • Water Quality Constituents of Concern
 - 30 • Selection of Monitoring Stations for Characterization of Water Quality
 - 31 • Existing Surface Water Quality—this characterization is meant to provide a general
32 understanding of water quality conditions and historical monitoring data in the study area. The
33 discussion is not meant to explicitly define the Existing Conditions for CEQA purposes. The
CEQA baseline, *Existing Conditions*, is defined in Appendix 3D and for the purposes of

1 quantitative water quality assessments (as described in Section 8.3.4, *Effects and Mitigation*
 2 *Approaches*) is represented by Existing Conditions modeling runs, not historical water quality
 3 monitoring data as presented in this section.

4 **8.1.3 Regulatory Setting**

5 Numerous federal, state and local acts, rules, plans, policies, and programs define the framework for
 6 regulating water quality in California. The second part of the chapter, Regulatory Setting, describes
 7 water quality requirements that are applicable to the BDCP.

8 **8.1.4 Environmental Consequences**

9 The third part of the chapter describes the anticipated environmental consequences of the no action
 10 alternative and each of the 15 action alternatives. This part of the chapter is divided into four
 11 sections. The first two sections (Sections 8.3.1 and 8.3.2) provide an important foundation for the
 12 analysis of the environmental effects. The third section contains the analysis of each alternative's
 13 impacts as well as associated environmental commitments and mitigation measures that would be
 14 implemented to reduce those impacts. The final section discusses cumulative effects. The four
 15 sections are as follows:

- 16 • Methods of Analysis (Section 8.3.1), which presents information on models used and their
 17 linkages, methods specific to three different regions of the affected environment (Upstream of
 18 the Delta, Plan Area/Delta, and SWP/CVP Export Service Area), mercury and selenium
 19 bioaccumulation models, and constituent-specific considerations used in the assessment. The
 20 constituent-specific considerations used in the assessment section specifically identifies the
 21 water quality criteria/objectives used in the assessments and other methodological details
 22 specific to each constituent.
- 23 • Determination of Adverse Effects (Section 8.3.2), which describes results of the constituent
 24 screening analysis, a description of the comparisons made in the Effects and Mitigation
 25 Approaches section, and the criteria for determining if an impact is adverse and/or significant.
- 26 • Effects and Mitigation Approaches (Section 8.3.3), which provides a full discussion by
 27 alternative (no action alternative and 15 project alternatives) of impacts and mitigation
 28 approaches of the BDCP conservation measures on water quality constituents. ***Important***
 29 ***information about the organization of the Effects and Mitigation Approaches section is***
 30 ***provided below.***
- 31 • Cumulative Analysis (Section 8.3.4) addresses the potential for the BDCP alternatives to act in
 32 combination with other past, present, and probable future projects or programs to create a
 33 cumulatively significant adverse impact.

34 **8.1.5 Organization of the Effects and Mitigation Approaches** 35 **Discussion (Section 8.3.3)**

36 The Effects and Mitigation Approaches section (Section 8.3.3) contains the analysis of the impacts
 37 and mitigation on water quality constituents for each alternative. The section begins with an
 38 analysis of the No Action Alternative and is then followed by the action alternatives. A discussion of
 39 cumulative effects is included as a standalone section (Section 8.3.4) after Alternative 9.

1 Each alternative begins with a brief description of the alternative itself, including the capacity of the
2 North Delta intake structures, the operational scenario, and any other major aspects of the
3 alternative. Following this is the “Effects of the Alternative on Hydrodynamics” section, which
4 includes a brief discussion of how water quality constituents would be expected to change in general
5 due to changes in Delta hydrodynamics, the general changes in hydrodynamics due to the
6 alternative, and the types of water quality changes seen in the alternative.

7 To the extent there are similarities between the No Action Alternative or Alternative 1A and the
8 other alternatives, the subsequent alternative analyses refer back to either the No Action Alternative
9 or the Alternative 1A analysis. This approach allows the analysis of Alternative 1A and Alternatives
10 1B through Alternative 9 to minimize redundancy and emphasize those aspects of the alternatives
11 that are different from the No Action Alternative or Alternative 1A. Hence, readers wishing to gain a
12 better understanding of the impacts and mitigation for Alternatives 1B through 9 should first
13 become familiar with the presentation of impacts and mitigation for the No Action Alternative and
14 Alternative 1A. Alternatives ending in ‘B’ or ‘C’ are different from the corresponding ‘A’ variant of the
15 alternatives. The difference is the physical type and/or location of water conveyance infrastructure.
16 In all other respects, including water operations, the ‘B’ and ‘C’ variants are identical to the
17 corresponding ‘A’ variant. For example Alternative 1B is different from Alternative 1A in that
18 Alternative 1A would convey water from the north Delta to the south Delta through
19 pipelines/tunnels, while Alternative 1B would convey water through a surface canal. The effects on
20 water quality do not differ otherwise, so the analysis of the ‘B’ and ‘C’ alternatives is condensed and
21 refers the reader back to the corresponding ‘A’ alternative for specific details.

22 Restoration and Other Conservation Measures are the same among all but two of the alternatives.
23 The exceptions are Alternatives 5 and 7. Under Alternative 5, 25,000 acres of tidal habitat would be
24 restored, compared to 65,000 acres for Alternative 1A. Under Alternative 7, there would be 20,000
25 acres of seasonally inundated floodplain and 40 miles of channel enhancement, versus 10,000 acres
26 of seasonally inundated floodplain and 20 miles of channel margin enhancement under Alternative
27 1A. However, these differences do not substantially affect water quality impact conclusions
28 discussed in this chapter, and thus for Alternatives 1B through 9, the reader is referred back to
29 Alternative 1A for details. To help guide the reader, bookmark their location in the chapter, and
30 maintain consistency with Alternative 1A, the impact headers are retained in these other
31 alternatives and followed by a general summary in some instances and cross reference to
32 appropriate analysis located elsewhere in the chapter.

33 The BDCP conservation measures (see Table 3.3 Summary of Proposed BDCP Conservation
34 Measures of All Action Alternatives in Chapter 3, *Description of Alternatives*) that are analyzed for
35 each water quality constituent under each alternative are treated in two distinct categories for
36 purposes of impact analysis. Those categories are as follows:

- 37 ● Potential impacts resulting from water operations and maintenance of Conservation Measure 1
38 (Conservation Measure 1 provides for the development and operation of a new water
39 conveyance infrastructure and the establishment of operational parameters associated with
40 both existing and new facilities). For the purposes of the assessment, the study area was divided
41 into the three regions which are discussed separately for each constituent for Conservation
42 Measure 1:
 - 43 ○ Upstream of the Delta (including the Sacramento and San Joaquin River watersheds).

- 1 ○ Plan Area, including the Yolo Bypass, SWP North Bay Aqueduct service area, and Suisun
- 2 Marsh.
- 3 ○ SWP/CVP Export Service Area (south of the Delta, areas served by the California Aqueduct,
- 4 Delta Mendota Canal, and South Bay Aqueduct).
- 5 ● Potential impacts resulting from other conservation measures, Conservation Measures 2-22
- 6 (these include habitat restoration measures that provide for the protection, enhancement and
- 7 restoration of habitats and natural communities and measures to reduce the direct and indirect
- 8 adverse effects of other stressors on covered species).

9 Operations-related water quality changes (i.e., CM1 under the BDCP Alternatives) would be partly
 10 driven by geographic and hydrodynamic changes resulting from restoration actions (i.e., altered
 11 hydrodynamics attributable to new areas of tidal wetlands (CM4), for example). There is no way to
 12 disentangle the hydrodynamic effects of CM4 and other restoration measures from CM1, since the
 13 Delta as a whole is modeled with both CM1 and the other conservation measures implemented. To
 14 the extent that restoration actions alter hydrodynamics within the Delta region, which affects mixing
 15 of source waters, these effects were included in the modeling assessment of operations-related
 16 water quality changes (CM1 under the BDCP Alternatives). Other effects of CM2–22 not attributable
 17 to hydrodynamics, for example, additional loading of a water quality constituent to the Delta, are
 18 discussed within the impact heading for CM2–22.

19 After the discussion for each water quality constituent, construction-related water quality effects
 20 are discussed. As opposed to discussing construction-related water quality effects for each water
 21 quality constituent within the constituent-specific assessments described above, construction-
 22 related water quality effects on all constituents are discussed in a single section for all Conservation
 23 Measures 1–22. Within each alternative discussion section, the impacts of the BDCP conservation
 24 measures are analyzed in the following order:

- 25 ● Ammonia
- 26 ● Boron
- 27 ● Bromide
- 28 ● Chloride
- 29 ● Dissolved Oxygen
- 30 ● Electrical Conductivity
- 31 ● Mercury
- 32 ● Nitrate
- 33 ● Organic Carbon
- 34 ● Pathogens
- 35 ● Pesticides and Herbicides
- 36 ● Phosphorus
- 37 ● Selenium
- 38 ● Trace Metals
- 39 ● TSS and Turbidity

- Construction-related Activities

8.1.6 NEPA and CEQA Impact Conclusions

The analysis in Chapter 8 has been prepared in accordance with NEPA and CEQA. Each impact is presented as a NEPA analysis, using the appropriate terminology for presence or absence of adverse effects. This analysis is followed by a CEQA conclusion, which is identified as such. The CEQA conclusion uses the terminology appropriate to describing the presence or absence of significant impacts.

In some instances, the NEPA and CEQA discussions differ for a particular impact discussion because NEPA and CEQA have different points of comparison (or “baselines” in CEQA terms). The NEPA point of comparison for each alternative is based on the comparison of the action alternative (Alternatives 1A through 9) at 2060, with the no action alternative which supposes conditions at 2060 in the absence of the proposed project. The CEQA baseline is based on the comparison of the action alternative (Alternatives 1A through 9) at 2060 with existing conditions. Consistent with this, the NEPA point of comparison accounts for anticipated climate change conditions at 2060, whereas the CEQA baseline is assumed to occur during existing climate conditions. Therefore, differences in model outputs between the CEQA baseline and the action alternative (Alternatives 1A through 9) are due primarily to both the impacts of proposed alternative as well as future climate change conditions (sea level rise and altered precipitation patterns).

8.2 Environmental Setting/Affected Environment

This section defines the environmental setting/affected environment for surface water quality, reviews the environmental and regulatory setting with respect to water quality, and provides an assessment of existing water quality conditions in the study area (the area in which impacts may occur), shown in Figure 1-4, which includes the Plan Area (the area covered by the BDCP), upstream of the Delta, and the State Water Project/Central Valley Project (SWP/CVP) Export Service Areas. Water quality conditions refer to the chemical and physical properties of the surface water in the study area.

Conveying, using, and disposing of water occurs in association with domestic, industrial, and agricultural uses. Natural and anthropogenic contaminants, or *constituents of concern*, can enter Delta waters from various point and nonpoint sources. Point sources are any discernible, confined and discrete conveyance, including any pipe, ditch, channel, tunnel, conduit, or well from which pollutants (constituents of concern) are or may be discharged (Clean Water Act [CWA], Section 502[14]), and include treated water from industrial and municipal facilities, or points of agricultural discharge. The term *nonpoint source* is defined to mean any source of water pollution that does not meet the legal definition of *point source* in Section 502(14) of the CWA and includes urban and irrigation runoff. In the case of nonpoint sources, constituents of concern may enter receiving waters at multiple discrete and diffuse points throughout a watershed (i.e., not traceable to a single point). Daily tidal action has a major water quality influence from the high salinity of the Pacific Ocean and specific salinity constituents (e.g., sodium, potassium, chloride transported inland to the Delta through the San Francisco Bay.

Temperature, pH, dissolved oxygen (DO), nutrients, and concentrations of other various constituents such as methylmercury and total organic carbon (TOC) can be affected by tidal marsh

1 and floodplain habitats, especially when marsh waters are exchanged with other Delta waters both
 2 upstream and downstream of the tidal marsh/floodplain habitats. Because the primary concern of
 3 water temperature is effects on fish and aquatic organisms, temperature is addressed in Chapter 11,
 4 *Fish and Aquatic Resources*.

5 **8.2.1 Affected Environment**

6 For the purposes of characterizing the existing water quality conditions and evaluating the
 7 consequences of implementing the BDCP alternatives on surface water quality, the affected
 8 environment is defined as anywhere an effect could occur, which includes but is not necessarily
 9 limited to the statutory Delta, Suisun Bay and Marsh, and areas to the north and south of the Delta,
 10 which are defined in various parts of this chapter as Upstream of the Delta and the SWP/CVP Export
 11 Service Areas, as shown in Figure 1-4. When compared to the watershed boundaries, it is noted that
 12 the affected environment falls primarily within the Sacramento and San Joaquin River watersheds.

13 This section identifies the watershed factors that affect water quality, the water quality standards
 14 applicable to the affected environment, and the known impairments (i.e., CWA Section 303[d], the
 15 primary constituents of concern in these areas, the regulatory framework, and the key water quality
 16 monitoring stations). Finally, water quality data from selected monitoring stations were reviewed
 17 for specific constituents in Section 8.1.3.

18 Because of the very distinct hydrologic and hydraulic characteristics (including the various
 19 inflow/outflow conditions) and specific operational details, the water quality in the Delta is
 20 described separately from the northern and southern parts of the study area. The Delta environment
 21 is much more complex and dynamic than the rest of the study area and requires a more detailed
 22 approach. Hence, the water quality conditions in the Delta were reviewed at a greater level of detail.

23 To characterize the existing water quality conditions in the Delta, it is important to evaluate the
 24 water quality of the primary inflows to and outflows from the Delta. Consequently, the water quality
 25 data compiled and described in this section include monitoring data from the three major rivers in
 26 the north (Sacramento, Feather, and American Rivers), the tributaries from the east (Cosumnes,
 27 Mokelumne, and Calaveras Rivers), the San Joaquin River from the south (including its major
 28 tributaries), San Francisco Bay water from the west, and agricultural runoff in the Delta. It also is
 29 important to characterize water quality at points where water is pumped out of the Delta (e.g.,
 30 Harvey O. Banks Pumping Plant [Banks pumping plant], C. W. "Bill" Jones Pumping Plant [Jones
 31 pumping plant], Contra Costa Water District [CCWD] Pumping Plant #1 (CCWD pumping plant #1),
 32 North Bay Aqueduct Pumping Plant), and in areas south of the Delta where exported water is
 33 conveyed and stored. Examples of the latter include the Delta-Mendota Canal, the California
 34 Aqueduct, and San Luis Reservoir. Similarly, net outflow from the Delta occurs into Suisun Bay at
 35 Mallard Island, which is on the western boundary of the Delta and is the approximate boundary
 36 between limnetic (salinity of 0–0.5 parts per thousand [ppt]) and oligohaline (salinity of 0.5–5 ppt)
 37 areas during median flow conditions (Jassby 2008:4).

38 **8.2.1.1 Organization of the Section**

39 The following sections (Sections 8.1.1.2 through 8.1.3.17) describe the Existing Conditions in the
 40 study area with respect to surface water quality and are organized in the following sequence.

- 1 • **Overview of the Sacramento and San Joaquin River Watersheds**—Brief overview of the
2 watersheds and the Delta environment; location, physical description, and characteristics of the
3 watersheds; climate; and hydrology.
- 4 • **Water Management and the State Water Project and Central Valley Project Systems**—Brief
5 overview of the SWP and CVP, their key features, and the complex hydrodynamics of the study
6 area.
- 7 • **Primary Factors Affecting Water Quality**—Brief discussion and listing of point and nonpoint
8 pollutant sources, including historical and recent drainage from inactive and abandoned mines,
9 industrial and municipal water treatment plant (WTP) discharges, agricultural and urban storm
10 water runoff, recreational uses, and wildlife.
- 11 • **Beneficial Uses**—Brief overview of the designated beneficial uses in the study area, as defined
12 in the Regional Water Quality Control Boards' (Regional Water Boards') water quality control
13 plans (WQCPs or Basin Plans).
- 14 • **Water Quality Objectives and Criteria**—Brief discussion of regulatory water quality standards
15 as described in the California Toxics Rule (CTR), water quality control plans, and California
16 drinking water standards.
- 17 • **Water Quality Impairments**—Description of Section 303(d) list of impaired water bodies in
18 the study area, existing Total Maximum Daily Loads (TMDLs), and descriptions of major ongoing
19 water quality monitoring programs.
- 20 • **Water Quality Constituents of Concern**—Rationale for selecting specific water quality
21 constituents of concern that are important to maintaining the water quality in the study area,
22 and discussion of sensitive receptors affected by water quality.
- 23 • **Selection of Monitoring Stations for Characterization of Water Quality**—Brief description
24 of the data sources, selection of monitoring stations to be analyzed, and data availability at the
25 selected locations.
- 26 • **Regulatory Setting**—Brief description of federal, state, and regional/local regulatory agencies
27 and the applicable guidance related to surface water quality.

28 Section 8.1.2, *Selection of Monitoring Stations for Characterization of Water Quality*, includes detailed
29 discussions of the selected water quality constituents of concern in the study area. For each
30 constituent, the discussion is organized by: (1) background information available in the literature;
31 (2) importance of the constituent in the study area, including its potential effects on other resources;
32 (3) Existing Conditions, including concentrations at various monitoring locations; and (4) spatial
33 and temporal trends.

34 **8.2.1.2 Overview of the Sacramento River and San Joaquin River** 35 **Watersheds**

36 **Geographic Location and Physical Description**

37 The Delta watershed includes the watersheds of the Sacramento and San Joaquin Rivers, the two
38 largest rivers in the state. Together, the watersheds make up roughly one third of the state's land
39 area. These rivers originate in the Coast Range, Cascade Range, and Sierra Nevada and flow through
40 the Central Valley before entering the Delta. Following is a brief overview of watershed

1 characteristics of the study area; for additional detailed discussion, refer to Chapter 5, *Water Supply*,
2 and Chapter 6, *Surface Water*.

3 The Delta is a complex system of stream channels, sloughs, marshes, canals, and islands in northern-
4 central California at the confluence of the Sacramento and San Joaquin Rivers. The Delta covers
5 738,000 acres, which includes 59 islands, 1,100 linear miles of levees, hundreds of thousands of
6 acres of farmland, and various habitat types (California Department of Water Resources 1993:91).
7 The Delta lands and waterways support communities, agriculture, and recreation while providing
8 essential habitat for a multitude of fish and wildlife species.

9 Delta inflow consists of runoff from the Sacramento River watershed, the San Joaquin River
10 watershed, and the eastside tributaries (Cosumnes, Mokelumne, and Calaveras Rivers). Long-term
11 average annual Delta inflow is approximately 22 million acre-feet (MAF), with a range of less than
12 8 MAF to more than 74 MAF (CALFED Bay-Delta Program 2000). Dry and critical year Delta inflow
13 averages about 12 MAF annually under Existing Conditions (CALFED Bay-Delta Program 2000). As a
14 contributor to the state's agricultural irrigation system and a major source of drinking water for two
15 thirds of California's population, the Delta is a critical component of the state's water supply
16 infrastructure.

17 **Area Climate, Hydrology, and Watershed Characteristics**

18 **Sacramento River Watershed**

19 The Sacramento River watershed drains the northern part of California's Central Valley. The
20 Sacramento River, California's longest river, is approximately 447 miles long and drains
21 approximately 27,000 square miles of land. Predominant land uses in the Sacramento River
22 watershed are agriculture, natural (undeveloped), and urban areas. The major Sacramento River
23 watershed drainages are the upper Sacramento, Feather, Yuba, and American Rivers (Figure 8-1).

24 The climate in the Sacramento River watershed is mediterranean in character, typified by cool, wet
25 winters and warm, dry summers. Daily high air temperatures in the Sacramento Valley range from
26 around 45 degrees Fahrenheit (°F) in the winter to over 100°F in the summer. Average air
27 temperatures in the mountainous regions of the watershed are typically 5–10° less than the
28 temperature on the valley floor. Annual precipitation in the Sacramento River watershed ranges
29 from 80 to 90 inches of primarily snowfall in the mountainous regions, to 41 inches of rain in
30 Redding and 19 inches in Sacramento. Average annual precipitation for the entire watershed is
31 approximately 36 inches. Most precipitation falls between November and April, with little or no
32 precipitation falling between May and October (CALFED Bay-Delta Program 2000).

33 The majority of the runoff in the Sacramento River watershed is in the upper Sacramento River
34 watershed and in the rivers flowing out of the western slope of the Sierra Nevada. Numerous
35 reservoirs are located in the Sacramento River watershed. The major reservoirs in the Sacramento
36 River watershed are Shasta Lake, Lake Oroville, and Folsom Lake. Trinity Lake lies in the coastal
37 watershed, and water is diverted from it to the Sacramento River watershed. Total reservoir
38 capacity in the Sacramento River watershed, including Trinity Lake, is approximately 16 MAF
39 (California Department of Water Resources 2005).

40 An important characteristic of the Sacramento River watershed is that precipitation patterns are
41 highly variable from year to year and within years. Figure 8-2 illustrates the precipitation pattern in
42 the Sacramento Valley for water years between 1977 and 2008. Surface water supply is measured

1 by water year. A *water year* is defined as the 12-month period of October 1 through September 30 of
 2 the following year. The water year is designated by the calendar year in which it ends (e.g., the year
 3 ending September 30, 2010, is called the *2010 water year*). The Sacramento River Index is a
 4 yardstick of northern California water supply or water availability from the Sacramento River
 5 watershed. The index is used to project the current water-year type and is based partially on the
 6 previous year's index and on the sum of the unimpaired runoff (in MAF) of four rivers: Sacramento
 7 River above Bend Bridge near Red Bluff, Feather River inflow to Lake Oroville, Yuba-River at
 8 Smartville, and American River inflow to Folsom Lake. Unimpaired runoff is an estimate of the
 9 runoff that would occur in a watershed if unaltered by upstream diversions, storage, or
 10 export/import of water to/from other watersheds. Based on the unimpaired runoff, the water year-
 11 type classifications are defined as follows.

- 12 • Wet: equal to or greater than 9.2 MAF.
- 13 • Above normal: greater than 7.8 and less than 9.2 MAF.
- 14 • Below normal: greater than 6.5 and less than or equal to 7.8 MAF.
- 15 • Dry: greater than 5.4 and less than or equal to 6.5 MAF.
- 16 • Critical: equal to or less than 5.4 MAF.

17 Relative water availability from the watershed is greatest in wet years and lowest in critical years. In
 18 the water years between 1977 and 2008, 10 years were wet (31%), six years were above normal
 19 (19%), two years were below normal (6%), seven years were dry (22%), and seven years were
 20 critical (22%), as shown in Figure 8-2.

21 **San Joaquin River Watershed**

22 The San Joaquin River watershed drains the southern part of the Central Valley. The San Joaquin
 23 River, California's second longest river, is approximately 330 miles long and drains approximately
 24 15,200 square miles of land. Similar to the Sacramento River watershed, predominant land uses in
 25 the San Joaquin River watershed consist of agriculture, natural (undeveloped), and urban areas. The
 26 main San Joaquin River watershed drainages are the upper San Joaquin, Merced, Tuolumne, and
 27 Stanislaus Rivers (Figure 8-1).

28 The climate in the San Joaquin River watershed is similar to the Sacramento River watershed but is
 29 generally warmer and drier. Air temperatures in the city of Fresno range from 37°F in the winter to
 30 over 100°F in the summer. Annual precipitation in the San Joaquin Valley ranges from 8 to 12 inches
 31 of rain.

32 The warmer and drier conditions in the San Joaquin River watershed result in considerably less
 33 runoff compared to the Sacramento River watershed. The annual unimpaired runoff of the San
 34 Joaquin River watershed is approximately 5.5 MAF, with 60% of runoff occurring on the Merced,
 35 Tuolumne, and Stanislaus Rivers. Of the 5.5 MAF total unimpaired runoff, losses account for
 36 approximately 2.5 MAF via diversions for agricultural or municipal water supply, or losses to
 37 evaporative and groundwater infiltration, and 3 MAF flows into the Delta, past Vernalis (CALFED
 38 Bay-Delta Program 2000). Major reservoirs and impoundments in the San Joaquin River watershed
 39 are New Melones Lake, Hetch Hetchy, New Don Pedro Lake, Lake McClure, and Millerton Lake. Total
 40 reservoir capacity in the San Joaquin River watershed is approximately 11 MAF (California
 41 Department of Water Resources 2005). Figure 8-3 illustrates the highly variable precipitation
 42 pattern in the San Joaquin Valley for water years between 1977 and 2008. The water year-type

1 classification used in Figure 8-3 is determined based partially on the previous year's index and on
 2 the sum of unimpaired flow (in MAF) at Stanislaus River below Goodwin Reservoir (inflow to New
 3 Melones Lake), Tuolumne River below LaGrange (inflow to New Don Pedro Lake), Merced River
 4 below Merced Falls (inflow to Lake McClure), and San Joaquin River inflow to Millerton Lake. The
 5 water year-type classifications are defined as follows.

- 6 • Wet: equal to or greater than 3.8 MAF.
- 7 • Above normal: greater than 3.1 and less than 3.8 MAF.
- 8 • Below normal: greater than 2.5 and equal to or less than 3.1 MAF.
- 9 • Dry: greater than 2.1 and equal to or less than 2.5 MAF.
- 10 • Critical: equal to or less than 2.1 MAF.

11 In the water years between 1977 and 2008, 12 years were wet (37%), four years were above normal
 12 (13%), one year was below normal (3%), five years were dry (16%), and 10 years were critical
 13 (31%), as shown in Figure 8-3.

14 **East Side Tributaries Watersheds**

15 The east side tributaries to the Delta include the Cosumnes, Mokelumne, and Calaveras Rivers. All
 16 three rivers drain the west slope of the Sierra Nevada. The Cosumnes River is approximately 50
 17 miles long, drains approximately 725 square miles, and is the only river draining the west slope of
 18 the Sierra Nevada without a major dam. The Cosumnes River empties into the Mokelumne River just
 19 within the Delta. The Mokelumne River is approximately 95 miles long, drains approximately 2,140
 20 square miles, and feeds both Pardee Reservoir and Camanche Reservoir. The Calaveras River is
 21 approximately 50 miles long, drains approximately 470 square miles, and feeds New Hogan Lake.
 22 The Calaveras River empties into the San Joaquin River north of Stockton. The climate and
 23 watershed characteristics of these drainages vary, but are generally similar to those described for
 24 the Sacramento and San Joaquin River watersheds above.

25 **8.2.1.3 Water Management and the State Water Project and** 26 **Central Valley Project Systems**

27 The management of the SWP and CVP systems to meet water supply, flood management, and
 28 environmental obligations has a substantial effect on the quantity and timing of inflows to the Delta
 29 and on water quality in the study area. This section provides a brief overview of the SWP and CVP
 30 facilities and their operations. Following is a brief overview of surface water management in the
 31 study area; for additional detailed discussion, refer to Chapter 5, *Water Supply*, and Chapter 6,
 32 *Surface Water*, which provide an overview of key facilities in the SWP and CVP systems.

33 **State Water Project**

34 The SWP's 33 water storage facilities, 600 miles of aqueducts, and multiple pumping plants and
 35 hydroelectric plants supply water to over 25 million Californians and to approximately
 36 700,000 acres of farmland. Depending on the water-year type (i.e., available water supply) and
 37 demands, the SWP annually delivers up to about 3.7 MAF to meet contract demands. However, in
 38 drier water-year types when supply is limited, deliveries are considerably lower with an estimated
 39 50% delivery reliability in any given water year of less than 2.7 MAF (California Department of
 40 Water Resources 2010). The primary objectives of the SWP are water supply; flood control; power

1 generation; recreation, fish, and wildlife protection; and water quality improvements in the
2 Sacramento–San Joaquin Delta.

3 Distribution of SWP water begins with releases from Oroville Dam into the Feather River, which
4 flows into the Sacramento River at River Mile 80 and, ultimately, to the Delta. SWP pumps water into
5 the North Bay Aqueduct from Barker Slough in the north Delta for use in Napa and Solano Counties.
6 In the south Delta, water also is pumped into the South Bay Aqueduct to serve areas of Alameda
7 County and Santa Clara County, and via the Banks pumping plant into the 444-mile-long California
8 Aqueduct (California Department of Water Resources 2009a). The California Aqueduct conveys
9 water south primarily to meet potable water demands of SWP contractors serving Central Valley
10 and southern California counties, and to meet agricultural demands in the San Joaquin Valley and
11 Tulare Basin. The California Aqueduct delivers water to O’Neill Forebay and the San Luis Reservoir,
12 a storage reservoir jointly owned by the SWP and CVP. Water is delivered to Santa Clara County and
13 San Benito County from San Luis Reservoir via the Santa Clara and Hollister conduits. The Coastal
14 Branch Aqueduct diverts water from the California Aqueduct to areas west in San Luis Obispo and
15 Santa Barbara Counties. In southern California, water is delivered to the major storage reservoirs of
16 Lake Perris, Silverwood Lake, Castaic Lake, and Lake Pyramid.

17 California Department of Water Resources (DWR), in its management of the SWP to supply the 29
18 contracting public agencies with water supply and provide flood control, additionally provide
19 recreation opportunities, generate hydroelectric power, and protect fish and wildlife. These benefits
20 of the SWP operations are achieved by increasing or decreasing upstream water releases, changing
21 Delta pumping rates, or storing river flows south of the Delta at the San Luis Reservoir (Water
22 Education Foundation 2004). During February through June, DWR reduces the ratio of water
23 exports to inflows to reduce potential impacts on migrating salmon and spawning delta smelt,
24 Sacramento splittail, and striped bass (Jassby et al. 1995). SWP facilities are operated to meet
25 numerous water quality objectives, such as the X2 location objective. X2 refers to the horizontal
26 distance from the Golden Gate up the axis of the Delta estuary to where tidally averaged near-
27 bottom salinity concentration of 2 parts of salt in 1,000 parts of water occurs; the X2 standard was
28 established to improve shallow water estuarine habitat in the months of February through June and
29 relates to the extent of salinity movement into the Delta (Jassby et al. 1995). The location of X2 is
30 important to both aquatic life and water supply beneficial uses. Chapter 5, *Water Supply*, describes
31 the multiple water supply, flood control, and water quality targets that are used for SWP facilities
32 management and operations.

33 **Central Valley Project**

34 The CVP annually delivers approximately 7 MAF of water for agricultural, urban, and wildlife use
35 and is the largest water storage and delivery system in California (Bureau of Reclamation 2009a;
36 CALFED Bay-Delta Program 2000). The CVP system consists of 20 dams and reservoirs, 11
37 hydropower plants, 500 miles of major canals, and additional related facilities (Bureau of
38 Reclamation 2009a).

39 Transfer of water through the CVP system and the Delta begins with the release of water from
40 reservoirs located on the Trinity, Sacramento, American, and Stanislaus Rivers (Bureau of
41 Reclamation 2009a) Water released from Trinity and Shasta Dams flows into Keswick Reservoir and
42 then is released into the Sacramento River from Keswick Dam at River Mile 303. A portion of the
43 river’s flow is diverted into the Tehama-Colusa and Corning Canals to irrigate the western side of the
44 Sacramento Valley (Water Education Foundation 2002). The remainder of the Trinity and Shasta

1 releases continue flowing south in the Sacramento River, combining with CVP releases from Folsom
 2 and Nimbus Dams at the confluence of the Sacramento and American Rivers and, ultimately, flowing
 3 to the Delta in the vicinity of Freeport. The Stanislaus River releases of water from New Melones
 4 Lake serve as a water source for CVP users in the Stanislaus River watershed and in the northern
 5 San Joaquin Valley (Bureau of Reclamation 2009a).

6 In the Delta, the released water is used to meet D-1641 Delta outflow and water quality objectives
 7 and to support export from the Delta at the Jones pumping plant into the Delta-Mendota Canal,
 8 which conveys water south for agricultural uses in the San Joaquin Valley. Water transported in the
 9 117-mile Delta-Mendota Canal can be used as an irrigation supply, a source of San Luis Reservoir
 10 water, for managed wetland refuges, or as a replacement for upper San Joaquin River water used in
 11 the Friant-Kern and Madera Canal systems (Bureau of Reclamation 2009a). The San Luis Reservoir
 12 is an off stream storage reservoir that is used by both SWP and CVP to provide water to Central
 13 Valley and Bay Area users (Bureau of Reclamation 2009b). The Friant-Kern and Madera Canal
 14 systems originate at Friant Dam and transport upper San Joaquin River water approximately 152
 15 miles south to Bakersfield and approximately 36 miles to the north, respectively (Water Education
 16 Foundation 2002). Additionally, CVP's Contra Costa Canal conveys Delta water from Rock Slough.
 17 CCWD's Los Vaqueros Pipeline diverts water from Old River to the west to meet potable demands of
 18 Bay Area users served by CCWD (Bureau of Reclamation 2009a).

19 Reclamation operates the CVP to meet the following objectives (Bureau of Reclamation 2009a).

- 20 ● Regulate rivers and improve flood management and navigation.
- 21 ● Provide water for irrigation and domestic use.
- 22 ● Generate power.
- 23 ● Provide recreation opportunities.
- 24 ● Protect fish and wildlife.
- 25 ● Improve water quality.

26 Reclamation's operation of the CVP facilities changes seasonally based on varying management
 27 objectives. During the winter and early spring months when flood management is a priority, CVP
 28 reservoirs are operated to store winter runoff (Water Education Foundation 2002). Releases during
 29 May through October are timed to meet a variety of water supply needs, manage water quality, and
 30 create available storage capacity for flood flows (Water Education Foundation 2002).

31 **Hydrodynamics in the Delta**

32 Delta hydrodynamics are a product of a complex interaction of tributary inflows, tides, in-Delta
 33 diversions, and SWP and CVP operations, including conveyance, pumping plants, and operations of
 34 channel barriers and gates designed to direct tributary inflows to certain regions of the Delta. Each
 35 region is affected differently by these variables, and the nature of the effect varies daily, seasonally,
 36 and from year to year, depending on the magnitude of inflows, the tidal cycle, and the extent of
 37 pumping at the SWP and CVP pumping plants.

38 For example, the SWP and CVP pumping plants can affect the direction of flow of water in the Delta
 39 channels, particularly during periods of low water flow and high export quantities. Normally, net
 40 flows in the Delta travel toward Suisun and San Francisco Bays. However, SWP and CVP pumping

1 can cause the net flows within the interior south Delta to reverse, which causes more saline water to
2 move farther inland (Bureau of Reclamation 2009a).

3 The Delta Cross Channel is a controlled diversion channel that transports Sacramento River water to
4 Snodgrass Slough and then to the Mokelumne River, where it flows into the central and south Delta.
5 Opening the Delta Cross Channel's gates generally can reduce salinity in some channels of the
6 central and southern Delta, particularly during the summer months, through the transport of
7 relatively low-salinity Sacramento River water into the Delta (Bureau of Reclamation 2009a).

8 Flow in the Delta channels can change direction as a result of tidal exchange, ebbing and flooding
9 with the two tides per day, which is a major factor of Delta hydrodynamics. The daily, seasonal, and
10 year-to-year differences in source water contributions to various locations throughout the Delta
11 affect the water quality in the Delta, particularly with regard to salinity. Figure 8-4 and Figure 8-5
12 show the variations in maximum intrusion of chloride into the Delta since 1921, which demonstrate
13 that variability and intrusion distance generally have been reduced following construction of the
14 major storage reservoirs and implementation of Delta water management facilities and operations.

15 **8.2.1.4 Primary Factors Affecting Water Quality**

16 Primary factors affecting water quality in the study area include patterns of land use in the upstream
17 watersheds and the Delta; SWP and CVP operations; and in-Delta/upstream activities and sources of
18 pollutants. Point and nonpoint pollutant sources include historical and recent drainage from
19 inactive and abandoned mines and related debris/sediment, industrial and municipal WTP
20 discharges, agricultural drainage, urban storm water runoff, atmospheric deposition, recreational
21 uses, and metabolic waste (e.g., pathogens) from wildlife.

22 Figure 8-6 shows land uses and major point sources (consisting primarily of municipal WTPs) and
23 nonpoint sources (e.g., urban storm water runoff) of pollutants. Natural erosion and in stream
24 sediments, atmospheric deposition, and geothermal inputs (CALFED Bay-Delta Program 2000) also
25 affect Delta water quality. The magnitude of the effect of each of these sources is correlated with the
26 relative contribution from each source and can differ, for different constituents or with conditions
27 (e.g., hydrologic and climatic), during different times of a given year. The principal contaminants and
28 conditions affecting water quality in the Delta are as follows (CALFED Bay-Delta Program 2000).

- 29 ● Historical drainage and sediment discharged from upstream mining operations in the late 1800s
30 and early 1900s has contributed metals, such as cadmium, copper, and mercury.
- 31 ● Storm water runoff can contribute metals, sediment, pathogens, organic carbon, nutrients,
32 pesticides, dissolved solids (salts), petroleum products, oil and grease, and other chemical
33 residues.
- 34 ● Wastewater discharges from treatment plants can contribute salts, metals, trace organics,
35 nutrients, pathogens, pesticides, organic carbon, personal care products, pharmaceuticals, and
36 oil and grease.
- 37 ● Agricultural irrigation return flows and nonpoint discharges can contribute salts (including
38 bromide), organic carbon, nutrients, pesticides, pathogens, and sediment.
- 39 ● Large dairies and feedlots can contribute nutrients, organic carbon, pathogenic organisms,
40 hormones, and veterinary pharmaceuticals/antibiotics.

- 1 • Water-based recreational activities (such as boating) can contribute hydrocarbon compounds,
2 nutrients, and pathogens.
- 3 • Atmospheric deposition can contribute metals, nutrients, pesticides, and other synthetic organic
4 chemicals and may lower pH.
- 5 • Seawater intrusion can contribute salts, including bromide, which affect total dissolved solids
6 (TDS) concentrations and can contribute to formation of unwanted chemical disinfection by-
7 products (DBPs) in treated drinking water. Additionally, seawater can contribute sulfate, which
8 can influence the methylation of mercury.
- 9 • Selenium can originate from the Sacramento River and San Joaquin River. Major sources of
10 selenium include irrigation drainage from agricultural lands of the western San Joaquin Valley.
11 Refinery wastewater discharges in North San Francisco Bay also serve as a source of selenium in
12 the Delta.
- 13 • Organic loading from the San Joaquin River can contribute to low DO conditions in the Delta.

14 Both variations in watershed hydrology and SWP and CVP operations affect the variability of water
15 quality in the study area; also both SWP/CVP and non-SWP/CVP water diversions reduce the
16 amount of water available for dilution and assimilation of contaminant inputs and hydrodynamic
17 conditions associated with channel flows and tidal action in the Delta. Water quality can vary
18 seasonally in response to winter-spring runoff and summer-fall lower-flow periods or seasonal
19 agricultural practices and cropping; water quality also can vary from year to year as a result of
20 precipitation and snowpack levels in the upper watersheds and the resulting releases from
21 upstream reservoirs for water supply, flood management, and environmental obligations (e.g., fish
22 flows, Delta water quality objective compliance), operations of the Delta Cross Channel, and
23 seasonal and annual variations in SWP and CVP pumping rates.

24 **8.2.1.5 Beneficial Uses**

25 Beneficial uses are designated for specific water bodies, either as existing or potential, by each
26 Regional Water Board in their respective WQCPs or Basin Plans. Water bodies in the study area are
27 used for many purposes as evidenced by the number of beneficial uses shown in Table 8-1. For
28 water bodies where beneficial uses have not been identified specifically in a Basin Plan, the *tributary*
29 *rule* allows a Regional Water Board to apply the designated beneficial uses that exist in the nearest
30 downstream tributary. Established in the 1978 WQCP for the San Francisco Bay/Sacramento–San
31 Joaquin Delta estuary (Bay-Delta WQCP), designated beneficial uses of Delta water remain
32 unchanged in the 1991, 1996, and 2006 WQCPs. Additionally, the individual Basin Plans for the San
33 Francisco Bay Regional Water Quality Control Board (San Francisco Bay Water Board) and Central
34 Valley Regional Water Quality Control Board (Central Valley Water Board) identify beneficial uses of
35 the Delta areas within their jurisdictions.

1 **Table 8-1. Designated Beneficial Uses for Water Bodies in the Study Area**

Name ^a	Abbreviation ^a	Beneficial Uses ^a
Designated Beneficial Uses Common to Inland Waters in All Basin Plans and the Delta		
Municipal and Domestic Supply	MUN	Uses of water for community, military, or individual water supply systems including drinking water supply
Agricultural Supply	AGR	Uses of water for farming, horticulture, or ranching including irrigation (including leaching of salts), stock watering, or support of vegetation for range grazing
Industrial Service Supply	IND	Uses of water for industrial activities that do not depend primarily on water quality, including mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, and oil well repressurization
Industrial Process Supply	PRO	Uses of water for industrial activities that depend primarily on water quality
Groundwater Recharge	GWR	Uses of water for natural or artificial recharge of groundwater for purposes of future extraction, maintenance of water quality, or halting of saltwater intrusion into freshwater aquifers
Navigation	NAV	Uses of water for shipping, travel, or other transportation by private, military, or commercial vessels
Water Contact Recreation	REC-1	Uses of water for recreational activities involving body contact with water where ingestion of water is reasonably possible, including swimming, wading, water-skiing, skin and scuba diving, surfing, white-water activities, fishing, and use of natural hot springs
Non-Contact Water Recreation	REC-2	Uses of water for recreational activities involving proximity to water but where there is generally no body contact with water or any likelihood of ingestion of water, including picnicking, sunbathing, hiking, beachcombing, camping, boating, tide pool and marine life study, hunting, sightseeing, and aesthetic enjoyment in conjunction with the above activities
Commercial and Sport Fishing	COMM	Uses of water for commercial or recreational collection of fish, shellfish, or other organisms, including uses involving organisms intended for human consumption or bait purposes
Warm Freshwater Habitat	WARM	Uses of water that support warm water ecosystems, including preservation or enhancement of aquatic habitats, vegetation, fish, and wildlife, including invertebrates
Cold Freshwater Habitat	COLD	Uses of water that support cold water ecosystems, including preservation or enhancement of aquatic habitats, vegetation, fish, and wildlife, including invertebrates
Wildlife Habitat	WILD	Uses of water that support terrestrial or wetland ecosystems, including preservation and enhancement of terrestrial habitats or wetlands, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), and wildlife water and food sources
Preservation of Biological Habitats of Special Significance	BIOL	Uses of water that support designated areas or habitats, such as established refuges, parks, sanctuaries, ecological reserves, or Areas of Special Biological Significance, where the preservation or enhancement of natural resources requires special protection
Rare, Threatened, or Endangered Species	RARE	Uses of water that support aquatic habitats necessary, at least in part, for the survival and successful maintenance of plant and animal species established under state or federal law as rare, threatened, or endangered

Name ^a	Abbreviation ^a	Beneficial Uses ^a
Migration of Aquatic Organisms	MIGR	Uses of water that support habitats necessary for migration and other temporary activities by aquatic organisms, such as anadromous fish
Spawning, Reproduction, and/or Early Development	SPWN	Uses of water that support high quality aquatic habitats suitable for reproduction and early development of fish
Shellfish Harvesting	SHELL	Uses of water that support habitats suitable for the collection of filter feeding shellfish (e.g., clams, oysters, mussels) for human consumption, commercial, or sport purposes
Additional Beneficial Uses of the Delta		
Estuarine Habitat	EST	Uses of water that support estuarine ecosystems, including preservation or enhancement of estuarine habitats, vegetation, fish, shellfish, and wildlife (e.g., estuarine mammals, waterfowl, shorebirds)
Additional Beneficial Uses of Inland Waters (not common to all Basin Plans)		
Freshwater Replenishment ^b	FRSH	Uses of water for natural or artificial maintenance of surface water quantity or quality
Hydropower Generation ^c	POW	Uses of water for hydropower generation
Aquaculture ^c	AQUA	Uses of water for aquaculture or mariculture operations, including propagation, cultivation, maintenance, and harvesting of aquatic plants and animals for human consumption or bait purposes
Inland Saline Water Habitat ^d	SAL	Uses of water that support inland saline water ecosystems, including preservation or enhancement of aquatic saline habitats, vegetation, fish, and wildlife, including invertebrates
Limited Warm Freshwater Habitat ^e	LWRM	Waters that support warm water ecosystems that are severely limited in diversity and abundance as the result of concrete-lined watercourses and low, shallow dry weather flows, which result in extreme temperature, pH, and/or DO conditions; naturally reproducing finfish populations are not expected to occur in LWRM waters

^a The names, abbreviations, and beneficial use descriptions are not identical in each Basin Plan.

^b Potential beneficial use identified in Sacramento–San Joaquin, San Francisco Bay, Central Coast, Los Angeles, and San Diego Basin Plans.

^c Potential beneficial use identified in Sacramento–San Joaquin, Central Coast, Los Angeles, Santa Ana, and San Diego Basin Plans.

^d Potential beneficial use identified in Central Coast, Los Angeles, and San Diego Basin Plans.

^e Potential beneficial use identified in Santa Ana Basin Plan only.

Sources: Central Coast Regional Water Quality Control Board 2011; Central Valley Water Board 2009a; Los Angeles Regional Water Quality Control Board 1994; Santa Ana Regional Water Quality Control Board 2008; San Diego Regional Water Quality Control Board 2007; San Francisco Bay Regional Water Quality Control Board 2007; State Water Resources Control Board 2006.

- 1
- 2 There are several additional beneficial uses in the Central Valley Water Board Basin Plan that are
- 3 applicable to surface waters other than the Delta in the Sacramento River basin and south of the
- 4 Delta export service area. Additionally, south-of-Delta exports are conveyed to service areas of SWP
- 5 contractors that lie within the jurisdictions of the Central Coast, Los Angeles, Santa Ana, and San
- 6 Diego Regional Water Boards, which address several other beneficial uses that are unique to those
- 7 geographic regions.

1 8.2.1.6 Water Quality Objectives and Criteria

2 It is important to define the terms *standards*, *numerical and narrative Basin Plan water quality*
 3 *objectives*, *CTR criteria*, and U.S. Environmental Protection Agency (USEPA) *recommended criteria* as
 4 they relate to the assessment of water quality. As defined by USEPA, water quality standards consist
 5 of: (1) the designated beneficial uses of a water segment; (2) the water quality criteria (referred to
 6 as *objectives* by the state) necessary to support those uses; and (3) an antidegradation policy that
 7 protects existing uses and high water quality. Each Regional Water Board's Basin Plan identifies
 8 numeric and narrative water quality objectives, together with the beneficial uses assigned to water
 9 bodies and the state antidegradation policy. By definition, Basin Plan objectives have gone through
 10 the standard-setting process, which includes public participation, consideration of economics,
 11 environmental review, and state and federal agency review and approval. Consequently, Basin Plan
 12 objectives are legally applicable and enforceable. In addition, the *Water Quality Control Plan for the*
 13 *San Francisco Bay/Sacramento-San Joaquin Delta Estuary* (Bay-Delta WQCP) (State Water Resources
 14 Control Board 2006) identifies beneficial uses of water in the Delta to be protected, water quality
 15 objectives for the reasonable protection of beneficial uses, and an implementation program to
 16 achieve the water quality objectives. The CTR criteria were established through the USEPA-led
 17 water quality standard-setting process. Hence, the CTR criteria, together with the beneficial uses
 18 assigned to water bodies and the state antidegradation policy, constitute additional water quality
 19 standards for the regions (beyond those specified in the Basin Plans). Finally, USEPA periodically
 20 recommends ambient water quality criteria to states for their consideration in adopting state
 21 standards. As stated by USEPA, the USEPA recommended criteria (also referred to as 304[a][1]
 22 criteria) "...are not regulations, and do not impose legally binding requirements on EPA, States,
 23 tribes or the public." Therefore, USEPA-recommended criteria and other nonenforceable guidance
 24 values are referred to as *advisory* when discussed in this chapter in order to distinguish them from
 25 adopted objectives and criteria.

26 Applicable ambient surface water quality criteria and objectives for the study area are contained in
 27 the following sources.

- 28 • CTR (criteria applicable to all surface waters in California).
- 29 • 2006 Bay-Delta WQCP (or the 1995 Bay-Delta WQCP) (objectives applicable to the Delta only,
 30 regulated through water rights conditions by the State Water Resources Control Board [State
 31 Water Board]).
- 32 • Central Valley Water Board and San Francisco Bay Water Board Basin Plans (objectives
 33 applicable to the Delta and other surface waters in the study area, regulated through point and
 34 nonpoint source controls).
- 35 • Basin Plans for the Central Coast, Los Angeles, Santa Ana, and San Diego Regional Water Boards
 36 (applicable to surface waters in the south-of-Delta areas served by SWP exports).

37 State objectives can be narrative or numeric. A narrative objective establishes a *desired level of*
 38 *protection* or describes a *favorable condition to be achieved* rather than defining a specific numerical
 39 concentration. An example of a narrative objective is "Waters shall not contain chemical constituents
 40 in concentrations that adversely affect beneficial uses." A numeric objective defines a concentration
 41 that must not be exceeded for a parameter (e.g., 10 milligrams per liter [mg/L]). Along with the
 42 concentration value, numerical water quality objectives also typically specify an averaging period to
 43 which the concentration value applies to protect the beneficial use of interest. Averaging periods
 44 typically depend on the sensitivity of the use, such as a 1-hour averaging period for objectives

1 designed to prevent acute toxicity in aquatic life, to longer averaging periods (e.g., 30-day, annual
2 average) for less-sensitive effects (e.g., human health effects, industrial uses, agricultural crop
3 production). The value of some numerical water quality objectives (primarily for aquatic life)
4 depends on the prevailing ambient freshwater and saltwater salinity conditions. With regard to
5 these objectives, the salinity conditions across the large majority of the Delta are sufficiently low
6 that the Delta channels are subject to the freshwater regulatory water quality criteria/objectives.
7 However, tidal influence and associated saltwater intrusion can result in salinity concentrations in
8 areas of the west Delta that require regulation with saltwater criteria/objectives. Salinity standards
9 themselves are discussed in the section below on the Bay-Delta WQCP. Appendix 8A, *Water Quality*
10 *Criteria and Objectives*, summarizes the specific water quality criteria/objectives that apply to the
11 Delta.

12 **California Toxics Rule**

13 CTR criteria are established only for aquatic life and human health protection. CTR criteria for
14 aquatic life protection for some constituents (most metals, cyanide, various organic compounds) are
15 specified for freshwater and saltwater conditions. The CTR states that the salinity characteristics
16 (fresh water versus saltwater) of the receiving water must be considered in determining the
17 applicable criteria. Freshwater criteria apply to waters with salinity equal to or less than 1 ppt at
18 least 95% of the time. Saltwater criteria apply to waters with salinity equal to or greater than 10 ppt
19 at least 95% of the time. For waters with salinity between these two categories, or tidally influenced
20 freshwaters that support estuarine beneficial uses, the applicable criteria are the lower of the
21 freshwater or saltwater values for each substance. CTR criteria for the protection of human health
22 are specified that apply to any receiving water where human consumption of water and/or
23 organisms occurs. Refer to Section 8.2, *Regulatory Setting*, for additional detail about the CTR and
24 other applicable water quality regulations. Appendix 8A provides the applicable CTR criteria
25 specified for aquatic life protection and human health protection.

26 **Water Quality Control Plan for the San Francisco Bay/Sacramento–San Joaquin** 27 **Delta Estuary**

28 The Bay-Delta WQCP (State Water Resources Control Board 2006) identifies the beneficial uses of
29 the Bay–Delta to be protected, the water quality objectives for reasonable protection of beneficial
30 uses, and a program of implementation for achieving the water quality objectives. Unless otherwise
31 indicated, water quality objectives cited for a general area, such as for the south Delta, are applicable
32 for all locations in that general area, and specific compliance locations are used to determine
33 compliance with the cited objectives within the area. Numeric objectives for chloride are included
34 for the protection of municipal and industrial water supply beneficial uses. Objectives for electrical
35 conductivity (EC) are included for multiple western, interior, and south Delta compliance locations
36 for the protection of agricultural supply beneficial uses. Salinity objectives also are specified for fish
37 and wildlife protection in the form of EC objectives for eastern and western locations in Suisun
38 Marsh, a narrative salinity objective for brackish tidal marshes of Suisun Bay, and the X2 standard
39 that regulates the location and number of days of allowable encroachment into the west Delta of
40 salinity exceeding 2 ppt. In general, the chloride and EC objectives (and Delta inflow/outflow
41 operational objectives) vary depending on the month of the year and the water-year type. EC and DO
42 objectives are included for the protection of fish and wildlife beneficial uses. Additionally, Delta
43 inflow and outflow operational objectives (Delta outflow, river flows, export limits, and Delta Cross
44 Channel gate operations) are specified for the protection of fish and wildlife beneficial uses.

1 Compliance with salinity objectives in particular is largely dependent on Delta inflows and outflows.
2 The current water quality objectives under this plan are included in Appendix 8A.

3 The State Water Board is now in the midst of a four-phased process of developing and implementing
4 updates to the Bay-Delta WQCP and flow objectives for priority tributaries to the Delta to protect
5 beneficial uses in the Bay-Delta watershed. Phase 1 of this work involves updating San Joaquin River
6 flow and southern Delta water quality requirements included in the Bay-Delta WQCP. Phase 2
7 involves other comprehensive changes to the Bay-Delta WQCP to protect beneficial uses not
8 addressed in Phase 1. Phase 3 involves changes to water rights and other measures to implement
9 the changes to the Bay-Delta WQCP from Phases 1 and 2. Phase 4 involves developing and
10 implementing flow objectives for priority Delta tributaries outside of the Bay-Delta WQCP updates
11 (State Water Resources Control Board 2013).

12 **Water Quality Control Plan for the Sacramento and San Joaquin River Basins**

13 The Basin Plan for the Sacramento and San Joaquin Rivers defines the beneficial uses, water quality
14 objectives, implementation programs, and surveillance and monitoring programs for waters of the
15 Sacramento and San Joaquin River basins. The Basin Plan contains specific numeric water quality
16 objectives that are applicable to certain water bodies, or portions of water bodies. Numerical
17 objectives have been established for bacteria, DO, pH, pesticides, EC, TDS, temperature, turbidity,
18 and trace metals. The Basin Plan also contains narrative water quality objectives for certain
19 parameters that must be attained through pollutant control measures and watershed management.
20 Narrative water quality objectives also serve as the basis for the development of detailed numerical
21 objectives. The narrative water quality objectives and numeric freshwater criteria/objectives
22 adopted for the Delta are included in Appendix 8A (Regions 2 and 5).

23 **Water Quality Control Plan for San Francisco Bay**

24 The Basin Plan for the San Francisco Bay basin (San Francisco Bay Water Board 2007) is similar to
25 the Basin Plan for the Central Valley and defines numerical and narrative water quality objectives
26 for San Francisco Bay (including San Pablo Bay) and portions of the west Delta. The designated
27 beneficial uses for the Delta are consistent with the Central Valley Basin Plan. This Basin Plan
28 contains both freshwater and saltwater criteria for several priority pollutant trace metals.
29 Freshwater objectives apply to waters lying outside the zone of tidal influence and having salinities
30 lower than 5 ppt at least 75% of the time. Saltwater objectives apply to waters with salinities greater
31 than 5 ppt at least 75% of the time. For waters with salinities between the two categories, or tidally
32 influenced freshwaters that support estuarine beneficial uses, the objectives are the lower of the
33 freshwater or saltwater objectives, based on ambient hardness, for each substance. Appendix 8A
34 provides the numeric freshwater and saltwater objectives adopted for the Delta.

35 **Water Quality Control Plans Applicable to the State Water Project South-of-Delta** 36 **Service Area**

37 The Basin Plans for the Central Coast, Los Angeles, Santa Ana, and San Diego Regional Water Boards
38 similarly define beneficial uses and numeric and narrative water quality objectives for inland and
39 coastal waters and other water bodies in the service areas of SWP contractors that use water from
40 the California Aqueduct and are located generally south of the Central Valley and in the central and
41 southern California coastal counties. In general, the narrative and numeric water quality objectives
42 for inland waters established in these Basin Plans are similar to the Central Valley and San Francisco

1 Bay Regions. However, because salinity is a primary water quality constituent of concern in the
2 inland and coastal counties of arid southern California, the Basin Plans for these regions all contain
3 specific numeric water quality objectives for salinity constituents (e.g., TDS, hardness, sodium,
4 chloride, sulfate) for the protection of municipal/domestic and agricultural water supply beneficial
5 uses. The established salinity-based objectives for specific water bodies in these Basin Plans can
6 vary substantially based on specific base-level conditions.

7 **Water Quality Control Plans Applicable to Suisun Marsh**

8 Suisun Marsh is located at the northern edge of Suisun Bay, just west of the confluence of the
9 Sacramento and San Joaquin Rivers and is not within the statutory Delta. Suisun Marsh consists of
10 tidal wetlands, sloughs, managed diked wetlands, managed seasonal wetlands, and upland
11 grasslands. The marsh contains approximately 59,000 acres of marsh, managed wetlands, and
12 adjacent grasslands, plus 30,000 acres of open-water areas. Most of the managed wetlands are
13 within levee systems with a majority owned by private duck hunting clubs. About 14,000 acres are
14 state-owned and managed by the California Department of Fish and Wildlife (CDFW), and about
15 1,400 acres on channel islands are federal lands. Elevation and salinity are the principal factors
16 controlling the distribution of tidal marsh plants in the marsh. Within the diked wetlands, water
17 diversion and release operations are managed to maximize the production of aquatic vascular plants
18 that traditionally have been considered important for wintering waterfowl.

19 The regulatory framework for managing water quality conditions in Suisun Marsh began in the
20 1970s with the development of the Suisun Marsh Protection Plan by the Bay Conservation and
21 Development Commission (BCDC) and the adoption of salinity objectives for marsh channels in the
22 1978 Bay-Delta WQCP to protect the beneficial uses for fish and wildlife. The State Water Board
23 water rights decision (D-1485), applicable to DWR and Reclamation for the management of SWP and
24 CVP operations, was adopted with provisions to meet the Suisun Marsh salinity objectives. DWR's
25 1984 Plan of Protection for Suisun Marsh was developed to meet the D-1485 requirements and
26 outlined a staged implementation for a combination of proposed physical salinity management
27 initial facilities, monitoring, a wetlands management program for marsh landowners, and
28 supplemental releases of water from SWP and CVP reservoirs. In 1987, federal and state agencies
29 adopted the Suisun Marsh Preservation Agreement (SMPA) to mitigate impacts on marsh salinity
30 from the SWP, CVP, and other upstream diversions. The SMPA identified the schedule for
31 construction of large-scale facilities in Suisun Marsh that would enable the salinity objectives to be
32 met. The 1991 Bay-Delta WQCP increased to seven the number of locations in the marsh where
33 numerical salinity objectives were to be met. The 1994 Principles of Agreement on Bay-Delta
34 Standards (Bay-Delta Accord that formed CALFED), the 1995 Bay-Delta WQCP, and the adoption of
35 State Water Board water rights decision (D-1641) in 1999 all resulted in refinements to the Suisun
36 Marsh salinity standards, added narrative salinity objectives for the tidal marshes of the
37 surrounding Suisun Bay, and mandated the formation of a Suisun Marsh Ecological Work Group that
38 would provide recommendations for water quality objectives to improve conditions for beneficial
39 uses (wildlife habitat; rare, threatened and endangered species; and estuarine habitat) and
40 recommend future research and monitoring needs for the marsh. Because evidence showed a
41 potential for actions to meet the salinity objectives at two compliance stations within the marsh
42 might cause harm to the beneficial uses they were intended to protect, the State Water Board in D-
43 1641 did not require that DWR and Reclamation attain the objectives at these stations. The salinity
44 objectives for the marsh remained unchanged in the 2006 Bay-Delta WQCP, but it notes that salinity
45 objectives will be finalized, including adoption of numerical objectives for brackish marshes in

1 Suisun Bay and other locations (if necessary), by 2015 and following development and
 2 implementation of a comprehensive Suisun Marsh Plan. Federal and state agencies recently
 3 completed environmental compliance documentation for the Suisun Marsh Plan (Bureau of
 4 Reclamation et al. 2011), which assesses a comprehensive 30-year plan designed to address use of
 5 resources within about 52,000 acres of wetland and upland habitats in the marsh, restoration of
 6 tidal wetlands, and the enhancement of managed wetlands and their functions.

7 The Suisun Marsh Salinity Control Gates (SMSCG) were constructed on Montezuma Slough near
 8 Collinsville and began operating in late 1988. The gates are operated periodically from September to
 9 May to meet the salinity standards of the 1995 Bay-Delta WQCP and D-1641 requirements. The
 10 SMSCG operation acts to restrict the inflow of high-salinity flood-tide water from Grizzly Bay into
 11 the marsh but allow passage of freshwater ebb-tide flow from the mouth of the Delta. Operation of
 12 the gates in this fashion lowers salinity in Suisun Marsh channels and results in a net movement of
 13 water from east to west. When Delta outflow is low to moderate and the gates are not operating, net
 14 movement of water is from west to east, resulting in higher-salinity water in Montezuma Slough.
 15 Because the SMSCG operations have been more effective than anticipated, and as a result of
 16 additional freshwater Delta outflows required by the 1995 Bay-Delta WQCP, other previously
 17 proposed large physical facilities to promote further salinity controls in the marsh have not been
 18 implemented. The SMSCG are operated only as needed and generally do not operate from June
 19 through August.

20 **Other Water Quality Plans**

21 The State Water Board has begun development of a statewide mercury regulatory program to
 22 address reservoirs on the state's 303(d) list for mercury. The plans are at the scoping level as of first
 23 quarter 2012.

24 In 2005, the State Water Board directed the San Francisco and Central Valley Water Board to
 25 address the public health impacts of mercury in fish. In response, the Central Valley Basin Plan
 26 requires all entities subject to controlling methylmercury in the Delta and Yolo Bypass to participate
 27 in a program to reduce human exposure to mercury through eating fish. The Mercury Exposure
 28 Reduction Program (MERP) was developed to meet this objective. The primary goals of the Delta
 29 MERP are to increase understanding of contaminants in fish and reduce exposure to mercury among
 30 people who eat fish from the Delta.

31 The Delta Regional Monitoring Program (RMP) is currently under development by the Central Valley
 32 Water Board as of August 2013. The RMP was initiated by the Central Valley Water Board to
 33 establish a system for coordinating among the many agencies and groups that monitor water
 34 quality, flows, and ecological conditions in the Delta, whereby all data are synthesized and assessed
 35 on a regular basis, with the primary goal of tracking and documenting the effectiveness of beneficial
 36 use protection and restoration efforts through comprehensive monitoring of contaminants and
 37 contaminant effects in the Delta.

38 **California Drinking Water Standards Incorporated by Reference in Basin Plans**

39 Both the Central Valley and San Francisco Bay Basin Plans incorporate by reference the California
 40 Department of Public Health (DPH) numerical drinking water maximum contaminant levels (MCLs).
 41 The incorporation of the MCLs, which apply to treated drinking water systems regulated by DPH,
 42 makes the MCLs also applicable to ambient receiving water with respect to the regulatory programs
 43 administered by the Regional Water Boards. DPH establishes state drinking water standards,

1 enforces both federal and state standards, administers water quality testing programs, and issues
 2 permits for public water system operations. The drinking water regulations are found in Title 22 of
 3 the California Code of Regulations (CCRs). The state drinking water standards consist of primary and
 4 secondary MCLs. Primary MCLs are established for the protection of environmental health, and
 5 secondary MCLs are established for constituents that affect the aesthetic quality of drinking water,
 6 such as taste and odor. The incorporation by reference of the MCLs in Basin Plans is meant to
 7 ensure, to the extent possible, that adequate source water quality is maintained to support the
 8 domestic and municipal water supply beneficial use, particularly from constituents that WTPs are
 9 not typically designed to remove. The state primary and secondary MCLs applicable to the Central
 10 Valley and San Francisco Bay Basin Plans are provided in Appendix 8A.

11 **8.2.1.7 Water Quality Impairments**

12 **Water Quality–Limited Water Bodies, Watershed Monitoring Programs, and Total** 13 **Maximum Daily Loads**

14 Constituents of concern in the study area have been identified through ongoing regulatory,
 15 monitoring, and environmental planning processes. Important programs are CALFED, the Basin Plan
 16 functions of the Central Valley and San Francisco Bay Water Boards, Bay-Delta planning functions of
 17 the State Water Board, and the CWA Section 303(d) listing process for state water bodies that do not
 18 meet applicable water quality objectives.

19 The CALFED Bay-Delta Program was established in 1995 to develop a long-term comprehensive
 20 plan to restore ecological health and improve water management for beneficial uses of the Bay-Delta
 21 System. Senate Bill 1653 established the California Bay-Delta Authority to act as the governance
 22 structure, as of January 1, 2003, and is housed within the California Resources Agency.

23 Under CWA Section 303(d), states, territories, and authorized tribes are required to develop a
 24 ranked list of water quality–limited segments of rivers and other water bodies under their
 25 jurisdiction. Listed waters are those that do not meet water quality standards even after point
 26 sources of pollution have installed the minimum required levels of pollution control technology. The
 27 law requires that action plans, or TMDLs, be developed to monitor and improve water quality. TMDL
 28 is defined as the sum of the individual waste load allocations from point sources, load allocations
 29 from nonpoint sources and background loading, plus an appropriate margin of safety. A TMDL
 30 defines the maximum amount of a pollutant that a water body can receive and still meet water
 31 quality standards. TMDLs can lead to more stringent National Pollutant Discharge Elimination
 32 System (NPDES) permits (CWA Section 402).

33 The State Water Board and USEPA have approved TMDLs for organic enrichment/low DO and
 34 methylmercury in the Delta, and for salt and boron in the San Joaquin River at Vernalis. TMDLs for
 35 other constituents remain under planning or development. Additionally, the San Francisco Bay
 36 Water Board is currently developing a TMDL for Suisun Marsh to address impairment by
 37 methylmercury, DO, and nutrient enrichment (San Francisco Bay Water Board 2012).

38 The State Water Board recently compiled the 2010 Section 303(d) list of impaired waters based on
 39 recommendations from the Regional Water Boards and information solicited from the public (and
 40 other interested parties). In October 2011, USEPA gave final approval to the list. Table 8-2 lists the
 41 constituents identified in the Section 303(d) list for impaired Delta waters (State Water Resources
 42 Control Board 2011).

1 **Table 8-2. Clean Water Act Section 303(d) Listed Pollutants and Sources in the Delta**

Pollutant/Stressor	Listing Region	Listed Source	Delta Location of Listing
Boron	Central Valley	Agriculture	Exp
Chlordane	Central Valley and San Francisco Bay	Agriculture, nonpoint source	N, W
Chloride	Central Valley	Source unknown	TomP
Chlorpyrifos	Central Valley	Agriculture, urban runoff/ storm sewers	N, S, E, W, NW, C, Exp, Stk, CalvR, Duck, Five, French, MokR, Morm, Mosh, OldR, Pix
Copper	Central Valley	Resource extraction	MokR
DDT	Central Valley and San Francisco Bay	Agriculture, nonpoint source	N, S, E, W, NW, C, Exp, Stk
Diazinon	Central Valley	Agriculture, urban runoff/ storm sewers	N, S, E, W, NW, C, Exp, Stk, CalvR, Five, French, Mosh, Pix
Dieldrin	San Francisco Bay	Nonpoint source	N, W
Dioxin compounds	Central Valley and San Francisco Bay	Source unknown, atmospheric deposition	W, Stk
Disulfoton	Central Valley	Agriculture	Pix
E. coli	Central Valley	Source unknown	E, French, Pix
Invasive species	Central Valley and San Francisco Bay	Source unknown, ballast water	N, S, E, W, NW, C, Exp, Stk
Furan compounds	Central Valley and San Francisco Bay	Contaminated sediments, atmospheric deposition	Stk
Group A pesticides ^a	Central Valley	Agriculture	N, S, E, W, NW, C, Exp, Stk
Mercury	Central Valley and San Francisco Bay	Resource extraction, industrial- domestic wastewater, atmospheric deposition, nonpoint source	N, S, E, W, NW, C, Exp, Stk, CalvR, MokR, Mosh
Pathogens	Central Valley	Recreational and Tourism Activities (nonboating), Urban Runoff/Storm Sewers	Stk, CalvR, Five, Morm, Mosh, Walk
PCBs	Central Valley and San Francisco Bay	Source unknown	W, N, Stk
Unknown toxicity ^b	Central Valley	Source unknown	N, S, E, W, NW, C, Exp, Stk, French, MokR, Morm, Pix
EC	Central Valley	Agriculture	S, W, NW, Exp, Stk, OldR, TomP
Organic enrichment /low DO	Central Valley	Municipal point sources, urban runoff/storm sewers	Stk, CalvR, Five, MidR, MokR, Morm, Mosh, OldR, Pix, TomP
Sediment toxicity	Central Valley	(Not specified)	French
Selenium	San Francisco Bay	Refineries, invasive species, natural sources	W
TDS	Central Valley		S, OldR
Zinc	Central Valley	Resource extraction	MokR

Source: State Water Resources Control Board 2011.

^a Group A pesticides include aldrin, dieldrin, chlordane, endrin, heptachlor, heptachlor epoxide, benzene hexachloride (BHC; including lindane), endosulfan, and toxaphene.

^b Toxicity is known to occur, but the constituent(s) causing toxicity is unknown.

Notes: DDT = dichlorodiphenyltrichloroethane, PCB = polychlorinated biphenyls, EC = electrical conductivity, DO = dissolved oxygen, TDS = total dissolved solids.

Delta Locations: C = Central, E = East, Exp = export area, N = north, NW = northwest, S = south, Stk = Stockton Deep Water Ship Channel, W = west (includes Central Valley list and San Francisco Bay list for "Bay-Delta" category).

Specific Delta Waterways: CalvR = Calaveras River, Duck = Duck Slough, Five = Five Mile Slough, French = French Camp Slough, MidR = Middle River, MokR = Mokelumne River, Morm = Mormon Slough, Mosh = Mosher Slough, OldR = Old River, Pix = Pixley Slough, TomP = Tom Paine Slough, Walk = Walker Slough.

1 There are several ongoing watershed-monitoring programs in the study area. These monitoring
 2 programs are associated with Section 303(d) TMDL programs, the State Water Board Surface Water
 3 Ambient Monitoring Program, and numerous other efforts of local governments and public/private
 4 entities.

5 Section 303(d) requires that states evaluate and rank water quality impairments that cannot be
 6 resolved through point source controls and, in accordance with the priority ranking, the TMDL for
 7 those pollutants the USEPA identifies under Section 304(a)(2) as suitable for such calculation. The
 8 TMDL must be established at a level necessary to implement the applicable water quality standards
 9 with seasonal variations and a margin of safety that takes into account any lack of knowledge
 10 concerning the relationship between effluent limitations and water quality. The TMDL is the amount
 11 of loading that the water body can receive and still meet water quality standards. The TMDL must
 12 include an allocation of allowable loadings to point and nonpoint sources, with consideration of
 13 background loadings. Table 8-3 summarizes the TMDLs that have been completed or are being
 14 developed for Section 303(d) listed constituents in the Delta, and the portion of the study area in the
 15 Sacramento and San Joaquin River basins (Central Valley Water Board 2009b).

16 **Table 8-3. Summary of Completed and Ongoing Total Maximum Daily Loads in the Bay-Delta and**
 17 **Sacramento and San Joaquin River Portions of the Study Area**

Pollutant/Stressor	Water Bodies Addressed	TMDL Status
Chlorpyrifos and diazinon	Sacramento County Urban Creeks	TMDL report completed—September 2004 State-Federal approval—November 2004
Chlorpyrifos and diazinon	Lower San Joaquin River	TMDL report completed—October 2005 State-Federal approval—December 2006
Chlorpyrifos and diazinon	Sacramento and San Joaquin Rivers and Delta	TMDL report completed—June 2006 State-Federal approval—October 2007
Chlorpyrifos and diazinon	Sacramento and Feather Rivers	TMDL report completed—May 2007 State-Federal approval—August 2008
Chlorpyrifos and diazinon	Lower San Joaquin River	TMDL report completed—October 2005 State-Federal approval—December 2006
DO	Stockton Deep Water Ship Channel	TMDL report completed—February 2005 State-Federal approval—January 2007
Mercury/methylmercury	Delta	TMDL report completed—April 2010
Mercury/methylmercury	Reservoirs	Ongoing
Pathogens	Tributaries affected by city of Stockton urban runoff	Ongoing
Pesticides	Basin-wide	Ongoing
Organochlorine pesticides	Specific Sacramento and San Joaquin River tributaries; Delta	Ongoing
Salt and Boron	San Joaquin River at Vernalis	TMDL report completed—October 2005 State-Federal approval—February 2007
Selenium	San Joaquin River at Vernalis	TMDL report completed—August 2001 State-Federal approval—March 2002

Source: Central Valley Water Board 2009b.

Notes: DO = dissolved oxygen, TMDL = Total Maximum Daily Load.

18

1 Table 8-4 summarizes only the total number of Section 303(d) listed water bodies in the regions of
 2 the Central Coast, Los Angeles, Santa Ana, and San Diego Regional Water Boards where SWP south-
 3 of-Delta exports are conveyed. This information is presented at a lesser level of detail than for the
 4 Delta and Sacramento–San Joaquin regions because the effects of storage and conveyance of Delta
 5 export water in the southern SWP service areas to the large majority of these listed water bodies are
 6 only indirect or nonexistent. Moreover, not all of the Section 303(d)–listed water bodies in these
 7 regions necessarily occur in the SWP service areas because the SWP service areas do not cover the
 8 entire regions.

9 **Table 8-4. Clean Water Act Section 303(d) Listed Water Bodies in Regions of the Study Area Served**
 10 **by SWP South-of-Delta Exports**

Pollutant	Regional Water Board				
	San Francisco	Central Coast	Los Angeles	Santa Ana	San Diego
Hydromodification			10		
Mercury	36	6	11	2	2
Other metals	27	44	142	24	159
Miscellaneous	17	147	52	11	36
Nuisance		3	27		14
Nutrients	15	321	183	29	179
Other inorganics	2		39		14
Other organics	64	11	102	10	18
Pathogens	32	451	171	44	324
Pesticides	95	142	187	16	32
Salinity	1	194	72	2	46
Sediment	10	168	23	10	20
Toxicity	7	105	49	8	109
Trash	27		87		7

Source: State Water Resources Control Board 2011.

12 8.2.1.8 Water Quality Constituents of Concern

13 Constituents that are of concern in the study area are those that, at elevated concentrations, have
 14 the potential to adversely affect or impair one or more beneficial uses (Table 8-1), such as the
 15 constituents identified from the Section 303(d) listing process described above (Tables 8-1 and 8-2).

16 Salinity is an important parameter of concern for the Delta that reflects the total ionic content of the
 17 water, ranging from very low levels deemed fresh water to the high salinity content of seawater.
 18 Chloride, bromide, and boron are specific ions that contribute to overall salinity and are constituents
 19 of concern. Salinity can affect multiple beneficial uses, including defining the types and distribution
 20 of aquatic organisms that are adapted to fresh water versus brackish, or saline, water conditions in
 21 the Delta.

22 Other constituents of concern for the Delta in particular are of importance to municipal water
 23 suppliers, including organic carbon (total and dissolved) and bromide, which are precursors for the
 24 formation of DBPs such as trihalomethanes (THMs), haloacetic acids (HAAs), bromate, chlorite, and
 25 nitrosamines at treated drinking water treatment processes. The DBPs mentioned are of concern

1 because they are known or suspected human carcinogens when consumed at elevated
2 concentrations over many years. Pathogens are of importance to municipal water suppliers as well
3 as recreational uses.

4 In addition, elevated nutrient concentrations can affect municipal water suppliers that store
5 diverted Delta water in reservoirs. Elevated nutrient levels contribute to algae growth and affect the
6 taste and odor of treated water, filter clogging at WTPs, and increased levels of organic carbon.
7 Increased salinity concentrations also can alter the taste of finished drinking water.

8 Constituents of concern to agricultural users in the study area include boron and salinity. Many
9 crops are sensitive to these constituents, which can affect their yield.

10 Numerous constituents, including temperature, turbidity and suspended sediment, DO, pesticides,
11 herbicides, nutrients, and trace metals, can cause adverse effects on aquatic life in the study area.
12 Trace metals, pesticides, and herbicides can be toxic to aquatic life at relatively low concentrations.
13 Temperature and DO are of concern because the Delta serves as a migration and rearing corridor for
14 anadromous salmonids, which are sensitive to these parameters. Because the primary concern of
15 water temperature is effects on fish and aquatic organisms, temperature is addressed in Chapter 11,
16 *Fish and Aquatic Resources*. Excess nutrients can cause blooms of nuisance algae and aquatic
17 vegetation, and their decay can result in depleted DO.

18 Finally, an emerging class of constituents of concern is endocrine-disrupting compounds (EDCs),
19 pharmaceutical and personal care products (PPCPs), and nitrosamines. EDCs and PPCPs are thought
20 to have potential to cause adverse effects on aquatic resources, and their potential presence in
21 drinking water supplies has received significant attention (World Health Organization 2002; U.S.
22 Geological Survey 2002). Nitrosamines have long been suspected carcinogens, but their more recent
23 discovery as a DBP, along with lower detection limits for the analytical methods used to measure
24 them, has spurred more attention in recent years.

25 As noted in Table 8-2, the entire Delta is identified on the Section 303(d) list as impaired by
26 unknown toxicity. Aquatic toxicity refers to the mortality of aquatic organisms or sublethal (e.g.,
27 growth, reproductive success) effects. Aquatic toxicity can be caused by any number of individual
28 constituents of concern, or through additive and synergistic effects attributable to the presence of
29 multiple toxicants. No TMDLs have been developed for the Delta to address the sources of toxicity,
30 identify alternatives to reduce toxicity, or identify the allocation of the allowable loading of
31 constituents that would result in achieving the Basin Plan narrative toxicity objective that forms the
32 basis for the Section 303(d) listing. Because unknown toxicity is a primary concern for fish and
33 other aquatic organisms, Chapter 11, *Fish and Aquatic Resources*, addresses the subject in detail.

34 In light of these issues, the constituents of concern identified in Table 8-5 are addressed in detail for
35 the purposes of characterizing existing water quality in the study area (Section 8.1.3, *Existing Water*
36 *Quality*) and to support the water quality impact assessments. Table 8-5 also relates the constituents
37 of concern to the various receptors in the study area that could be adversely affected by their
38 concentrations. For purposes of this characterization, the receptors are categorized by the
39 designated beneficial uses specified in the Bay-Delta WQCP. The constituent-specific sections
40 described subsequently (Section 8.1.3) characterize the potential effects on beneficial uses and
41 various receptors, including known information regarding specific locations in the Delta most
42 affected by the constituents.

8.2.2 Selection of Monitoring Locations for Characterization of Water Quality

8.2.2.1 Water Quality Monitoring Programs and Sources of Data

In compiling water quality data for the constituents of concern (Table 8-5), data sets from the following monitoring programs/entities were obtained through the Bay-Delta and Tributaries Project (BDAT) database for the period from 1990 through 2009 (Bay Delta and Tributaries Project 2009). This effort began in early 2010, when data more recent than 2009 were not available. Revision of the data summarized below to account for more recent monitoring data was not considered necessary because there was no reason to expect that water quality conditions as represented by these monitoring databases would be substantially changed relative to the data already collected. Also, any differences would not be of a magnitude that would alter the nature of the characterization or the assessment in any substantial way.

- California National Water Information System Water Quality Data (U.S. Geological Survey [USGS]).
- Environmental Monitoring Program (DWR) (continuous and discrete data).
- Municipal Water Quality Investigations Program data (DWR).
- Surface Water Ambient Monitoring Program (State Water Resources Control Board and Regional Water Boards).

BDAT contains environmental data concerning the Bay-Delta and provides public access to those data. More than 50 organizations voluntarily contribute biological, water quality, meteorological, and other data to this database. In the event the monitoring programs listed above, as accessed through BDAT, did not provide data for all the constituents of interest, additional data were obtained from one or more of the following monitoring programs/databases to provide a more comprehensive characterization of Delta water quality.

- California Data Exchange Center (DWR).
- Interagency Ecological Program (multiagency).
- National Water Information System (USGS).
- San Francisco Estuary Institute ([SFEI] multi-agency in Bay Area).
- Sacramento River Coordinated Monitoring Program (Sacramento Stormwater Quality Partnership and the Sacramento Regional County Sanitation District (SRCSD)).
- Sacramento River Watershed Program (nonprofit 501[c][3] organization).
- Water Data Library (DWR).

8.2.2.2 Surface Water Quality Monitoring Locations

Based on data availability, data continuity, and geographic location, a total of 20 water quality monitoring stations were selected to characterize the water quality conditions in the study area (Figure 8-7). Because of the complexity of the Delta environment, a detailed characterization of water quality was necessary for the statutory Delta to represent the effects of water quality on the broad beneficial use categories (e.g., agriculture, aquatic life, recreation) and more specific issues

1 such as major water diversion locations. For example, major water diversions include CCWD's three
2 intakes at Rock Slough, Old River, and Victoria Canal; the North Bay Aqueduct; Jones and Banks
3 pumping plants; seasonal Antioch and Mallard Slough diversions; and the City of Stockton's new
4 diversion from the central Delta. The following section provides a brief illustration of how the data
5 from these stations were used to represent various parts of the study area. Table 8-6 presents the
6 specific reasons for selecting these locations and describes the spatial area of the study area for
7 which specific stations provide adequate representation.

Table 8-5. Receptors Affected by Water Quality—Characterized by the Designated Beneficial Uses of the Study Area

Constituent	Freshwater Replenishment	Municipal and Domestic Supply and Groundwater Recharge	Agricultural Supply	Industrial Process Supply	Recreation		Shellfish Harvesting and Aquaculture	Commercial/Sport Fishing	Freshwater Habitat		Migration/Spawning	Estuarine Habitat	Wildlife Habitat	Endangered Species and Areas of Biological Significance
					Contact	Non-Contact			Warm	Cold				
Physical Parameters														
Temperature							X	X	X	X	X	X		X
Turbidity/suspended solids	X	X		X	X	X			X	X	X	X		X
Inorganic parameters														
Salinity (EC/TDS)	X	X	X	X			X	X	X	X	X	X	X	X
Bromide	X	X												
Chloride	X	X	X	X			X	X	X	X	X	X	X	X
Boron	X		X											
Organic carbon	X	X												
Ammonia (nitrogen)		X					X	X	X	X	X	X		X
Other nutrients (nitrogen, phosphorus)	X	X					X	X	X	X	X	X	X	X
DO							X	X	X	X	X	X		X
Trace Metals														
Mercury	X	X					X	X	X	X	X	X	X	X
Selenium	X		X						X	X	X	X	X	X
Others (e.g., copper, lead, zinc,)	X	X					X	X	X	X	X	X		X
Other														
Pathogens	X	X			X		X	X						
Pesticides and herbicides	X	X					X	X	X	X	X	X	X	X
Dioxins/furans and PCBs	X	X					X	X	X	X	X	X	X	X
Polycyclic aromatic hydrocarbons	X	X					X	X	X	X	X	X	X	X
Emerging pollutants (EDCs/PPCPs)	X	X					X	X	X	X	X	X	X	X
Applicable Basin Plan	N, S, Ext	D, N, S, Ext	D, N, S, Ext	D, N, S, Ext	D, N, S, Ext	D, N, S, Ext	D, N, S, Ext	D, N, S, Ext	D, N, S, Ext	D, N, S, Ext	D, N, S, Ext	D	D, N, S, Ext	D, N, S, Ext

Notes:

- D = Delta.
- EDC = endocrine-disrupting compound.
- Ext = export area.
- N = north.
- PCB = polychlorinated biphenyl.
- PPCP = pharmaceutical and personal care product.
- S = south.

Applicable Basin Plans

- Delta: Central Valley and San Francisco Bay Water Boards
- Export Area: Central Valley, San Francisco Bay, Central Coast, Santa Ana, and Los Angeles Water Boards
- North: Central Valley Water Board
- South: Central Valley Water Board

1 **Table 8-6. Locations Selected to Represent Existing Water Quality in the Delta**

Location	Data Sources	Justification for Selecting Location
North of Delta Locations		
Sacramento River at Keswick	DWR	Characterizes water quality in the area north of the Delta
Feather River at Oroville	DWR	Characterizes water quality in the area north of the Delta
American River at the E.A. Fairbairn Water Treatment Plant	DWR	Characterizes water quality in the area north of the Delta
Sacramento River at Verona	DWR	Characterizes water quality in the area north of the Delta
Delta Source Water Locations		
Sacramento River at Hood	BDAT, CDEC, MWQI	Characterizes water quality at the northern boundary of the Delta
San Joaquin River near Vernalis	BDAT, CDEC, MWQI	Characterizes water quality at the southern boundary of the Delta
Mokelumne River (South Fork) at Staten Island	BDAT, WDL	Characterizes EC from a major eastern Delta boundary river
Suisun Bay at Bulls Head Point near Martinez	BDAT	Characterizes water quality at the western export area of the Delta; represents saltwater intrusion into the Delta
Delta Interior		
San Joaquin River at Buckley Cove	BDAT	Represents effects of Stockton Deep Water Ship Channel in the eastern Delta near the city of Stockton
Franks Tract at Russo's Landing	BDAT	Characterizes water quality in a reclaimed area in the central portion of the Delta
Old River at Rancho del Rio	BDAT	Characterizes water quality in the central portion of the Delta
Major Outflows		
Sacramento River above Point Sacramento	BDAT, SFEI	Characterizes Sacramento River water quality prior to its confluence with the San Joaquin River; essentially the same location as the SFEI's BG20 station
San Joaquin River at Antioch Ship Channel	BDAT, SFEI	Characterizes San Joaquin River water quality prior to its confluence with the Sacramento River; essentially the same location as the SFEI's BG30 station
Sacramento River at Mallard Island	DWR, MWQI	Characterizes water quality at the western boundary of the Delta; essentially the same location as Sacramento River at Chipps Island
Major Diversions		
North Bay Aqueduct at Barker Slough Pumping Plant	CDEC, MWQI	Major municipal water supply intake in northwestern portion of the Delta
Contra Costa Pumping Plant No. 1	MWQI	Major municipal water supply intake in western portion of the Delta
Harvey O. Banks Pumping Plant	CDEC, MWQI	Major water supply intake; pumps SWP water into the California Aqueduct
C. W. "Bill" Jones Pumping Plant	BDAT, CDEC, MWQI	Major water supply intake; pumps CVP water into the Delta-Mendota Canal
South-of-Delta Locations		
California Aqueduct at Check 13	DWR	Characterizes water quality in the area south of the Delta
California Aqueduct at Check 29	DWR	Characterizes water quality in the area south of the Delta
Notes: BDAT = Bay Delta and Tributaries Project; CDEC = California Data Exchange Center; DWR = California Department of Water Resources; EC = electrical conductivity; MWQI = Municipal Water Quality Investigations; SFEI = San Francisco Estuary Institute; WDL = Water Data Library; WTP = water treatment plant.		

1 North of Delta

2 The hydrology north of the Delta is dominated by three major rivers—the Sacramento, Feather, and
 3 American. To characterize the water quality for the area north of the Delta, it is important to review
 4 the water quality entering these three rivers from their major reservoirs (Shasta Lake, Lake Oroville,
 5 and Folsom Lake, respectively). For the purpose of this assessment, the water quality of the area
 6 north of the Delta is represented by locations downstream of these three lakes, as well as a
 7 monitoring location at the Sacramento River at Verona (immediately downstream of the confluence
 8 of the Feather and Sacramento Rivers, representing the water quality of the combined flow after
 9 mixing) Figure 8-7 shows the selected locations.

- 10 ● Sacramento River at Keswick.
- 11 ● Feather River at Oroville.
- 12 ● American River at the E. A. Fairbairn Water Treatment Plant.
- 13 ● Sacramento River at Verona.

14 Because organic carbon data were not monitored at the Verona location, data from a monitoring
 15 location approximately 9 miles downstream of the Verona location (Sacramento River at Vietnam
 16 Veterans Memorial Bridge [Interstate 5] [Veterans Bridge]) were reviewed and analyzed for organic
 17 carbon. Water quality downstream of the confluence of American and Sacramento Rivers is
 18 represented by the monitoring station at Hood, which is addressed in the following section, *Delta*
 19 *Source Waters*.

20 8.2.2.3 Delta Source Waters

21 Water quality in the Delta at any given location and time is primarily the result of the sources of
 22 water to that location (i.e., the percentage of the water at the site comprising water from the
 23 Sacramento River, the San Joaquin River, eastside tributaries, Bay water, in-Delta runoff, and
 24 agricultural return flows). Consequently, it is important to characterize the quality of the major
 25 sources of water entering the Delta to determine how Delta water quality may change, as the source
 26 fractions of water to various locations change with implementation of alternative activities. For the
 27 purpose of this section, the water quality of the major Delta source waters will be represented by
 28 the following locations.

- 29 ● Sacramento River at Hood.
- 30 ● San Joaquin River at Vernalis.
- 31 ● Mokelumne River at Staten Island.
- 32 ● Bay water intrusion to Suisun Bay at Martinez.

33 Figure 8-7 shows the selected locations. It should be noted that the selected Sacramento, San
 34 Joaquin, and Mokelumne Rivers monitoring stations are within the statutory Delta and can be
 35 affected by tidal action, depending on the stream flow rates. Additionally, the Mokelumne River is
 36 directly affected by the flow of Sacramento River water when the Delta Cross Channel is open.
 37 However, these locations generally represent the water quality occurring at these perimeter
 38 locations in the Delta.

1 Interior Delta and Outflow Locations

2 In addition to characterizing the quality of the major source water inputs to the Delta, a number of
3 interior Delta locations were identified for characterizing existing interior Delta water quality. The
4 locations chosen for this purpose were selected based on the following criteria.

- 5 • Availability of water quality data (locations used by the various water quality monitoring
6 programs).
- 7 • Geographic location in the Delta, in an effort to have one or more stations in the northern,
8 central, eastern, western, and southern portions of the Delta.
- 9 • Locations of the primary water supply intakes.
- 10 • Bay-Delta WQCP EC compliance locations.
- 11 • Other related considerations (e.g., locations of output nodes for Delta Simulation Model 2
12 [DSM2], reasonable number of locations to support the water quality impact assessments).

13 Based on the selection criteria listed above, 10 interior and outflow Delta locations were chosen
14 (Figure 8-7) to characterize existing water quality in the Delta and to support the water quality
15 impact assessments.

16 South of the Delta

17 The system south of the Delta is influenced primarily by the numerous dams and reservoirs and
18 hundreds of miles of canal that constitute the SWP and CVP (described previously). The SWP and
19 CVP serve as a major source of municipal water supply for Central Coast, San Joaquin Valley, and
20 southern California water contractors and also as one of the major sources of agricultural water
21 supply for the San Joaquin Valley. For the purpose of this assessment, the water quality of the area
22 south of the Delta is represented by two locations along the California Aqueduct.

- 23 • California Aqueduct at Check 13.
- 24 • California Aqueduct at Check 29.

25 Figure 8-7 shows the selected locations for the area south of the Delta.

26 The San Luis Reservoir is a major storage reservoir 50 miles south of the Delta that is used for
27 various control purposes within the system (e.g., storing water from the San Joaquin River and
28 Sacramento River to re-release into the aqueducts). Hence, the water quality downstream of this
29 reservoir is of great importance in characterizing the water quality in the service area. Water exiting
30 the San Luis Reservoir passes through the O'Neill Forebay, which also is fed by water from the
31 California Aqueduct and the Delta-Mendota Canal. The water quality monitoring location at the exit
32 point of the O'Neill Forebay is called the California Aqueduct at Check 13.

33 South of O'Neill Forebay, there are inflows to the aqueduct, including storm water and flood flows at
34 crossings of several streams and groundwater inflows, prior to water being pumped over the
35 Tehachapi Mountains and into watersheds of water supply reservoirs in the Los Angeles region and
36 areas to the south. DWR accepts the introduction of local groundwater into the aqueduct ("Pump-In"
37 Projects) in accordance with California Water Code provisions that state that nonproject water may
38 be conveyed, wheeled, or transferred in the SWP provided that water quality is protected.

8.2.3 Existing Surface Water Quality

In the following subsections, each constituent of concern (or category of similar constituents) is reviewed in detail to characterize the general patterns of concentrations that exist in the study area at present. The review process followed the steps outlined below.

- Literature review—A wide range of scientific articles, agency reports, and site-specific studies was reviewed to collect the following information:
 - The various structural and nonstructural features and operations in the study area that affect water quality.
 - The importance and relevance of each of the constituents of concern in the study area.
 - The interaction of various constituents and the combined effect on water quality.
 - The historical and current patterns in concentrations of the constituents at selected locations.
 - The variation in concentrations in wet and dry years.
 - Applicable standards and regulatory criteria, and known impairments.
- Some of the key documents reviewed include:
 - Basin Plan for the Sacramento and San Joaquin River Basins.
 - Bay-Delta WQCP.
 - CALFED Bay-Delta Program 2000 Water Quality Program Plan.
 - CALFED 2008 State of Bay-Delta Science.

Water quality data for the identified constituents were collected from various monitoring programs and databases. Data were downloaded for selected locations (described in previous section) for each constituent for the period between 1990 and 2009 and stored in a database. In the discussions below, various periods of record are discussed for different constituents and different purposes. The time period of data used to characterize present conditions varied by constituent according to what was available in the database, but in general, data from 2001–2006 are presented as a representative time period that contained both wet and dry years and for which data were available for the entirety of all water years. It must be noted that the characterization provided below is meant to provide a general understanding of water quality conditions and historical monitoring data in the study area. The discussion below is not meant to explicitly define the Existing Conditions for CEQA purposes. The CEQA baseline, *Existing Conditions*, is defined in Appendix 3D and for the purposes of quantitative water quality assessments (as described in Section 8.3.4, *Effects and Mitigation Approaches*) is represented by Existing Conditions modeling runs, not historical water quality monitoring data as presented below. For more information on the comparisons made to the Existing Conditions modeling run for assessment purposes, see Section 8.3.3.2, *Comparisons*. For these reasons, the time period 2001–2006 was generally considered sufficient for characterization purposes because inclusion of more recent data that have been made available since the start of the environmental review process would not alter the nature of the characterization or the assessment in any substantial way. For instances in which it would be expected that water quality conditions would have changed since this time period, for example, if major sources of a constituent of concern to the Delta were created or eliminated, more recent data was examined and characterized. Appendix 8B summarizes the data availability for each of the constituents of concern and locations

1 where substantial information exists for characterizing the Existing Conditions. Depending on the
2 availability of data, the information was presented in various forms.

- 3 • Spatial distribution—data presented in a map for individual constituents identifying the location
4 of the sampling station; the date range; and the maximum, minimum, average, and median
5 values.
- 6 • Seasonal patterns—plots showing the change in concentrations over time.
- 7 • Tabular—tables showing concentrations of constituents where data are discrete or
8 discontinuous.

9 **8.2.3.1 Ammonia**

10 **Background and Importance in Study Area**

11 Ammonia, a form of nitrogen, exists primarily in two forms: un-ionized ammonia (NH_3) and an
12 ionized form—ammonium (NH_4^+). In general terms, ammonia and ammonia-N refer to total
13 ammonia (i.e., un-ionized ammonia plus ammonium) in this chapter. The relative levels of un-
14 ionized ammonia and ammonium in a water body depend primarily on pH, and to a lesser extent on
15 temperature and salinity (U.S. Environmental Protection Agency 2009a). Un-ionized ammonia is a
16 gas that is toxic to animals, while ammonium is a solid dissolved in water and an important nutrient
17 for plants and algae. Both ammonium and ammonia are present in effluent from WTPs that employ
18 only secondary treatment methods, in some types of agricultural runoff (e.g., fertilizers, animal
19 wastes), fish and other wildlife wastes, urban runoff, and atmospheric depositions (Ballard et al.
20 2009:2). Concern about total ammonia effects in the Delta have led to focused efforts to define and
21 assess the issue (e.g., March 2009 CALFED Science Program Workshop, August 2009 Ammonia
22 Summit). The Sacramento Regional Wastewater Treatment Plant (SRWTP) discharge into the
23 Sacramento River at Freeport is a large point source of ammonia in the Delta. The SRWTP's output
24 has increased with human population growth, and it has contributed to an increase in ammonium
25 concentrations in the Delta downstream of the discharge (Ballard et al. 2009:3). The primary source
26 of total ammonia-N at Hood location is the SRWTP (Central Valley Water Board 2010a). The
27 discharge from the SRWTP accounts for 90% of the ammonium load in the Sacramento River at
28 Hood (Jassby 2008).

29 In the aquatic environment ammonia-N may rapidly cycle among the water, organisms, and
30 sediments. The presence of high concentrations of ammonia-N usually is associated with reducing
31 conditions and/or proximity to locally high concentrations of ammonia-N discharge such as WTP
32 discharges. Ammonia-N is rapidly oxidized in the flowing river environment to nitrate-N (NO_3^-).
33 More than three quarters of the ammonia present in the Sacramento River downstream of Freeport
34 is converted to nitrate by the time the water reaches Chipps Island (Central Valley Water Board
35 2010a Update memo:4).

36 Concerns regarding ammonia in the Delta include potential toxicity to fish and other organisms,
37 shifts in algal community structure (e.g., dominant species), and inhibition of nitrate uptake by
38 diatoms. Ammonia can be toxic to aquatic organisms at very low concentrations. The results of a
39 2008 pilot study to assess the potential acute toxicity of ammonia in treated wastewater effluent
40 from the SRWTP to larval delta smelt suggest that ammonia concentrations present in the
41 Sacramento River below the SRWTP were not acutely toxic to 55-day-old delta smelt. In general, un-
42 ionized ammonia concentrations in the Delta appear to be too low to cause acute mortality of even

1 the most sensitive species. It is unclear whether lower concentrations of ammonia may have chronic
2 effects on species survival, growth, or reproduction (Ballard et al. 2009:7).

3 There may be a potential for toxic ammonia concentrations in very productive areas in the southern
4 Delta, or smaller productive sloughs or shallow areas throughout the Delta, when high
5 concentrations of un-ionized ammonia coincide with warm temperatures and elevated pH
6 (phytoplankton productivity increases pH, which influences how much un-ionized ammonia is
7 present). In addition, the potential for combined effects of un-ionized ammonia with other toxicants
8 and stressors, and differences in fish sensitivity depending on health status, age, and physiological
9 state, add uncertainty to data analyses (Ballard et al. 2009:7).

10 Human-induced excesses in nitrogen concentrations, which includes ammonia, can cause
11 eutrophication, or increased biological production. Eutrophic conditions result in enhanced death
12 and decay of biomass and create an oxygen demand in sediments that lowers DO concentrations in
13 the water column (Wetzel 2001). Eutrophic conditions also can affect turbidity and, therefore, the
14 light regime, which can cause changes in the balance of benthic and planktonic productivity.
15 Increases in algal and macrophyte growth can add to the concentrations of dissolved organic carbon
16 (DOC) and TOC in water. Organic carbon in source waters is a constituent of drinking water concern
17 because of DBP formation during water treatment. See the organic carbon section for more on water
18 quality concerns associated with organic carbon and DBPs. Additionally, NH₃ can form nitrogenous
19 DBPs when combined with chlorine.

20 Nutrient concentrations currently in the Delta are high enough that they are probably not a true
21 limiting factor for overall algal growth, and therefore increases in ammonia generally will not lead to
22 an increase in algal growth (Jassby et al. 2002:1). However, it is unclear whether nutrient levels are
23 adversely affecting algal composition and thus primary productivity. For example, recent work has
24 suggested that elevated blue-green algal concentrations in the Delta interior were associated with
25 nitrogen (including ammonia) and phosphorus concentrations (Lehman et al. 2010). The
26 composition of the phytoplankton community has generally shifted from diatoms toward green
27 algae, cyanobacteria, and miscellaneous flagellate species (Lehman 2000). The changes in
28 phytoplankton composition, and especially the now regularly occurring *Microcystis* blooms, have
29 been implicated as possible factors in the decline of important Delta pelagic fish species, but the
30 connection with ammonia is not clear (Ballard et al. 2009:5).

31 In addition, Glibert (2010) analyzed more than 30 years of Delta water quality data, concluding that
32 aquatic organism population shifts were associated with changes in the quality and quantity of
33 nutrients discharged from the SRWTP. Subsequently, others have criticized this work by
34 demonstrating that the statistical techniques used were not appropriate and, therefore, that the
35 conclusions were flawed (Cloern et al. 2012:1). Glibert and others agreed that the statistical
36 conclusions of the 2010 review paper should be disregarded (Lancelot et al. 2012). However, a
37 subsequent paper emphasized that changes in nutrient concentrations and nutrient ratios
38 (primarily nitrogen to phosphorus) over time fundamentally affect biogeochemical nutrient
39 dynamics that can lead to conditions conducive to invasions of rooted macrophytes, benthic grazing
40 bivalve mollusks, and blooms of potentially harmful cyanobacteria (Glibert et al. 2011).

41 Research also has indicated that ammonia, while stimulating diatom growth at very low
42 concentrations, also can inhibit uptake of nitrate in diatoms as concentrations increase above about
43 4 micromoles per liter (µmol/L) (0.056 mg/L-N) (Dugdale et al. 2007:23). This may be of concern in
44 Suisun Bay, where algal blooms may be prevented when conditions otherwise would be favorable

1 (Wilkerson et al. 2006:1). A recent study showed that indeed, ammonia concentrations downstream
2 of the SRWTP appeared to inhibit phytoplankton nitrate uptake, and that chlorophyll a and primary
3 productivity were also concurrently reduced for many miles downstream (Parker et al. 2012). The
4 authors attribute the reduced chlorophyll a and primary productivity to the nitrate uptake
5 inhibition, though primary productivity decreases in the reach of the Sacramento River upstream of
6 the SRWTP. Therefore, there is some uncertainty as to the cause of the declines, as the Central Valley
7 Water Board discussed in its findings of the SRWTP NPDES permit issued in 2010: “the SRWTP
8 discharge cannot be cause of pigment decline upstream of the discharge point, and may not be
9 contributing to the decline downstream of the discharge point” (Central Valley Water Board 2010b).

10 Elevated concentrations of ammonium-N and other nutrients also may benefit invasive aquatic
11 plants in the Delta, which are controlled in Delta channels through chemical herbicides and
12 mechanical removal (Ballard et al. 2009:6). However, it is not clear how often ammonia
13 concentrations rise above those concentrations (Engle and Suverkropp 2010).

14 Research assessing the effects of nitrogen and phosphorus on phytoplankton in the Delta is far from
15 complete due in part to the large number of physical, chemical, and biological interactions occurring
16 in the Delta, e.g., Glibert et al. (2011). In addition to nutrients, Delta phytoplankton can be affected
17 by light conditions, filtration feeders (e.g., *Corbula amurensis*, *Corbicula fluminea*), and microbial
18 processing of organic carbon, to name a few factors (Sacramento Regional County Sanitation District
19 2009). Manipulation of all these factors to determine their relative contribution to Delta
20 phytoplankton quantity/quality is a significant task that likely will require a broad array of
21 experiments (both laboratory and field) and modeling studies to tease apart causal relationships.

22 The beneficial uses that could be affected most by ammonia concentrations include aquatic
23 organisms (cold freshwater habitat, warm freshwater habitat, and estuarine habitat) or activities
24 that depend on aquatic life (shellfish harvesting, commercial and sport fishing). Drinking water
25 supplies (municipal and domestic supply) and recreational activities (water contact recreation,
26 noncontact water recreation) are indirectly affected by nuisance eutrophication effects of ammonia
27 (Table 8-1).

28 As mentioned above, the SRWTP discharge to the Sacramento River at Freeport is a large point
29 source of ammonia in the Delta. In 2010, the Central Valley Water Board issued an updated NPDES
30 permit for the SRWTP requiring nitrification (i.e., conversion of ammonia to nitrate) and partial
31 denitrification (i.e., removal of nitrate). In its findings, the permit states: “However, as described
32 above, the ammonia discharged by the Discharger is impacting beneficial uses of the Sacramento
33 River, Delta and the Suisun Bay. Therefore, Best Practical Treatment and Control (BPTC)
34 technologies in the form of nitrification and denitrification is required to assure that a pollution or
35 nuisance will not occur and the highest water quality consistent with maximum benefit to the people
36 of the State will be maintained” (Central Valley Water Board 2010b). The term BPTC appears in the
37 state antidegradation policy, however BPTC is not defined specifically. BPTC is generally recognized
38 to refer to best available and cost-effective methods that meet performance requirements, such as
39 federal CWA requirements in the case of wastewater treatment plants, and maintain water quality
40 standards. In the discussion leading up to this statement, many concerns regarding ammonia in the
41 discharge are discussed, including potential toxicity concerns, inhibition of diatom primary
42 production, algal community shifts, effects on dissolved oxygen, and nitrosamine formation during
43 disinfection. Subsequently, the permit was appealed to the State Water Board, and the State Water
44 Board upheld requirements related to ammonia removal (State Water Board 2012). Further
45 lawsuits were also settled, and therefore the SRWTP will begin ammonia removal in 2021.

Existing Conditions in the Study Area

Most examined locations in the Delta have had low concentrations of ammonia-N in recent years (water years 2001–2006), with mean values typically ranging from 0.03 to 0.11 mg/L (Figure 8-8). The two exceptions are the Sacramento River at Hood and the San Joaquin River at Buckley Cove. The Hood station had a mean value of 0.27 mg/L, a median value of 0.23 mg/L, and a maximum value of 0.84 mg/L. The source of the majority of the ammonia-N at Hood is the SRWTP. The Buckley Cove station had instances of elevated ammonia prior to 2007, due to ammonia-N discharged from the City of Stockton Regional Wastewater Control Facility (RWCF). However, the City of Stockton has since installed a nitrifying biotower system that converts nearly all ammonia in the wastewater to nitrate in the final effluent that is discharged to the San Joaquin River. Therefore, data summarized for this monitoring location in Figure 8-8 is from water years 2008-2012, to reflect current conditions.

Mean values for the north-of-Delta area ranged from 0.01 mg/L at the Feather River at Oroville to 0.07 mg/L at the Sacramento River at Keswick (Table 8-7). South-of-Delta mean values ranged from 0.02 to 0.03 mg/L.

Table 8-7. Ammonia Concentrations at Selected North- and South-of-Delta Stations, Water Years 2001–2006^a

Location	Ammonia (mg/L as N)				
	Samples	Min	Max	Mean	Median
Sacramento River at Keswick	25	0.03	0.24	0.07	0.03
Sacramento River at Verona	9	0.01	0.10	0.04	0.03
Feather River at Oroville	8	0.01	0.03	0.01	0.01
American River at WTP	14	0.01	0.06	0.02	0.02
California Aqueduct at Check 13	26	0.01	0.12	0.03	0.02
California Aqueduct at Check 29	20	0.01	0.04	0.02	0.01

Notes: mg/L = milligrams per liter; WTP = water treatment plant.

^a Sample size represents water quality samples having values at or greater than the reporting limit.

Source: California Department of Water Resources 2009b

Time series data indicate that ammonia-N concentrations at the examined stations generally fluctuate on an annual basis (Figure 8-9 and Figure 8-10). Higher values have tended to occur during the months of November through March.

Regulatory criteria with respect to ammonia are as follows. Regarding narrative objectives, as stated in the San Francisco Bay Water Board Basin Plan and Central Valley Water Board Basin Plan, ammonia might be considered a biostimulatory substance because it is the preferred form of nitrogen for plant nutrient uptake, and a toxic compound under certain circumstances (e.g., high un-ionized ammonia concentrations). There are no numerical water quality criteria for the CTR or the Central Valley Water Board Basin Plan, and there is no California drinking water MCL associated with ammonia. The San Francisco Bay Water Board Basin Plan water quality objective of 0.025 mg/L ammonia-N 4-day average for fresh water refers to un-ionized ammonia, which is a function of ionized ammonia, pH, temperature, and salinity. Available data are inadequate to assess whether the sites examined herein exceeded this standard. Because the Central Valley Water Board Basin Plan and CTR lack objectives/criteria for ammonia, the Regional Water Board regulates ammonia

1 through its narrative toxicity objective. Water Board staff rely on the USEPA National Recommended
2 Water Quality Criteria for ammonia (U.S. Environmental Protection Agency 1999a, 2009a) to
3 numerically interpret the narrative standard with regard to ammonia. The USEPA has established
4 criteria for ammonia-N with respect to the toxicity of un-ionized ammonia-N, which is dependent on
5 water temperature and pH (U.S. Environmental Protection Agency 1999a, 2009a). The 2009
6 document represents draft criteria. A final relevant threshold includes a recommended goal for
7 sensitive crops of 1.5 mg/L-N (Ayers and Westcot 1994).

8 **8.2.3.2 Boron**

9 **Background and Importance in Study Area**

10 Boron is a naturally occurring compound found in sediments and sedimentary rocks in the form of
11 borates (e.g., boron oxide, boric acid, borax). Natural weathering of rocks is thought to be the
12 primary source of boron compounds in water and soil (Agency for Toxic Substances and Disease
13 Registry 2007). The richest deposits in the United States are located in California (sediments and
14 brines). Natural sources include releases to air from oceans, volcanoes, and geothermal steam. Total
15 natural global releases of boron from weathering, volcanoes, and geothermal steam are
16 approximately 360,000 metric tons per year (U.S. Environmental Protection Agency 2008a), while
17 releases from seawater range from 800,000 to 4,000,000 metric tons per year (U.S. Environmental
18 Protection Agency 2008b).

19 Human uses of boron compounds include production of glass, ceramics, soaps, fire retardants,
20 pesticides, cosmetics, photographic materials, and high-energy fuels (U.S. Environmental Protection
21 Agency 2008a). Anthropogenic releases of boron compounds occur through such pathways as air
22 emissions (power plants, chemical plants, manufacturing facilities), soils (fertilizers, herbicide, and
23 industrial wastes), and water (industrial wastewaters, municipal sewage) (Agency for Toxic
24 Substances and Disease Registry 2007). Approximately 180,000 to 650,000 metric tons of boron are
25 released annually into the atmosphere from the industries that use boron and boron-containing
26 products (U.S. Environmental Protection Agency 2008b).

27 Even though it is found naturally in many fruits and vegetables, boron does not accumulate in
28 human tissues (Waggot 1969; Butterwick et al. 1989). While boron may serve as a trace mineral
29 nutrient for humans, it has potential detrimental health effects such as nausea, vomiting, swallowing
30 difficulties, diarrhea, and rashes due to acute overdoses (U.S. Environmental Protection Agency
31 2008b). Related effects have occurred in animals. Aquatic plants and animals accumulate boron, but
32 residues do not increase through the food chain (U.S. Environmental Protection Agency 2008a).

33 USEPA recently evaluated boron and its potential for contamination of drinking water supplies (73
34 Federal Register [FR] 44251–44261) and made a determination not to regulate boron with a
35 National Primary Drinking Water Regulation. Because boron is not likely to occur at concentrations
36 of concern when considering both surface and groundwater systems, USEPA believes that a National
37 Primary Drinking Water Regulation does not present a meaningful opportunity for health risk
38 reduction.

39 Agricultural supply uses, specifically crop irrigation, are the most sensitive receptor to boron
40 because of issues related to boron deficiency (Nable et al. 1997) and boron toxicity (Chauhan and
41 Powar 1978; Nable et al. 1997) in crops. Ayers and Westcot (1994) provide a discussion of boron
42 toxicity to plants. Very sensitive plants, which include lemons and blackberries, may show signs of
43 toxicity at concentrations less than 500 micrograms per liter ($\mu\text{g/L}$) but are not widely grown in the

1 Delta and areas upstream (refer to Chapter 14, *Agricultural Resources*, Table 14-2). Sensitive crops
2 begin to show signs of toxicity between 500 and 750 µg/L and include a variety of fruit and nut trees
3 that are commonly grown in the Delta.

4 In a study of groundwater from the Sacramento Valley aquifer, boron was detected in all 31 samples,
5 in concentrations ranging from 12 µg/L to 1,100 µg/L (Dawson 2001). The median concentration
6 was 42 µg/L. Two of the 31 samples had concentrations in excess of the then-current Health
7 Advisory Level of 600 µg/L.

8 Assessment of how human atmospheric emission sources of boron in the Delta directly affect the
9 Delta would be difficult, given the complexity of area meteorology. Such sources would need to be
10 identified and undergo air transport modeling to determine deposition rates onto land and water in
11 the study area. Human activities related to boron land and water emissions may be more easily
12 quantified. Land applications of boron in the Delta may include fertilizer, herbicide, and industrial
13 waste; water sources may include industrial wastewaters, municipal sewage, and agricultural return
14 drains.

15 Approximately 85% of the boron load to the Delta originates from the western side of the lower San
16 Joaquin River, represented by the Grasslands and Northwest Side Subareas. Agricultural drainage,
17 discharge from managed wetlands, and groundwater accretions are the principal sources of boron
18 loading to the river. Additionally, large-scale, out-of-basin water transfers have reduced the
19 assimilative capacity of the river, thereby exacerbating the water quality issues associated with
20 boron.

21 The source analysis contained in the Central Valley Water Board's TMDL describes the magnitude
22 and location of the sources of boron loading to the lower San Joaquin River. The watershed is
23 divided into seven component subareas to elucidate differences in boron loading between different
24 geographic areas (Figure 8-11).

25 Contributions of boron to the Delta also originate from other sources, including the Sacramento
26 River, the eastside tributaries, Delta agricultural return drains, and San Francisco Bay. The next
27 section describes how these sources, in addition to the San Joaquin River, contribute to boron
28 concentrations in the Delta.

29 **Existing Conditions in the Study Area**

30 Most examined locations in the Delta have had low concentrations of boron in recent years (water
31 years 2001–2006), with mean values ranging from 0.1 to 0.5 mg/L (Figure 8-12). The Sacramento
32 River at Mallard Island location had a mean value of 0.5 mg/L. Maximum boron values were in the
33 0.1 to 1.5 mg/L range, with higher values at the San Joaquin River near Vernalis (0.8 mg/L) and the
34 Sacramento River at Mallard Island (1.5 mg/L).

35 Minimal data were available for the north-of-Delta area, while the mean value for the south-of-Delta
36 stations was 0.2 mg/L (Table 8-8).

37 Time series data indicate that boron concentrations at the examined stations generally fluctuate on
38 an annual basis (Figure 8-13 and Figure 8-14). Higher values have tended to occur during the
39 months of November through March.

Table 8-8. Boron Concentrations at Selected North- and South-of-Delta Stations, Water Years 2001–2006^a

Location	Boron (dissolved, mg/L)				
	Samples ^a	Minimum	Maximum	Mean	Median
Sacramento River at Keswick	1	—	—	0.1	—
Sacramento River at Verona	n/a	—	—	—	—
Feather River at Oroville	n/a	—	—	—	—
American River at WTP	n/a	—	—	—	—
California Aqueduct at Check 13	64	0.1	0.4	0.2	0.2
California Aqueduct at Check 29	74	0.1	0.3	0.2	0.2

Notes:

mg/L = milligrams per liter

n/a = not available

WTP = water treatment plant

^a Sample size represents water quality samples having values at or greater than the reporting limit.

Source: California Department of Water Resources 2009b.

Regulatory criteria with respect to boron are as follows. Because boron is not a priority pollutant, there are no criteria established for boron in the National Toxics Rule (NTR) or CTR. The Bay-Delta WQCP also does not contain objectives for boron, and there are no California drinking water MCLs. The lower San Joaquin River is listed on the Section 303(d) list as impaired for boron. The impairment extends from downstream of the Mendota Pool to the Airport Way Bridge near Vernalis. As an outcome of the Section 303(d) listing for the lower San Joaquin River and associated TMDL development process, the Central Valley Basin Plan contains a monthly average boron objective for the lower San Joaquin River to Vernalis of 800 µg/L for the irrigation season (March 15 through September 15), and 1,000 µg/L for the non-irrigation season (Central Valley Water Board 2009a). Additionally, the San Francisco Bay Basin Plan contains agricultural objectives, with a lower value of 500 µg/L for irrigation and a value of 5,000 µg/L for stock watering.

8.2.3.3 Bromide

Background and Importance in the Study Area

Bromide is an inorganic anion that is generally present at low concentrations in freshwater bodies. Bromide has the potential to most directly affect municipal and domestic supply, agricultural supply, and industrial service supply beneficial uses (Table 8-1). Typical drinking water source concentrations of bromide in the United States average 0.062 mg/L (Amy et al. 1998); typical seawater concentrations of bromide are 65–67 mg/L (Morris and Riley 1966: 699; Hem 1985).

In addition to its contribution to salinity, bromide is of concern in water as a precursor to the formation of bromate, bromoform and other brominated THMs, and HAAs, which are potentially harmful DBPs in municipal water supplies (CALFED Bay-Delta Program 2003). These compounds have been shown to cause carcinogenic, negative developmental, and negative reproductive effects in laboratory animals (U.S. Environmental Protection Agency 2010). DBP formation is increased when the source water contains both dissolved organic compounds and halides (CALFED Bay-Delta Program 2007a). Bromate forms when water that contains bromide is disinfected with ozone, a

1 technique employed by many drinking water treatment plants as an alternative to chlorination to
2 reduce DBP formation (in compliance with THM Rule, DBP Stage 1 and Stage 2 Rules).

3 The primary source of bromide in the Delta is seawater intrusion from the west (CALFED Bay-Delta
4 Program 2000). As discussed in the salinity subsection with respect to salinity, bromide in the Delta
5 is the result of a complex interplay between hydrology (dilution), water operations, bromide
6 sources, and hydrodynamics. Because there are several major water diversions in the Delta for
7 municipal water supplies, bromide in the source water is of concern because of the potential for DBP
8 formation. Bromide concentrations also can be generally higher in the lower San Joaquin River and
9 Delta island agricultural drainage as a result of agricultural irrigation practices and evaporative
10 concentration that occurs in water diverted from the Delta for irrigated agriculture. Recirculation, or
11 the process of agricultural drainage entering the San Joaquin River and its subsequent and repetitive
12 diversion for agricultural practices, has also contributed to elevated bromide concentrations in the
13 San Joaquin River.

14 Median concentrations at the southern Delta export pumps are about 16 times higher than in the
15 Sacramento River at Hood, and other tributaries upstream of any seawater influence (CALFED Bay-
16 Delta Program 2007b). Based on historical data and current conditions, bromide concentration in
17 water diverted from the southern Delta can be estimated from EC or chloride data, with chloride
18 being the most reliable indicator (Public Policy Institute of California 2008).

19 **Existing Conditions in the Study Area**

20 Locations in the northern Delta have had low concentrations of bromide in water years 2001–2006
21 with mean values of 0.02 and 0.04 mg/L at the Sacramento River at Hood and Barker Slough pump
22 locations, respectively (Figure 8-15). Higher mean concentrations typically are seen in the southern
23 Delta, with values of 0.18 mg/L at the Banks pumps, 0.27 mg/L at the San Joaquin River near
24 Vernalis, and 0.28 mg/L at CCWD pumping plant #1. The highest mean value examined was 5.18
25 mg/L at the Sacramento River at Mallard Island.

26 Time series data indicate that bromide concentrations at the examined stations generally fluctuate
27 on an annual basis (Figure 8-16) but depend on location. For example, higher values have tended to
28 occur during the months of March through May at the Barker Slough pumps, while higher values
29 occurred during the October to early January period at CCWD pumping plant #1. Bromide data for
30 the north and south-of-Delta stations were sparse; values were available for the American River at
31 WTP and were all reported as 0.01 mg/L.

32 There are presently no regulatory water quality objectives for bromide in the Delta. Bromide is not a
33 priority pollutant; thus, the CTR has no criteria for bromide. There are no state or federal regulatory
34 water quality objectives/criteria for bromide, or any USEPA-recommended criteria. The state
35 drinking water primary MCL for bromate is 0.01 mg/L. To reduce the potential for DBP formation in
36 municipal water supplies, the CALFED Drinking Water Quality Program has the goal of achieving
37 either a bromide concentration of 0.05 mg/L at the southern and western Delta water export
38 locations, along with an average TOC concentration of 3 mg/L (CALFED Bay-Delta Program 2000),
39 or an “Equivalent Level of Public Health protection” for municipal water supply purveyors.
40 Specifically, the goal of the CALFED Drinking Water Program is to:

41 achieve either: (a) average concentrations at Clifton Court Forebay and other southern and central
42 Delta drinking water intakes of 50 µg/L bromide and 3.0 mg/L total organic carbon, or (b) an
43 equivalent level of public health protection using a cost-effective combination of alternative source
44 waters, source control, and treatment technologies.”

1 In general, bromide concentrations are frequently above 0.05 mg/L at Delta locations influential to
2 the water quality of surface water supply purveyors.

3 **8.2.3.4 Chloride**

4 **Background and Importance in the Study Area**

5 Chloride is an inorganic anion generally found at low concentrations in freshwater bodies; however,
6 chloride is the dominant anion in seawater at about 19,000 mg/L (Hem 1985). Chloride commonly
7 occurs in nature as salts of sodium, potassium, and calcium. Tidal seawater intrusion is the primary
8 source of chloride in the Delta. Delta tidal water containing elevated levels of chloride, which is
9 subsequently diverted for agricultural irrigation uses on Delta islands or exported from the Delta via
10 the Banks and Jones pumping plants to the San Joaquin valley, returns to the Delta as agricultural
11 drainage (CALFED Bay-Delta Program 2007a). Chloride concentrations in these return flows to the
12 Delta can contain additional chloride as a result of evaporative concentration of salts that occurs in
13 water diverted for agricultural irrigation. Chloride is a potential concern for crop yields in
14 agricultural irrigation water, and excess chloride can impart an unpalatable, “salty” taste in drinking
15 water supplies. Taste thresholds for chloride range from 200 to 300 mg/L, depending on the
16 associated cation (World Health Organization 2003).

17 **Existing Conditions in the Study Area**

18 Locations in the northern Delta had low concentrations of chloride in water years 2001–2006, with
19 mean values of 6 and 22 mg/L at the Sacramento River at Hood and Barker Slough pump locations,
20 respectively (Figure 8-17). Higher mean concentrations typically are seen in the southern Delta,
21 with values ranging from 59 mg/L at the Banks pumps to 90 mg/L at both CCWD pumping plant #1
22 and Franks Tract. Chloride mean concentrations increased at the mouths of the Sacramento River
23 and San Joaquin River, with the highest value of 6,380 mg/L at Suisun Bay at Bulls Head near
24 Martinez.

25 Chloride mean concentrations in the north-of-Delta locations were very low (water years 2001–
26 2006), ranging from 1 to 5 mg/L (Table 8-9). South-of-Delta locations had mean values of 69 mg/L,
27 which were higher than that reported at the Banks headworks (59 mg/L, Figure 8-17).

28 **Table 8-9. Chloride Concentrations at Selected North of Delta and South-of-Delta Stations, Water**
29 **Years 2001–2006^a**

Location	Chloride (dissolved, mg/L)				
	Samples	Minimum	Maximum	Mean	Median
Sacramento River at Keswick	46	1	6	2	2
Sacramento River at Verona	21	2	15	5	4
Feather River at Oroville	29	1	3	1	1
American River at WTP	69	1	3	2	2
California Aqueduct at Check 13	69	23	138	69	64
California Aqueduct at Check 29	81	16	127	69	66

^a Sample size represents water quality samples having values at or greater than the reporting limit.

Notes: mg/L = milligrams per liter; WTP = water treatment plant.

Source: California Department of Water Resources 2009b.

30

1 Time series data for chloride displayed annual fluctuations (Figure 8-18 and Figure 8-19), with
2 peaks typically occurring in fall/winter.

3 The Bay-Delta WQCP contains chloride objectives for municipal and industrial water supply
4 beneficial uses protection, including a maximum mean daily concentration of 250 mg/L year-round
5 at the five major municipal water supply diversion locations—Contra Costa Canal at pumping plant
6 #1, West Canal at mouth of Clifton Court Forebay, Jones pumping plant, Barker Slough at North Bay
7 Aqueduct, and Cache Slough at the City of Vallejo intake (abandoned). This standard has been
8 exceeded at the CCWD pumping plant #1 on several occasions and, on rare occasions, at the Delta-
9 Mendota Canal headworks. Additionally, the Bay-Delta WQCP contains a chloride objective for
10 Contra Costa Canal at pumping plant #1 or the San Joaquin River at Antioch Water Works intake that
11 specifies the number of days each calendar year that the maximum mean daily chloride
12 concentration must be less than 150 mg/L (must be provided in intervals of not less than 2 weeks'
13 duration). The days per year depend on water-year type, ranging from 155 days for critical water-
14 year types to 240 days in wet water-year types. The industrial uses for which this objective was
15 established (cardboard manufacturing in Antioch) no longer exist; however, the objective has been
16 retained for general municipal use protection (CALFED Bay-Delta Program 2007a). The secondary
17 MCL for chloride is specified as a range: 250 mg/L (recommended), 500 mg/L (upper), and 600
18 mg/L (short-term) and is applicable to all surface waters in the affected environment, other than the
19 Delta, that have the municipal and domestic supply beneficial use designation. The USEPA's
20 recommended chloride ambient water quality criteria for the protection of freshwater aquatic life
21 are 230 mg/L (chronic 4-day average) and 860 mg/L (acute 1-hour average). The San Francisco Bay
22 Water Board Basin Plan has a 355 mg/L chloride objective for agricultural supply. CCWD has a goal
23 of delivering treated water that has less than 65 mg/L chloride.

24 One channel in the southern Delta (Tom Payne Slough) and Suisun Marsh is on the state's CWA
25 Section 303(d) list because of elevated chloride (State Water Resources Control Board 2011).
26 Additionally, the lower San Joaquin River is on the 303(d) list as impaired for salt and boron, and a
27 TMDL has been developed with chloride identified as composing about 23% of the total ions
28 contributing to salinity in the lower San Joaquin River at the Vernalis location in the Delta (Central
29 Valley Water Board 2002).

30 **8.2.3.5 Dioxins, Furans, and Polychlorinated Biphenyls**

31 **Background**

32 Dioxins are a group of chemical compounds with similar chemical structures and biotic effects (U.S.
33 Food and Drug Administration 2009). There are several hundred of these compounds, which can be
34 grouped into three families: chlorinated dibenzo-p-dioxins, chlorinated dibenzofurans, and certain
35 polychlorinated biphenyls (PCBs). One of the most toxic (and most studied) dioxins is 2,3,7,8-
36 tetrachlorodibenzo-p-dioxin (TCDD). Chlorinated dibenzo-p-dioxins and chlorinated dibenzofurans
37 are created unintentionally, usually through combustion processes. PCBs are manufactured
38 products but are no longer produced in the United States. Dioxins break down very slowly in the
39 environment, indicating that past and present emissions will continue to interact with soils, water,
40 and biota (e.g., Wenning et al. 1999; Gullett et al. 2003; Brown et al. 2006).

41 The most common health effect in people exposed to large amounts of dioxins is chloracne, possibly
42 followed by skin rashes, skin discoloration, and excessive body hair and possibly mild liver damage
43 (U.S. Food and Drug Administration 2009). A substantial concern is the cancer risk associated with

1 dioxins. High exposures over long periods (animal studies, human workplace studies) have
2 suggested an increased cancer risk as well as possible reproductive and developmental effects.
3 Toxicity levels are very broad between the various dioxin compounds, up to several orders of
4 magnitude. The health effects associated with dioxins depend on a variety of factors, including the
5 level, timing, duration, and frequency of exposure.

6 PCBs can cause developmental abnormalities, growth suppression, disruption of the endocrine
7 system, impairment of immune function, and cancer (State Water Resources Control Board 2007).
8 PCBs can bioaccumulate and reach higher concentrations in higher levels of aquatic food chains;
9 predatory fish, birds, and mammals (including humans that consume fish) at the top of the foodweb
10 are particularly vulnerable to the effects of PCB contamination. Consequently, the beneficial uses
11 most directly affected by dioxin/furan compounds and PCBs are aquatic organisms (cold freshwater
12 habitat, warm freshwater habitat, and estuarine habitat); rare, threatened and endangered species if
13 the community population level were to be reduced by exposure through the aquatic environment;
14 harvesting activities that depend on aquatic life (shellfish harvesting, commercial and sport fishing);
15 and drinking water supplies (municipal and domestic supply) (Table 8-1).

16 Dioxins may enter the environment through air, water, and land pathways. Because the majority of
17 dioxin releases are to the atmosphere, some dioxins can be transported very long distances and can
18 be found in most places in the world (National Research Council 2006; U.S. Food and Drug
19 Administration 2009). In water, dioxins tend to settle into sediments where they can move up the
20 food chain. Dioxins can also be deposited on plants and enter the food chain. Animals tend to
21 accumulate dioxins in fatty tissues.

22 USEPA (2006a) estimated that the primary pathway of dioxin releases to the environment is
23 atmospheric (92.4%), with 5.7% to the land and 1.8% to water. It is important to note that this
24 estimate did not include natural sources of dioxins, which exceed those produced by human
25 activities (Centers for Disease Control 2005). Dioxins are ubiquitous, and all living organisms have
26 had some form of low-level exposure. Natural brush and forest fires produce dioxins, so it is
27 reasonable to assume that organisms have been exposed to dioxins for centuries. For example, 54%
28 of global dioxin emissions were from natural forest fires in 2004, with the remainder coming from
29 anthropogenic sources (Figure 8-20).

30 PCBs were used commonly in the United States for the production of transformers and capacitors in
31 electrical equipment (Brinkmann and de Kok 1980). Other uses included hydraulic fluids, lubricants,
32 inks, and as a plasticizer (State Water Resources Control Board 2007). While production of
33 transformers and capacitors containing PCBs ended in the United States in 1979, the persistent
34 nature of PCBs in the environment is still a source of concern (Davis et al. 2007).

35 **Importance in the Study Area**

36 Assessment of how human atmospheric emission sources of dioxins, furans, and PCBs in the study
37 area directly affect the Delta would be difficult, given the complexity of area meteorology. Based on
38 the USEPA (2006b) analysis, the major sources likely would be backyard barrel burning of refuse
39 and medical waste/pathological incineration. Such sources would need to be identified and undergo
40 air transport modeling to determine deposition rates onto land and water in the study area.

41 Human activities related to land and water emissions may be more easily quantified and, based on
42 the USEPA (2006b) analysis, likely would be dominated by application of municipal wastewater

1 treatment sludge (land), ethylene dichloride/vinyl dichloride production (land, water), chlor-alkali
2 facilities (water), and bleached, chemical wood pulp and paper mills (water).

3 **Existing Conditions in the Study Area**

4 There are two portions of the study area that are on the Section 303(d) listing for impairment with
5 respect to dioxins, furans, and PCBs. The Stockton Deep Water Ship Channel is listed for
6 dioxins/furans for the overall channel, and 3.3 miles of the channel are listed for PCBs. The north
7 Delta has a PCB impairment listing for 15.5 miles of drainage canal near Sacramento.

8 Hayward et al. (1996) found that sediment concentrations of dioxins and furans near a USEPA
9 Superfund site in the Stockton area (specifically, a wood treatment facility) were highly localized
10 and likely attributable to pentachlorophenol use at the facility.

11 Contributions of dioxins to the Delta originate from several sources, including the Sacramento River,
12 the San Joaquin River, the eastside tributaries, Delta agricultural return drains, and San Francisco
13 Bay. The section below quantifies how these sources contribute to concentrations in the Delta.

14 Minimal dioxin and furan data have been collected as part of water quality monitoring programs in
15 the study area. For example, pentachlorophenol and carbofuran have been analyzed at the Banks
16 pumping plant three times a year since 1995 with no detections.

17 There was a large monitoring effort from 1988 to 1993 to assess PCBs in the Delta. Analytes
18 examined included PCB-1016, PCB-1221, PCB-1232, PCB-1242, PCB-1248, PCB-1254, and PCB-1260
19 (Bay Delta and Tributaries Project 2009). The stations from this monitoring that coincide with the
20 stations examined in this section are the San Joaquin River at Buckley Cove, Sacramento River at
21 Hood (actually collected at Greene's Landing), Sacramento River above Point Sacramento, San
22 Joaquin River at Antioch Ship Channel, Old River at Rancho Del Rio, Suisun Bay at Bulls Head Point
23 near Martinez, and Franks Tract. Analysis of the monitoring results indicated that no detections of
24 PCBs occurred in any samples from these locations.

25 Recent monitoring efforts to assess PCBs in the study area are limited to four of the selected
26 locations, including the Banks pumping plant, the Barker Slough pumping plant, the Sacramento
27 River above Point Sacramento, and the San Joaquin River at Antioch Ship Channel. The latter two
28 stations were sampled for PCBs on an annual basis by SFEI as part of its monitoring program
29 (denoted as stations BG20 and BG30, respectively). The SFEI laboratory reporting limits are on the
30 order of 0.01 picograms per liter (pg/L), which are about 10,000,000 times more sensitive than the
31 laboratory reporting limits for the Banks and Barker Slough pumping plants.

32 Analytes examined in the present effort for the Banks and Barker Slough pumping plants include
33 PCB-1016, PCB-1221, PCB-1232, PCB-1242, PCB-1248, PCB-1254, and PCB-1260. The monitoring
34 program sampled for each of these analytes approximately 16 times during the water years 2001 to
35 2006 for each location. No detections were found.

36 Forty different PCB compounds ranging from PCB 008 to PCB 203 were examined by the SFEI
37 laboratory for the Sacramento River above Point Sacramento and the San Joaquin River at Antioch
38 Ship Channel locations. As mentioned previously, laboratory detection limits for the SFEI laboratory
39 are on the order of pg/L. These very low detection limits have enabled the detection of many PCBs
40 examined in the current study, which are presented as the sum of all PCBs in Table 8-10.

Table 8-10. Sum of All Polychlorinated Biphenyls at the Mouths of the Sacramento and San Joaquin Rivers, Water Years 2001–2006

Sum of all PCBs	Samples	Minimum (pg/L)	Maximum (pg/L)	Mean (pg/L)	Median (pg/L)
Sacramento River above Point Sacramento					
Dissolved	7	35	70	52	50
Total	6	67	138	99	95
San Joaquin River at Antioch Ship Channel					
Dissolved	5	47	60	53	53
Total	5	70	254	120	98

Source: San Francisco Estuary Institute 2010.

Notes: All concentrations in picograms per liter (pg/L). Sample size represents water quality samples having values at or greater than the reporting limit.

PCB = polychlorinated biphenyl

The samples were taken between late July and late August, which does not allow examination of wet versus dry season effects. The results indicate that all selected PCBs are still present in the Sacramento and San Joaquin River outflows during summer conditions, albeit at low concentrations. Values for PCBs were comparable at the two locations.

Sampling at south-of-Delta locations at California Aqueduct Check 13 and Check 29 for the same constituents also resulted in no detections during the same time period. Sampling at the north-of-Delta locations (approximately 35 to 60 visits per site) resulted in multiple detections at the Sacramento River at Keswick, the Feather River at Oroville, and the Sacramento River at Verona; however, the sampling and analytical protocol for these data were not available, and the validity of the data could not be confirmed.

Regulatory criteria with respect to dioxins, furans, and PCBs are as follows. Dioxin compounds are on the Section 303(d) list for San Francisco Bay (source of contamination unknown) and the Central Valley (source: unknown point source near the Stockton Deep Water Ship Channel). Furan compounds are on the Section 303(d) list for San Francisco Bay (source: atmospheric deposition) and the Central Valley (source: contaminated sediments). PCBs and dioxin compounds are on the Section 303(d) list for San Francisco Bay (sources: unknown nonpoint, unknown).

With regard to Basin Plan narrative objectives, any of the compounds above might be considered toxic at high concentrations. There are no numerical water quality objectives for the San Francisco Bay Water Board or Central Valley Water Board Basin Plans. The California drinking water standard MCL for 2,3,7,8-TCDD is 0.00000003 mg/L; the MCL for carbofuran is 0.018 mg/L. The CTR for 2,3,7,8-TCDD is 0.000000013 µg/L for Human Health: Water and Organisms, and 0.000000014 µg/L for Human Health: Organisms Only. Data are inadequate to assess whether the sites examined in this SFEI monitoring exceeded this standard.

The CTR criteria for PCBs (sum of six aroclors) is 0.014 µg/L (freshwater chronic), 0.03 µg/L (saltwater chronic), 0.00017 µg/L (Human Health: Water and Organisms), and 0.00017 µg/L (Human Health: Organisms Only). Data examined in this study indicate that these criteria have not been exceeded.

1 8.2.3.6 Dissolved Oxygen

2 Background and Importance in the Study Area

3 DO is a measure of the concentration of oxygen carried in a water body. Water gains oxygen from
4 the atmosphere and from aquatic plant photosynthesis. DO in water is consumed through
5 respiration by aquatic animals, decomposition of plant and animal material (microbial respiration),
6 sediment oxygen demand, and various chemical processes. DO depletion affects primarily aquatic
7 life beneficial uses, which include warm freshwater habitat; cold freshwater habitat; migration of
8 aquatic organisms and spawning, reproduction, and/or early development; estuarine habitat; and
9 rare, threatened, or endangered species (Table 8-1). The most sensitive receptors are cold
10 freshwater habitat and migration of aquatic organisms and spawning, reproduction, and/or early
11 development because of the relatively high DO requirements of coldwater fish, such as Chinook
12 salmon and steelhead. Low DO concentrations in water bodies can have adverse effects on aquatic
13 life, including fish kills, fish egg mortality, and growth rate reductions, and can serve as a barrier to
14 migration of anadromous fish such as Chinook salmon (Central Valley Water Board 2005; Schmieder
15 et al. 2008).

16 Seasonal declines in DO are typical in many estuaries, and DO concentrations are negatively affected
17 by increases in water temperature (Schmieder et al. 2008). Nutrient loading from point and
18 nonpoint sources can result in increased algal growth, thereby causing higher DO levels when
19 blooms are photosynthesizing and lowering DO levels during night time hours and when the blooms
20 die and decompose (Schmieder et al. 2008) Activities that disturb sediments and aquatic plants such
21 as dredging and clearing of aquatic plants from ship channels can cause increased decomposition of
22 organic material, resulting in decreases in DO concentrations (Greenfield et al. 2007; Schmieder et
23 al. 2008). However, removal of aquatic plants, especially invasive surface-covering plant species,
24 may allow light to better penetrate the water column, increasing photosynthesis and thereby
25 increasing DO concentrations (Greenfield et al. 2007). On the other hand, submerged macrophytes
26 tend to cause suspended sediment to settle and increase water clarity (Madsen et al. 2001)

27 Although localized incidents of depressed DO concentrations may occur in the study area, notable
28 low DO concentrations occur in the Stockton Deep Water Ship Channel, and to a lesser extent in
29 Middle River and Old River. Additionally, low DO conditions occur in areas of the Suisun Marsh
30 channels, particularly in small, isolated, backwater slough areas that receive little exchange of water
31 (San Francisco Bay Water Board 2012). The San Joaquin River experiences regular periods of low
32 DO concentrations in the Stockton Deep Water Ship Channel from the city of Stockton downstream
33 to Disappointment Slough. These conditions often violate the Basin Plan water quality objective for
34 DO in the Stockton Deep Water Ship Channel; they occur most often during the months of June
35 through October, although severe conditions have occurred in the winter months as well (Central
36 Valley Water Board 2005; Schmieder et al. 2008). Data also show that the frequency and severity of
37 low DO concentrations are generally worse during dryer water years (Table 8-11) (Central Valley
38 Water Board 2005). Jassby and Van Nieuwenhuysse (2005) found that low DO was due to a
39 combination of low flow and high nutrient loads. The 2012 draft *Pulse of the Delta* reports that DO in
40 the lower San Joaquin River has increased since the early 2000s, primarily due to the
41 implementation of algae removal ponds and nitrification treatment by the Stockton RWCF. However,
42 monthly minimum values continue to fall frequently below the statutory limits of 5 mg/L (December
43 1 to August 31) and 6 mg/L (September 1 to November 30) (Aquatic Science Center 2012:56).

1 **Table 8-11. Temporal Distribution of Low Dissolved Oxygen Impairment**

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1983	Excursion rate (%) ^a n/a n/a n/a n/a											
	<i>Minimum (DO)</i> ^b											
1984	Excursion rate (%) ^a 1 7 84 91 62 2											
	<i>Minimum (DO)</i> ^b 4.4 3.9 3.0 2.8 4.0 4.7											
1985	Excursion rate (%) ^a 6 48 78 15											
	<i>Minimum (DO)</i> ^b 4.4 3.3 3.5 4.2											
1986	Excursion rate (%) ^a 29 5 21 9											
	<i>Minimum (DO)</i> ^b 4.4 3.1 4.5 4.8											
1987	Excursion rate (%) ^a 44 43 3 29 <1											
	<i>Minimum (DO)</i> ^b 3.5 3.6 4.6 3.9 4.9											
1988	Excursion rate (%) ^a 51 52 52 3 10 62											
	<i>Minimum (DO)</i> ^b 3.5 3.3 3.8 4.8 4.4 2.3											
1989	Excursion rate (%) ^a 65 <1 37 2 38 14											
	<i>Minimum (DO)</i> ^b 3.7 4.9 4.1 4.8 2.4 4.2											
1990	Excursion rate (%) ^a 1 5 3 11 <1 <1											
	<i>Minimum (DO)</i> ^b 4.8 4.6 4.7 4.5 4.8 4.9											
1991	Excursion rate (%) ^a <1 8 37 34 1 5 14 55 99											
	<i>Minimum (DO)</i> ^b 4.7 4.3 4.4 4.2 4.9 4.7 4.4 1.8 0.4											
1992	Excursion rate (%) ^a 21 100 60 29 43 39 97 100 77 6											
	<i>Minimum (DO)</i> ^b 3.1 2.1 1.9 3.6 3.7 3.7 2.8 0.5 1.3 4.7											
1993	Excursion rate (%) ^a 25 8 2 29 54 87 81 23 1											
	<i>Minimum (DO)</i> ^b 3.7 4.7 4.8 3.6 3.7 2.6 2.6 1.6 4.8											
1994	Excursion rate (%) ^a 2 <1 61 80 63 16 46											
	<i>Minimum (DO)</i> ^b 4.8 4.9 4.0 3.7 3.4 4.3 3.2											
1995	Excursion rate (%) ^a 2 61 6											
	<i>Minimum (DO)</i> ^b 4.8 3.0 4.6											
1996	Excursion rate (%) ^a 15 n/a 8 63 94 89 15 18											
	<i>Minimum (DO)</i> ^b 4.1 4.8 3.4 2.0 2.5 3.7 4.3											
1997	Excursion rate (%) ^a 14 74 88 83 44 2 11											
	<i>Minimum (DO)</i> ^b 3.6 3.1 3.3 2.4 2.2 4.7 4.5											
1998	Excursion rate (%) ^a											
	<i>Minimum (DO)</i> ^b											
1999	Excursion rate (%) ^a n/a <1 48 20 43 100 93 39											
	<i>Minimum (DO)</i> ^b 4.9 3.0 3.1 1.8 1.7 3.8 3.8											
2000	Excursion rate (%) ^a 4 11 11 61 28 1 12											
	<i>Minimum (DO)</i> ^b 4.7 3.9 2.9 2.9 2.7 4.8 4.7											
2001	Excursion rate (%) ^a 5 69 75 73 61 n/a											
	<i>Minimum (DO)</i> ^b 4.7 2.5 2.3 3.0 2.9											
Avg ^c	5	6	14	6	6	27	34	37	36	23	3	4

Notes:

DO = dissolved oxygen.

For each month of the year in the table, the upper number presented is the percentage of hourly DO measurements below 5.0 mg/L recorded that month. If a cell is blank, there were no DO measurements below 5.0 mg/L that month. If a cell contains "n/a," no data were recorded at all for that month. The lower italicized number presented for each month is the minimum DO concentration measured that month. The average rate (weighted to account for months with partial data sets) for the 19-year period is shown in the bottom row.

^a Excursion rate is the number of hourly average DO measurements from the California Department of Water Resources monitoring station below 5.0 mg/L divided by the total number of such measurements recorded that month, shown as a percentage.

^b The minimum hourly average DO measurement for the month in mg/L.

^c Average excursion rate is not the simple average of all monthly data—it is weighted to account for months that had only partial data sets.

Source: Central Valley Water Board 2005.

1 The Stockton Deep Water Ship Channel is a portion of the San Joaquin River that has been dredged
2 by the U.S. Army Corps of Engineers (USACE) to a depth of 35 feet to allow the navigation of cargo
3 vessels between San Francisco Bay and the Port of Stockton (Central Valley Water Board 2005).
4 Upstream of the channel, the San Joaquin River is otherwise about 10 feet deep. The entire length of
5 the channel is within the tidal prism and experiences regular flow reversals (Central Valley Water
6 Board 2005). Increased water depth increases the time required to aerate the water column and the
7 residence time of water in the channel and promotes stronger thermal stratification during summer
8 months, which lessens the amount of mixing; these conditions negatively affect DO concentrations in
9 the channel (Schmieder et al. 2008).

10 The occurrence of low DO concentrations also coincides with periods of low-flow conditions,
11 indicating that flow and channel morphology in the San Joaquin River are important factors
12 influencing DO conditions in the Stockton Deep Water Ship Channel. Table 8-11 demonstrates that
13 the frequency of violations of the 5.0 mg/L objective since 1983 is highest, on the average, during
14 the months of June through October (Central Valley Water Board 2005; California Department of
15 Water Resources 2009b). Oxygen concentrations less than 5.0 mg/L, however, have occurred during
16 all months of the year. The frequency of violations is worse in dry years (1991 through 1993 and
17 less frequent during wet years (1998) (Central Valley Water Board 2005). An analysis of more than
18 20 years of time series data suggests that the low DO problem is attributable to a combination of
19 river discharge, river phytoplankton, and formerly discharges of elevated ammonia levels from the
20 Stockton RWCF, (which releases approximately 53 mgd of effluent), including large seasonal
21 wastewater loading from food canneries (Jassby and Van Nieuwenhuysen 2005).

22 **Existing Conditions in the Study Area**

23 All examined locations in the Delta had mean DO concentrations above 8.4 mg/L in recent years
24 (water years 2001–2006) except the San Joaquin River at Buckley Cove (6.8 mg/L, Figure 8-21). DO
25 minima were below 7.0 mg/L at approximately 40% of examined stations including the Sacramento
26 River at Hood (4.8 mg/L), which was the only value at that location below 6.0 mg/L during that time
27 period, the San Joaquin River at Vernalis (4.3 mg/L), the Sacramento River at Mallard Island (6.5
28 mg/L), and the San Joaquin River at Buckley Cove (3.3 mg/L), which falls under the Stockton Deep
29 Water Ship Channel water quality criteria. Mean values for the north-of-Delta area ranged from 9.6
30 mg/L at the American River at WTP to 11.0 mg/L at the Sacramento River at Keswick (Table 8-12).
31 South-of-Delta mean values were lower than north-of-Delta stations examined (8.2 to 8.9 mg/L).

32 Time series data indicate that DO concentrations at the examined stations generally fluctuate on an
33 annual basis (Figure 8-22 and Figure 8-23). Higher values have tended to occur during the months
34 of November through March, with lower values occurring during June through September. The San
35 Joaquin River at Buckley Cove site has continued to experience low DO concentrations, primarily in
36 the late summer to late fall period.

Table 8-12. Dissolved Oxygen Concentrations at Selected North- and South--of-Delta Stations, Water Years 2001–2006^a

Location	Dissolved Oxygen (mg/L)				
	Samples	Minimum	Maximum	Mean	Median
Sacramento River at Keswick	32	7.3	15.6	11.0	11.1
Sacramento River at Verona	15	5.4	13.0	10.0	10.0
Feather River at Oroville	29	7.4	12.5	10.1	10.2
American River at WTP	120	6.5	13.0	9.6	9.5
California Aqueduct at Check 13	68	5.7	10.9	8.9	9.0
California Aqueduct at Check 29	49	0.0	12.6	8.2	9.5

Notes: mg/L = milligrams per liter; WTP = water treatment plant.

^a Sample size represents water quality samples having values at or greater than the reporting limit.

Source: California Department of Water Resources 2009b.

The 2006 Bay-Delta WQCP, Region 2 Basin Plan, and Region 5 Basin Plan all contained DO objectives applicable to water bodies in the affected environment. A DO objective for protection of fish and wildlife beneficial uses exists in the 2006 Bay-Delta WQCP for the San Joaquin River between Turner Cut and Stockton: 6.0 mg/L from September through November (State Water Resources Control Board 2006). The Region 5 Basin Plan has the same objective for the San Joaquin River, and the Region 2 Basin Plan incorporates by reference the DO objectives in the 2006 Bay-Delta WQCP (Central Valley Water Board 2009a; San Francisco Bay Water Board 2007). The Region 5 Basin Plan contains the following additional numerical DO objectives for the Delta (Central Valley Water Board 2009a).

- At least 7.0 mg/L in the Sacramento River below the I Street bridge and west of the Antioch Bridge.
- At least 5.0 mg/L at all other locations and times, unless the water body has been constructed for special purposes and fish are excluded or not important as a beneficial use.

In addition, the Region 5 Basin Plan requires that water bodies outside the legal boundary of the Delta meet certain saturation levels and not be reduced below the following levels at any time.

- Waters designated WARM, 5.0 mg/L.
- Waters designated COLD, 7.0 mg/L.
- Waters designated SPWN, 7.0 mg/L.

The Region 2 Basin Plan also has minimum DO objectives for warm and coldwater habitat of 5.0 mg/L and 7.0 mg/L, respectively (San Francisco Bay Water Board 2007). Lastly, the Region 5 Basin Plan contains a DO objective for the Sacramento River from Keswick Dam to Hamilton City of 9.0 mg/L (or 95% saturation) from June 1 to August 31, and an objective of 8.0 mg/L for the Feather River from Fish Barrier Dam at Oroville to Honcut Creek from September 1 to May 31 (Central Valley Water Board 2009a). There are no DO criteria in the CTR (as it is not a priority pollutant), nor is there a California drinking water MCL for DO.

Water bodies in the affected environment listed on the state's CWA Section 303(d) list as impaired because of low DO levels include Middle River, Old River, the Stockton Deep Water Ship Channel and portions of other sloughs and rivers in the southern, eastern, and western Delta (State Water

1 Resources Control Board 2011). A TMDL for the Stockton Deep Water Ship Channel was approved
 2 by USEPA on February 27, 2007, and includes a Region 5 Basin Plan Amendment that contains a
 3 Control Program to reduce the amount of oxygen-demanding substances and their precursors in the
 4 San Joaquin River. The TMDL takes a phased approach to allow more time to gather additional
 5 informational on source and linkages to the DO impairment, while at the same time moving forward
 6 on improving DO conditions. TMDLs for listed water bodies are proposed for completion in 2012
 7 through 2021 (State Water Resources Control Board 2011).

8 Actions that are being taken to address DO conditions in the Stockton Deep Water Ship Channel, or
 9 have assisted in improving DO conditions, include the construction of water aeration devices by the
 10 Port of Stockton at the confluence of the San Joaquin River and Stockton Deep Water Ship Channel
 11 and by DWR with a new aeration facility at the west end of the Port of Stockton docks in the Deep
 12 Water Ship Channel. DWR's aeration facility is much larger than the Port of Stockton system and
 13 injects pure oxygen into the Deep Water Ship Channel through a 200-foot-long diffuser during
 14 periods when DO conditions approach, or drop below, 5 mg/L. Testing of the facility during 2008–
 15 2010 indicates that the aeration facility can help prevent exceedances of the DO objectives but is not
 16 sufficient to prevent low DO under all possible upstream oxygen loading conditions (ICF
 17 International 2010). Additionally, the Stockton RWCF constructed nitrifying bio-towers that became
 18 operational in 2006, which, by converting ammonia to nitrate, reduce the historical ammonia
 19 loading rate and its associated oxygen demand to the San Joaquin River by about 90%.

20 **8.2.3.7 Salinity and Electrical Conductivity**

21 **Background and Importance in the Study Area**

22 Salinity is the concentration of dissolved salts in water. Typical salts found include the major cations
 23 (calcium, magnesium, sodium, and potassium) and anions (sulfate, chloride, fluoride, bromide,
 24 bicarbonate, and carbonate). The relative proportion of the anions and cations are different in
 25 typical fresh water and seawater, with sodium and chloride dominating seawater salinity. The
 26 composition of dominant cations and anions in fresh water can vary to a much greater degree.
 27 Salinity can be measured in a variety of ways, including chloride concentration, TDS concentrations,
 28 and EC. While a recognized international measurement scale of salinity exists (Practical Salinity
 29 Units), the term is not commonly used, and the measured parameters EC and TDS are more often
 30 used interchangeably to refer to generalized effects of salinity. The beneficial uses most affected by
 31 salinity concentrations are municipal, agricultural, and industrial water supply.

32 Additionally, changes in salinity, including tidally influenced interfaces between fresh water and
 33 saltwater in the Delta, directly affect aquatic organisms and indirectly affect aquatic and wildlife
 34 habitats (warm freshwater habitat, cold freshwater habitat, estuarine habitat). Related beneficial
 35 uses such as commercial and sport fishing and shellfish harvesting also are affected.

36 EC and TDS values tend to be highly correlated because the majority of chemicals that contribute to
 37 TDS are charged particles that impart conductance of water. EC often is used to measure salinity
 38 because a simple electronic probe can measure salinity directly in the field and be recorded at
 39 frequent intervals (e.g., every 15 minutes), making it a cost-effective measurement. Other measures
 40 require field collection of water samples and laboratory analysis, which can be expensive. EC units
 41 commonly used are micromhos per centimeter ($\mu\text{mhos/cm}$) and milliSiemens per centimeter
 42 (mS/cm), and both are measures of the conductivity of the water.

1 Salinity can originate from natural sources such as seawater and rainfall-induced leaching of salts
2 from soils. Anthropogenic sources of salinity include drainage from irrigated agricultural lands and
3 managed wetlands, agricultural chemical soil additives, municipal and industrial wastewater
4 discharges, and urban stormwater. Salinity also increases through evaporative concentration, which
5 occurs during the dry, warm months of the year in ditches, canals, and reservoirs. Also, when excess
6 water is applied to land for crop irrigation, the excess runs off to drainage ditches where it can be
7 subject to evaporative concentration. Concern about salinity involves three main issues: drinking
8 water, crop irrigation, and biota/habitat. Elevated concentrations of salinity result in poor-tasting
9 water and also limit the ability to recycle wastewater for nonpotable uses (e.g., landscape irrigation).
10 The TDS concentration of water from Sierra Nevada streams is typically less than 100 mg/L, while
11 drinking water from the Delta typically has TDS concentrations from 150 to 300 mg/L, with
12 concentrations occasionally exceeding 500 mg/L (CALFED Bay-Delta Program 2007a). Bromide, a
13 constituent most commonly found in seawater and marine sediments, is a precursor to the
14 formation of DBPs in drinking water facilities, which can be harmful to humans and animals (see
15 Section 8.1.3.3 for a detailed discussion of bromide). In addition, industrial processes that require
16 low-salinity water can be negatively affected. Salt removal during the water purification process (for
17 either drinking or process water) is presently very expensive.

18 When salinity concentrations in irrigation water are too high, yields for salt-sensitive crops may be
19 reduced. Salinity can decrease water available to the plant and cause plant stress (CALFED Bay-
20 Delta Program 2007a). There are also fish, wildlife, and aquatic plant species that have adapted to
21 naturally occurring salinity ranges in the Bay-Delta system, with specific salinity requirements at
22 certain life stages in order to survive. There is evidence to suggest that the artificial stabilization of
23 salinity, which has been undertaken in the Delta to maximize drinking and agricultural water
24 quality, may create habitat more suitable for invasive species than for native species (Lund et al.
25 2007).

26 The primary source of salinity in the Delta is seawater intrusion from the west (CALFED Bay-Delta
27 Program 2000), which occurs at greater magnitudes when Delta outflow to San Francisco Bay is low.
28 Salinity also is elevated in the San Joaquin River inflows as a result of irrigated agricultural drainage
29 on southern San Joaquin Valley soils of marine origin that are naturally high in salts, and from salt in
30 Delta waters that are used for irrigation and returned back to the Delta. From a broad viewpoint,
31 salinity is determined as interplay between the amount of fresh water entering the Delta from the
32 major tributaries (e.g., Sacramento and San Joaquin Rivers) and seawater from San Francisco Bay.
33 During the late winter and spring months of seasonally elevated runoff and flows, and in particular
34 during wet years with high levels of runoff from interior California, the elevated freshwater flows
35 limit the extent of seawater intrusion into the Delta from the Bay. During low-flow summer and fall
36 months, and dry water-year types with low levels of runoff, the lower freshwater flows result in
37 greater amounts of seawater intrusion (Figures 8-6 and 8-7). Maximum salinity intrusions into the
38 Study area from the Bay are greatest during low-precipitation years.

39 The volume of Delta channels subject to daily tidal action is an important factor affecting the extent
40 of high-salinity seawater intrusion and also influences the behavior of saline water once in the Delta.
41 As described above, salinity in the Suisun Marsh channels are similarly affected by tidal seawater
42 intrusion, and the SMSCG facilities and operations were developed in the late 1980's in response to
43 the need to better manage changing salinity conditions. Increases in channel volume associated with
44 levee failures on Delta islands (Mierzwa and Suits 2005) can result in daily tidal exchange moving
45 considerably farther inland compared to conditions with the island levees intact. The June 2004
46 failure of a levee at Jones Tract, which flooded both upper and lower Jones Tract, resulted in

1 substantial increased salinity conditions in the southern and central Delta (Mierzwa and Suits
2 2005).

3 The description of salinity in the Delta provided above is intended as an overview; salinity in the
4 Delta can vary greatly in time and space (CALFED Bay-Delta Program 2007a) with many
5 contributing factors, including those following.

- 6 • Hydrology (precipitation and runoff).
- 7 • Water operations (reservoir releases, channel barrier operations, diversion pumping rates).
- 8 • Watershed sources (agriculture, managed wetlands, natural leaching, municipal and industrial
9 discharges).
- 10 • Hydrodynamics (geometry of water bodies, meteorology, salinity gradients, freshwater inputs,
11 tidal action).

12 Existing Conditions in the Study Area

13 During the water year 2001–2006 period, mean EC concentrations tended to increase from the
14 northern Delta to the southern Delta, and from the eastern Delta to the western Delta (Figure 8-24).
15 For example, EC mean concentrations in the northern Delta were 166 and 141 $\mu\text{mhos/cm}$ for the
16 Sacramento River at Hood and the Mokelumne River (South Fork) at Staten Island, respectively. In
17 the southern Delta region, EC mean concentrations were 590 and 673 $\mu\text{mhos/cm}$ for the San Joaquin
18 River at Buckley Cove and the San Joaquin River near Vernalis, respectively. As water exits the Delta,
19 mean EC concentrations were 3,481 and 2,366 $\mu\text{mhos/cm}$ for the Sacramento River above Point
20 Sacramento and the San Joaquin River at Antioch Ship Channel, respectively. Mean EC
21 concentrations increased to 4,920 $\mu\text{mhos/cm}$ at the Sacramento River at Mallard Island and were
22 highest at Suisun Bay at Bulls Head Point near Martinez, with a value of 19,331 $\mu\text{mhos/cm}$.

23 Mean values for the north-of-Delta area were lower than in the Delta region, ranging from
24 65 $\mu\text{mhos/cm}$ at the American River at the WTP to 120 $\mu\text{mhos/cm}$ at the Sacramento River at
25 Verona (Table 8-13). South-of-Delta mean values were higher than those for the north-of-Delta
26 stations examined (439 to 460 $\mu\text{mhos/cm}$), and slightly higher than the mean at the Banks
27 headworks (393 $\mu\text{mhos/cm}$) (Figure 8-24).

28 **Table 8-13. Electrical Conductivity Concentrations at Selected North- and South-of-Delta Stations,**
29 **Water Years 2001–2006**

Location	Electrical Conductivity ($\mu\text{mhos/cm}$)				
	Samples	Minimum	Maximum	Mean	Median
Sacramento River at Keswick	32	82	127	106	108
Sacramento River at Verona	15	92	148	120	117
Feather River at Oroville	29	53	239	86	83
American River at WTP	120	6	152	65	65
California Aqueduct at Check 13	69	217	981	460	465
California Aqueduct at Check 29	74	133	680	439	456

Notes: $\mu\text{mhos/cm}$ = micro mhos per centimeter; WTP = water treatment plant.

^a Sample size represents water quality samples having values at or greater than the reporting limit.

Sources: California Department of Water Resources 2009b.

30

1 Time series data indicate that EC concentrations at the examined stations generally fluctuate on an
 2 annual basis (Figure 8-25 and Figure 8-26). However, peak values occurred at different times of the
 3 year for the various locations. Factors influencing this variability may include hydrology, water
 4 operations, watershed sources, and hydrodynamics in the Delta.

5 Because EC is not a priority pollutant, there are no criteria established for EC in the NTR or CTR. The
 6 secondary MCL for EC is specified as a range: 900 microSiemens per centimeter ($\mu\text{S}/\text{cm}$) (1
 7 $\mu\text{S}/\text{cm}=1 \mu\text{mhos}/\text{cm}$) (recommended), 1,600 $\mu\text{S}/\text{cm}$ (upper), and 2,200 $\mu\text{S}/\text{cm}$ (short-term), and is
 8 applicable to all surface waters in the affected environment, other than the Delta, that have the
 9 municipal and domestic supply beneficial use designation. The Region 5 Basin Plan specifies EC
 10 objectives for the Sacramento River, Feather River, and San Joaquin River; it also contains EC
 11 objectives for the Delta, which have been superseded by the 2006 Bay-Delta WQCP. The Bay-Delta
 12 WQCP contains EC objectives for the Delta for agricultural and fish and wildlife beneficial use
 13 protection, which vary by month and water-year type (see Appendix 8A). The Bay-Delta WQCP EC
 14 objectives for agricultural protection are designed primarily to control salinity conditions in the
 15 interior and southern Delta channels, and San Joaquin River inflow to the Delta at Vernalis, which
 16 tend to have higher salinity concentrations and are influenced most by Delta exports. The Region 2
 17 Basin Plan contains agricultural EC objectives; however, the affected environment of the Delta and
 18 downstream Bay waters in Region 2 are generally saline and do not likely serve as a major water
 19 source for agricultural activity. For the protection of fish and wildlife habitat, the Bay-Delta WQCP
 20 regulates EC in western and interior Delta locations and Suisun Marsh.

21 Multiple water bodies in the affected environment are on the state's CWA Section 303(d) list for
 22 impairment by elevated EC levels, as follows: (a) southern, northwestern, and western channels in
 23 the Delta; (b) Delta export area; (c) Grasslands drainage area, Mud Slough, and Salt Slough in the San
 24 Joaquin River valley; (d) San Joaquin River from Bear Creek to Delta boundary; and (e) Suisun Marsh
 25 (State Water Resources Control Board 2011). A TMDL has been prepared for the lower San Joaquin
 26 River at Vernalis, and the TMDL for segments upstream from Vernalis is under development.

27 **8.2.3.8 Emerging Pollutants: Endocrine-Disrupting Compounds,** 28 **Pharmaceutical and Personal Care Products, and Nitrosamines**

29 **Background**

30 Emerging water quality contaminants represent a broad range of chemicals that have not
 31 traditionally been part of monitoring programs because they were not deemed important until
 32 recently or the ability to quantify them had not been possible until recent laboratory advances
 33 allowed their detection. As such, data for these parameters in the study area are relatively sparse.
 34 The beneficial uses most directly affected by emerging pollutant concentrations are aquatic
 35 organisms (cold freshwater habitat, warm freshwater habitat, and estuarine habitat) and drinking
 36 water supplies (municipal and domestic supply) (Table 8-1). The focus of the following section is on
 37 three classes of emerging contaminants: EDCs, PPCPs, and nitrosamines (e.g., NDMA).

38 **Endocrine-Disrupting Chemicals**

39 EDCs interfere with hormone (endocrine) systems in animals. Hormones are released by body
 40 organs (e.g., thyroid, ovaries, testes) and act as chemical messengers to other organs and tissues.
 41 Hormones bind with receptor sites in a way similar to how a key fits into a lock. Upon binding, the
 42 receptor carries out the hormone's instructions by either altering the cell's existing proteins or

1 turning on genes that will build a new protein (U.S. Environmental Protection Agency 2009b). Both
2 of these actions create reactions throughout the body. The hormone system operates from
3 conception through old age, affecting development, reproduction, metabolism, and other crucial
4 body functions.

5 The problem with EDCs is that they can bind to hormone receptor sites in the body. The effect of this
6 action varies but usually involves altering the function of the hormone system (U.S. Environmental
7 Protection Agency 2009b). For example, an EDC that mimics a natural hormone can result in over-
8 or underproduction of a chemical or response (e.g., too much growth hormone) or generation of a
9 response at an inappropriate time (e.g., producing insulin when not needed). Other EDCs can block
10 natural hormones from binding. Overall, the action of EDCs is typically undesirable because EDCs
11 can disrupt normal body function.

12 EDCs have been studied with respect to their potential impacts on aquatic organisms (e.g.,
13 Snyder 2003, 2008). For example, studies of the impact of estrogen exposure on fish downstream of
14 WTPs have detected elevated levels of vitellogenin, a female-specific egg yolk protein, in male fish. In
15 a 7-year study, investigators found that concentrations of estrogens/estrogen mimics observed in
16 fresh water could affect the sustainability of wild fish populations by altering the male population
17 (Kidd et al. 2007).

18 Examples of EDCs include natural plant and animal compounds, metals (e.g., arsenic, cadmium, lead,
19 mercury), dioxins, polycyclic aromatic hydrocarbons (PAHs), pesticides, PPCPs, and PCBs (Snyder
20 2008). Sources of anthropogenic EDCs include WTPs, private septic systems, urban stormwater
21 runoff, industrial effluents, landfill leachates, discharges from fish hatcheries and dairy facilities,
22 runoff from agricultural fields and livestock enclosures, and land amended with biosolids or manure.

23 WTPs are just beginning to examine their ability to treat for EDCs, with an encouraging degree of
24 success (e.g., Snyder 2008; Benotti et al. 2009; Contra Costa Water District 2009). Related research
25 suggests that estrogen compounds can be biodegraded in the stream sediments below plant outfalls
26 (Bradley et al. 2009).

27 **Pharmaceuticals and Personal Care Products**

28 PPCPs generally represent products used by humans for personal health (e.g., prescription and over-
29 the-counter drugs) or cosmetic (e.g., fragrances, lotions) reasons, as well as products used to
30 enhance livestock growth or health (e.g., hormones, antibiotics).

31 PPCPs in the environment have not yet been shown to adversely affect human health, but some
32 studies suggest that they contribute to ecological harm (U.S. Environmental Protection
33 Agency 2009c). PPCPs have been found in most places sampled but typically at very low
34 concentrations. Research to study the long-term exposure to very low PPCP concentrations is in its
35 infancy. Concern exists because so much is unknown about the effects of PPCPs and because the
36 number of PPCPs is growing.

37 According to the USEPA (2009c), people contribute PPCPs to the environment when medication
38 residues pass out of the body and into sewer lines, when externally applied drugs and personal care
39 products they use wash down the shower drain, and when unused or expired medications are
40 placed in the trash or flushed down a toilet. WTP operators are just beginning to examine their
41 ability to treat for PPCPs, with an encouraging degree of success (e.g., Snyder 2008; Benotti et al.
42 2009; Contra Costa Water District 2009).

1 Given the hundreds of EDCs and PPCPs that exist, determining which compounds to monitor
 2 presents a challenge (e.g., Hoenicke et al. 2007; de Voogt et al. 2009; Southern California Coastal
 3 Water Research Project 2009). National reconnaissance studies have keyed in on several dozen
 4 chemicals that are known to have or may have the potential to affect humans and wildlife.

5 The first nationwide study took place in 1999 and 2000 and examined 95 chemicals in 139 streams
 6 across 30 states (Kolpin et al. 2002). According to the study, the most frequently detected
 7 compounds were coprostanol (fecal steroid); cholesterol (plant and animal steroid); N,N-
 8 diethyltoluamide (insect repellent); caffeine (stimulant); triclosan (antimicrobial disinfectant); tri(2-
 9 chloroethyl) phosphate (fire retardant); and 4-nonylphenol (nonionic detergent metabolite). In a
 10 follow-up study, the most frequently detected chemicals targeted in surface water were cholesterol,
 11 metolachlor (herbicide), cotinine (nicotine metabolite), and β -sitosterol (natural plant sterol).

12 Nitrosamines

13 Nitrosamines are a family of semi-volatile organic chemicals containing a nitroso and an amine
 14 functional group. N-Nitrosodimethylamine (NDMA) is the best-known nitrosamine, although there
 15 are several others of importance, including N-Nitrosodiethylamine (NDEA) and N-Nitrosodi-
 16 n-propylamine (NDPA). Chlorination or chloramination of water containing organic-nitrogen, such as
 17 occurs during water and wastewater treatment, can lead to the production of NDMA and other
 18 nitrosamines. NDMA and other nitrosamines also can form or be leached during treatment of water
 19 by anion exchange resins. NDMA and other nitrosamines are not easily removed during treatment,
 20 as they do not readily biodegrade, adsorb, or volatilize. (Najm and Trussell 2001). “NDMA Formation
 21 in Water and Wastewater”)

22 NDMA has been used in the production of liquid rocket fuel, and in a variety of other industrial uses.
 23 It has been found in foods, beverages, drugs, and tobacco smoke (National Toxicology Program
 24 2011). NDMA and other nitrosamines can cause cancer in laboratory animals. The USEPA classifies a
 25 number of them as probable human carcinogens. In 2006, the Office of Environmental Health and
 26 Hazard Assessment established a public health goal of 3 nanograms per liter (ng/L) for NDMA. The
 27 DPH also has a 10 ng/L notification level for several nitrosamines, including NDMA.
 28 (<http://www.cdph.ca.gov/certlic/drinkingwater/pages/NDMA.aspx> accessed 4-23-12)

29 Importance in the Study Area

30 Studies of EDCs and PPCPs in California waters are, like the national studies, typically less than 10
 31 years old. A few of these studies are highlighted in the following sections.

32 In 2001 and 2002, a survey of raw and treated drinking water from four water filtration plants in
 33 San Diego County showed the occurrence of several PPCPs including phthalate esters, sunscreens,
 34 clofibrate, clofibric acid, ibuprofen, triclosan, and DEET (Loraine and Pettigrove 2006). This is
 35 important because on average, roughly a third of the water in San Diego County originates from the
 36 Delta via conveyances of the SWP. According to the study, occurrence and concentrations of these
 37 compounds were highly seasonally dependent, and reached maximums when the flow of the San
 38 Joaquin River was low and the quantity of imported water was high. The maximum concentrations
 39 of the PPCPs measured in the raw water were correlated with low-flow conditions in the Delta that
 40 feed the SWP.

41 Sampling in the Bay-Delta system in 2002 and 2003 resulted in detection of several EDCs and PPCPs
 42 (Hoenicke et al. 2007). In this study, the authors reported flame-retardant compounds, pesticides

1 and insecticide synergists, insect repellents, PPCPs, plasticizers, non-ionic surfactants, and other
2 manufacturing ingredients in water, sediment, and biological tissue samples. Several of these
3 compounds, especially polybrominated diphenyl ether flame retardants, exhibited concentrations of
4 environmental concern. The highest tissue concentrations of total polybrominated diphenyl ethers
5 in bivalves (oysters, mussels, and clams) were detected in samples near the outlets of the
6 Sacramento and San Joaquin Rivers. Another study evaluated the occurrence and fate and transport
7 of 33 target analytes representing EDCs, PPCPs, and other organic chemicals in wastewater from
8 quarterly samples (April 2008–2009) collected at 11 locations in the Sacramento River, Delta, and
9 California Aqueduct, along with similar watershed sample locations from the Santa Ana River and
10 imported Colorado River water distribution systems in southern California (Guo et al. 2010). With
11 the exception of the American River sample, all of the Sacramento River/Delta/Aqueduct sample
12 locations had one or more target analytes detected. The median concentration of individual analytes
13 was <30 ng/L, except for diuron (81 ng/L), an agricultural pre-emergent herbicide that is used
14 extensively in the region. Maximum concentrations for some analytes exceeded 100 ng/L. The study
15 determined that analyte concentrations were generally lower in locations upstream of domestic
16 WTPs, indicating that wastewater effluent discharges are the likely dominant sources of most PPCPs
17 detected.

18 A preliminary screening study of surface waters along the northern California coast and the Central
19 Valley took place between 2003 and 2005 to determine whether chemicals associated with
20 agricultural and urban land uses could be potential sources of EDCs (de Vlaming et al. 2006). The
21 authors concluded that there was no strong estrogenic activity equivalent to assay positive control.

22 In 2006, CCWD participated in a study to examine the toxicological relevance of EDCs and PPCPs in
23 both raw source and treated water (Contra Costa Water District 2009). Of the 62 compounds
24 analyzed, only five were detected in the treated water: sulfamethoxazole (pharmaceutical),
25 meprobamate (pharmaceutical), atrazine (herbicide—endocrine disruptor), triclosan
26 (pharmaceutical), and dioctyl phthalate (used to make plastics—endocrine disruptor). The study
27 concluded that detection occurred at low concentrations and should not pose any health threats.

28 Regarding nitrosamines, while several studies have examined NDMA and other nitrosamine
29 formation in water and WTPs, few studies have examined NDMA or other nitrosamines in the study
30 area. A study conducted in the Delta concluded that locations downstream of WTPs had the highest
31 levels of NDMA precursors, as measured by NDMA formation potential, although actual NDMA
32 concentrations were low. Formation potential as a result of diuron in the samples was low
33 (DiGiorgio 2009).

34 **Existing Conditions in the Study Area**

35 Data for most EDCs, PPCPs, and nitrosamines in the Delta and the north- and south-of-Delta
36 locations are very sparse because most compounds are not typically part of water quality sampling
37 programs. The aforementioned studies represent the most current information on the monitoring of
38 these compounds in the Delta. This reality lead EPA to recently conclude in its Advanced Notice of
39 Proposed Rule Making regarding water quality challenges in the Delta, “Although there is not
40 sufficient data in the published literature to adequately assess the ecological implications of these
41 compounds in the Bay Delta Estuary, there is ample evidence to warrant additional attention” (U.S.
42 Environmental Protection Agency 2011:48). As such, EPA included emerging contaminants on its list
43 of likely stressors affecting aquatic resources in the Delta (U.S. Environmental Protection Agency
44 2011:20, 48; 2012a:3).

1 Regulatory criteria with respect to emerging pollutants are as follows. Numerical water quality
2 objectives for the CTR, Central Valley Water Board Basin Plan, San Francisco Bay Water Board Basin
3 Plan, or California drinking water MCLs for pollutants that act as EDCs are discussed in previous
4 constituent subsections: mercury, other trace metals, dioxins, PAHs, PCBs, and pesticides. Listings
5 for emerging pollutants on the Section 303(d) list are limited to these aforementioned subsections
6 as well. With regard to Basin Plan narrative objectives, emerging pollutants might fall under the
7 *population and community ecology* or *toxic* categories. Finally, in addition to the aforementioned
8 DPH public health goal (3 ng/L for NDMA) and notification levels for some nitrosamines, three
9 nitrosamines (NDMA, NDPA, and N-Nitrosodiphenylamine) are listed in the CTR (0.00069, 0.005, 5.0
10 µg/L, respectively, for consumption of water and organisms).

11 **8.2.3.9 Mercury**

12 **Background**

13 Mercury and its more biologically available methylated form is an element of statewide concern.
14 Mercury present in the Delta, its tributaries, Suisun Marsh, and San Francisco Bay today is derived
15 both from current processes and as a result of historical deposition. The majority of the mercury
16 present (and hence the impacts on beneficial uses) is the result of historical mining of mercury ore
17 in the Coast Ranges (via Putah and Cache Creeks to the Yolo Bypass) and the extensive use of
18 elemental mercury to aid gold extraction processes in the Sierra Nevada (via Sacramento, San
19 Joaquin, Cosumnes, and Mokelumne Rivers) (Alpers et al. 2008:6; Wiener et al. 2003). Residual
20 mercury in soils affected by historical mining continues to contribute to mercury concentrations in
21 water and sediments of the Delta and its tributaries. The mercury supplied from historical gold
22 mining processes appears to be the most bioavailable of the two primary sources because that
23 mercury was purified prior to use rather than left as more refractory ore and tailings (Central Valley
24 Water Board 2008a).

25 The bioavailability and toxicity of elemental mercury (from whatever primary source) are greatly
26 enhanced through the natural, bacterial conversion of mercury to methylmercury in marshlands or
27 wetlands. These environments tend to be more stagnant, with reduced oxygen concentrations, and
28 promote chemical reduction processes that make methylation possible.

29 Areas of enhanced bioavailability and toxicity of mercury (created through the mercury methylation
30 process) exist in the Delta, and elevated methylmercury concentrations in fish tissue produce
31 subsequent exposure and risk to humans and wildlife. Consequently, the beneficial uses most
32 directly affected by mercury are shellfish harvesting and commercial and sport fishing activities that
33 pose a human health concern, and wildlife habitat and rare, threatened, and endangered species
34 resources that can be exposed to bioaccumulation of mercury (Table 8-1). Because of these
35 concerns, mercury was the first TMDL approved for San Francisco Bay in 2007 (San Francisco Bay
36 Water Board 2006). The Delta methylmercury TMDL was approved by the Central Valley Water
37 Board in 2010 and was approved as final on October 20, 2011 (Central Valley Water Board 2011b).
38 The Delta, several direct tributaries to the Delta (i.e., Sacramento River, San Joaquin River,
39 Mokelumne River, Putah Creek, and Calaveras River), and areas downstream (i.e., Suisun Bay and
40 Suisun Marsh) also are listed as impaired water bodies on the Section 303(d) lists for mercury in
41 fish tissue (State Water Resources Control Board 2011).

1 **Importance in the Study Area**

2 Limiting characterization to the routine monitoring of total mercury waterborne concentrations is
 3 inadequate to determine mercury bioavailability. A conceptual model is needed to determine the
 4 importance of sediment, fish tissue, and methylated mercury as measures of exposure and risk in
 5 the system. A description of this model follows, and then concentrations in sediment and fish tissues
 6 are detailed.

7 **Conceptual Model of Mercury and Methylmercury Transport and Fate in the Delta**

8 Several conceptual models have been created for the Delta to describe important linkages among
 9 waterborne loading, waterborne concentrations, and water, sediment, and biotic processing of
 10 mercury and methylmercury (Ecosystem Restoration Program Delta Regional Ecosystem
 11 Restoration Implementation Plan [ERP DRERIP]). Figure 8-27 shows the important linkages,
 12 pathways, and relative importance of each in determining bioavailability; the important links
 13 between sediment processes and biotic uptake are emphasized. Mercury is strongly particle-
 14 associated and tends to settle and accumulate in sediment deposition areas, where, if conditions are
 15 favorable, can facilitate mercury methylation by sulfur-reducing bacteria. From that point in the
 16 cycle, diet (rather than waterborne concentration) is the primary route for methylmercury exposure
 17 to fish, wildlife, and humans. Refer also to Chapter 25 (Public Health) for discussion of the effects of
 18 mercury to human health.

19 The goal of mercury conceptual models (such as Alpers et al. 2008:ii) and plans created for
 20 integrated mercury investigations as part of Delta restoration efforts (such as Wiener et al. 2003)
 21 has been to identify linkages that can be used to guide restoration efforts toward the least harmful
 22 alternatives (the alternative with the least potential to exacerbate mercury-related effects). Aside
 23 from controlling upstream sources of mercury and methylmercury loading to the Delta, it may be
 24 important to limit the conversion of mercury to the more bioaccumulative and toxic methylmercury
 25 in Delta environments. For that reason, the Central Valley Water Board has focused on controlling
 26 methylmercury to protect beneficial uses in the Delta (Central Valley Water Board 2008b). As shown
 27 in Figure 8-27, a series of drivers related to water quality and sediment determines methylmercury
 28 production and uptake in biota and subsequent health effects on humans or wildlife. At every step of
 29 the process, opportunities exist to modify final outcomes and minimize impacts from mercury
 30 toxicity.

31 As suggested in Figure 8-27 and summarized from the local and general literature (as discussed and
 32 cited in Alpers et al. 2008), the following environmental characteristics are most important for
 33 determining risks to fish, wildlife, and humans from waterborne mercury contamination in the
 34 Delta.

- 35 • Source of mercury (atmospheric and gold mining operations are most bioavailable).
- 36 • Nutrient enrichment (high nutrient supply, algal growth, and eutrophication favor mercury
 37 uptake, bioaccumulation, and methylation).
- 38 • Water column DO (oxygen depletion in water or surface sediments favors methylation).
- 39 • Sediment organic content and grain size (small size fractions and more organic characteristics
 40 favor methylation).
- 41 • Water residence time and sediment accumulation (high residence time and sediment deposition
 42 areas favor methylation).

- 1 • Periodic drying and wetting (seasonal or annual flooding enhances methylmercury production
2 and food chain bioaccumulation in certain areas of the Delta) (Slotton et al. 2007).
- 3 • Fish species and age structure (top predators and older, larger fish accumulate higher tissue
4 concentrations of methylmercury).

5 Although sulfate could affect rates of mercury methylation (due to the dependence on sulfate-
6 reducing bacteria for methylation), such a relationship is highly variable and site-specific and not a
7 good predictor of methylation potential. The environmental factors governing rates of methylation
8 are complicated and site-specific modeling is required (Moore et al. 2003). Although sulfate can be
9 important to the rate of mercury methylation (Gilmour et al. 1992), intermediate levels may be more
10 stimulatory than low or high concentrations (Shao et al. 2012). Furthermore, experiments have
11 revealed that sulfate supply does not always directly relate to rates of methylation (Johnson and
12 Beck 2012). In contrast, the importance of low DO and availability of organic carbon is well known
13 (Alpers et al. 2008; Gorski et al. 2007), as well as the necessary supply of inorganic mercury (Shao et
14 al. 2012). In addition, the availability of dissolved mercury may be determined by the availability of
15 solid FeS (Han et al. 2007). For these reasons, waterborne sulfate, by itself, is not considered a
16 reliable predictor of mercury methylation potential or correlated to methylmercury concentrations.

17 **Existing Conditions in the Study Area**

18 **Water Concentrations**

19 Water quality data from the Delta and Suisun Marsh include records of mercury and methylmercury
20 waterborne concentrations as total or filtered water fractions. Water quality summary information
21 since 1999 is shown in Table 8-14. The general pattern of mercury waterborne loading to the Delta
22 shows the dominance of mercury mining sources via Cache Creek and the Yolo Bypass (Central
23 Valley Water Board 2008b); however, the waterborne average concentrations do not reflect the
24 same pattern as loads (Table 8-15). Instead, the eastside tributaries and San Joaquin River show
25 higher mercury and methylmercury concentrations than the Sacramento River inputs. In general,
26 waterborne concentrations of total mercury fall below regulatory guidelines while most of the mean
27 methylmercury concentrations throughout the Delta exceed the Regional Board TMDL
28 concentration guidelines of 0.06 ng/L (Table 8-14).

29 **Sediment Concentrations**

30 It has been estimated that the flux of methylmercury from Delta sediments contributes up to 36% of
31 the waterborne methylmercury load in the Delta (Central Valley Water Board 2008a). Therefore, the
32 spatial variability of mercury and methylmercury in sediments is an important characteristic of the
33 Delta's current condition for mercury exposure and could be important for determining future
34 mercury risk. Table 8-15 shows the pattern of surface sediment mercury throughout the Delta and
35 Suisun Bay. The data is presented to show the pattern of mercury deposition and to aid future
36 planning, but sediment data (in contrast to water and fish) is not modeled as part of this evaluation
37 of future conditions for BDCP Alternatives.

38 The CALFED sediment mercury study reported that total mercury in sediments varied spatially but
39 not seasonally (Heim et al. 2007). Total mercury concentrations (the sum of elemental and
40 methylmercury) in sediment were most elevated in the influent tributary streams and Suisun Bay
41 compared to the central and southern Delta.

1 In contrast, methylmercury showed both spatial and seasonal variations in concentration. The
2 biologically mediated nature of mercury methylation was apparently important in creating a
3 seasonal summer maximum in sediment methylmercury concentrations. Methylmercury
4 concentrations were highest in the mid-Delta interior marshes (compared to peripheral rivers) and
5 varied on a small scale, with the highest concentrations in mid-marsh.

6 The pattern of mercury transport and fate in the Delta is one of waterborne loading from historical
7 source waters (and runoff from historically affected soils) to the interior Delta, followed by the
8 accumulation of fine sediments in the marsh and subsequent methylation of elemental mercury in
9 those locations (Heim et al. 2007).

10 **Fish Tissue Concentrations**

11 Resident Delta fish accumulate mercury primarily through dietary exposure; larger, piscivorous
12 (fish-eating) fish show the greatest levels of tissue mercury. In contrast to anadromous fish
13 (migratory species), the resident fish experience constant exposure to local mercury sources.
14 Resident species include larger fish with human health exposure (such as largemouth bass) and
15 smaller, forage fish (such as inland silversides). Fish tissues are the ultimate route of exposure to
16 mercury for aquatic-dependent birds and mammals, and for humans who consume locally caught
17 fish.

18 The mercury conceptual model illustrates these principles. Human health and wildlife health effects
19 resulting from mercury exposure and uptake are the final outcomes of the mercury conceptual
20 model (Figure 8-27). Available data show substantial levels of mercury contamination in fish
21 throughout the Delta. For example, the tissue concentrations of mercury in largemouth bass are
22 shown as a spatial distribution throughout the Delta in Figure 8-28 (1999–2000 data). Note that the
23 Mokelumne River, Cosumnes River, Sacramento River, and San Joaquin River inflows exhibit the
24 highest fish tissue bioaccumulation, whereas these larger sport fish had uniformly lower tissue
25 concentrations in the central Delta.

26 Larger, piscivorous resident fish, in general, provide a good record of fish tissue mercury as a
27 baseline condition for the Delta. Largemouth bass were chosen because they are popular sport fish,
28 top predators, live for several years, and tend to stay in the same area (exhibit high site fidelity).
29 Consequently, they are excellent indicators of long-term average mercury exposure, risk, and spatial
30 pattern for ecological and human health. Results from a study of mercury in sport fish from the Delta
31 region found the median largemouth bass tissue mercury concentration to be 0.53 mg mercury per
32 kilogram (Hg/kg) wet weight (Davis et al. 2008). Recent summaries from tributary inputs to the
33 Delta reveal average bass concentrations similar to or higher than this Delta-wide average (Table 8-
34 16).

35 Current fish tissue concentrations thus exceed both adopted regulatory standards and guidance
36 from the USEPA. In the draft Delta TMDL for methylmercury, the Central Valley Water Board has
37 recommended fish tissue goals (fillet concentrations, wet weight mercury) of 0.24 mg Hg/kg wet
38 weight in trophic level 4 fish (adult, top predatory sport fish, such as largemouth bass) (Central
39 Valley Water Board 2008b). These values are slightly lower than USEPA's national recommended
40 water quality criterion for fish tissue of 0.3 mg Hg/kg wet weight for protection of human health and
41 wildlife (U.S. Environmental Protection Agency 2001). Therefore, the Delta average for largemouth
42 bass fillet concentrations in the study by Davis et al. exceeds both recommended safe consumption
43 guidelines.

1 **Table 8-14. Mercury and Methylmercury Surface Water Concentrations at Tributary Inputs and the Delta’s Major Outputs**

Site	Mercury Concentration (ng/L)						Methylmercury Concentration (ng/L)					
	No. of Samples	Min.	Max.	Mean	Year Collected	Source	No. of Samples	Min.	Max.	Mean	Year Collected	Source
Mercury Concentrations for Tributary Inputs												
Sacramento River at Keswick	26	0.2	2.7	0.5	2006–2007	DWR 2010	—	—	—	—	—	—
Sacramento River at Keswick ^a	—	—	—	—	—	—	—	—	—	—	—	—
Feather River at Oroville	5	0.2	0.7	0.4	2006–2007	DWR 2010	—	—	—	—	—	—
Feather River at Oroville ^a	—	—	—	—	—	—	—	—	—	—	—	—
Sacramento River at Verona	5	0.8	2.6	1.6	2006–2007	DWR 2010	—	—	—	—	—	—
Sacramento River at Verona ^a	—	—	—	—	—	—	—	—	—	—	—	—
Sacramento River at Freeport	45	1.2	30.6	4.1	1999–2002	Central Valley Water Board 2008a	36	0.05	0.24	0.10	2000–2003	Central Valley Water Board 2008a
Sacramento River at Freeport ^a	0	—	—	—	—	—	1	0.03	0.03	0.03	2000	Central Valley Water Board 2008a
San Joaquin River at Vernalis	49	3.1	21.7	7.6	2000–2004	BDAT 2010; Central Valley Water Board 2008a	49	0.09	0.26	0.15	2000–2001, 2003–2004	BDAT 2010; Central Valley Water Board 2008a
San Joaquin River at Vernalis ^a	19	0.3	3.0	0.8	2000–2002	BDAT 2010; USGS 2010	25	0.01	0.08	0.03	2000–2002	BDAT 2010; Central Valley Water Board 2008a; USGS 2010
Mokelumne River at I-5	21	0.3	12.0	4.5	2000, 2001, 2003	Central Valley Water Board 2008a	23	0.02	0.32	0.12	2000, 2001, 2003	Central Valley Water Board 2008a
Mokelumne River at I-5 ^a	0	—	—	—	—	—	8	0.02	0.17	0.06	2000	Central Valley Water Board 2008a
Cosumnes River at Michigan Bar ^a	1	1.4	1.4	1.4	2002	USGS 2010	1	0.41	0.41	0.41	2002	USGS 2010

Site	Mercury Concentration (ng/L)						Methylmercury Concentration (ng/L)					
	No. of Samples	Min.	Max.	Mean	Year Collected	Source	No. of Samples	Min.	Max.	Mean	Year Collected	Source
Calaveras River at Rail Road upstream of West Lane	4	13	26	20	2003–2004	Central Valley Water Board 2008a	4	0.11	1.9	0.14	2003–2004	Central Valley Water Board 2008a
Mercury Concentrations for Delta's Major Outputs												
Delta-Mendota Canal at Byron Highway	23	1.9	6	3.3	2000, 2001, 2003	Central Valley Water Board 2008a	21	0.01	0.17	0.05	2000, 2001, 2003	Central Valley Water Board 2008a
Delta-Mendota Canal at Byron Highway ^a	0	—	—	—	—	—	8	0.02	0.09	0.03	2000	Central Valley Water Board 2008a
SWP	20	1.2	7.2	2.5	2000, 2001, 2003	Central Valley Water Board 2008a	20	0.01	0.14	0.04	2000, 2001, 2003	Central Valley Water Board 2008a
SWP ^a	0	—	—	—	—	—	8	0.02	0.08	0.03	2000	Central Valley Water Board 2008a
X2	20	4	49	15	2000, 2001, 2003	Central Valley Water Board 2008a	22	0.007	0.24	0.05	2000, 2001, 2003	Central Valley Water Board 2008a
X2 ^a	0	—	—	—	—	—	8	0.02	0.06	0.03	2000	Central Valley Water Board 2008a
Suisun Bay	34	2.52	35.24	9.43	2000–2008	SFEI 2010	36	8E-05	0.18	0.03	2000–2008	SFEI 2010
Suisun Bay ^a	35	0.16	4.80	0.84	2000–2008	SFEI 2010	32	8E-05	0.10	0.01	2000, 2002–2008	SFEI 2010
California Aqueduct Check 13	—	—	—	—	—	—	—	—	—	—	—	—
California Aqueduct Check 13 ^a	36	0.2 ^b	0.2 ^b	0.2 ^b	2000–2005	DWR 2010	—	—	—	—	—	—
California Aqueduct Check 29	—	—	—	—	—	—	—	—	—	—	—	—
California Aqueduct Check 29 ^a	152	0.2 ^b	0.2 ^b	0.2 ^b	2000–2010	DWR 2010	—	—	—	—	—	—

Notes: Max. = maximum, Min. = minimum, ng/L = nanograms per liter.

^a Dissolved concentration of analyte.

^b It is assumed that the units were reported incorrectly for the site.

Sources: Bay Delta and Tributaries Project (BDAT) 2010; Central Valley Water Board 2008a; California Department of Water Resources 2010; San Francisco Estuary Institute 2010; U.S. Geological Survey 2010.

1 **Table 8-15. Mercury and Methylmercury Sediment Concentrations for Tributary Inputs, the Delta, and Suisun Bay**

Site	Sample Type	Total Mercury (ng/g Dry Weight)					Methylmercury (ng/g Dry Weight)				
		Samples	Min.	Max.	Mean	Year	Samples	Min.	Max.	Mean	Year
Concentrations at Tributary Inputs											
Sacramento River, Freeport ^a	Colloid	4	140	290	208	1996–1997	—	—	—	—	—
Sacramento River, Freeport ^a	Bed Sediment	1	267	267	267	1996–1997	—	—	—	—	—
Concentrations in Delta and Suisun Bay											
North Delta ^b	Surficial Sediment	11	104	320	170	1999	11	0.12	0.64	0.35	1999
East Delta ^b	Surficial Sediment	12	10.5	340	110	1999	9	0.02	0.68	0.3	1999
Central and West Delta ^b	Surficial Sediment	15	10.5	370	77	1999	12	0.019	1.1	0.36	1999
Central and West Delta ^c	Surficial Sediment	18	16.5	417	106	2000–2008	18	0.02	0.7	0.11	2000–2008
Suisun Bay ^b	Surficial Sediment	21	66	580	270	1999	20	0.019	9.3	0.45	1999
Suisun Bay ^c	Surficial Sediment	69	0.03	413	114	2002–2007	69	0.004	0.82	0.13	2000–2008

Notes:

Max. = maximum.

Min. = minimum.

ng/g = nanograms per gram

^a Source: U.S. Geological Survey 2009.^b Source: Heim et al. 2007.^c Source: San Francisco Estuary Institute 2010.

Sources: Heim et al. 2007; San Francisco Estuary Institute 2010; U.S. Geological Survey 2009.

2

1 **Table 8-16. Mercury Concentrations in Largemouth Bass Fillets for Tributary Inputs**

Site	Fish	Length (mm)			Concentration (mg Hg/kg Wet Weight)			Year
		Min.	Max.	Mean	Min.	Max.	Mean	
San Joaquin River at and downstream of Vernalis	40	226	530	325	0.21	1.4	0.56	1998–2000
Mokelumne River downstream of Cosumnes River	22	210	425	331	0.31	1.6	0.83	1999–2000
Cosumnes River	19	201	485	329	0.34	2.1	0.87	1999–2000

Notes:

Max = maximum.

mg Hg/kg = milligrams mercury per kilogram.

Min = minimum.

mm = millimeters.

Source: Central Valley Water Board 2008a.

2

3 Surprisingly, spatial patterns of mercury bioaccumulation in larger piscivorous sport fish do not
 4 show a clear link to zones of active sediment methylation in the Delta. In the study by Davis et al., the
 5 highest levels of fish tissue concentrations were found in the north Delta, Cosumnes River, and San
 6 Joaquin River, and lower fish tissue concentrations were found in the central, marsh-like Delta
 7 locations (Davis et al. 2008). The pattern reflects the dominance of source waters carrying
 8 methylmercury as a driver of increased fish tissue concentrations relative to the contribution from
 9 areas of secondary methylation in marshy locations or wetlands. In fact, in a related comprehensive
 10 study of Delta sport fish (including largemouth bass), mercury concentrations in fish tissues were
 11 found not to directly relate to the presence of wetlands. The authors found that the data
 12 “contradicted the prevailing notion that wetlands generally increase methylmercury accumulation
 13 in the food web” (Melwani et al. 2007). Nevertheless, the authors acknowledged the complexity of
 14 developing such relationships on a watershed scale; small-scale local factors may be the most
 15 important determinants of mercury bioaccumulation. In a subsequent study, the same authors
 16 suggest that in the case of the Delta, waterborne methylmercury may be a more important
 17 determinant of fish bioaccumulation than sediment mercury and the associated sites where
 18 methylation occurs (Melwani et al. 2009). Furthermore, laboratory studies of mercury uptake in
 19 Delta species indicate that much higher assimilation and uptake were observed in waters of lower
 20 DOC (as might be expected from the tributaries versus the interior Delta) (Pickhardt et al. 2006).
 21 This finding may help explain the dissimilar spatial pattern between sediment and fish
 22 methylmercury concentrations in the areas studied; waterborne methylmercury loading may be
 23 more important than sediment methylation in explaining the patterns of fish mercury
 24 bioaccumulation in the Delta.

25 In addition to human exposure as estimated from large-fish monitoring, the monitoring of whole-
 26 body fish tissues from various smaller species provides slightly different information. Monitoring of
 27 these so-called *biosentinel species*, such as inland silversides, prickly sculpin, and juvenile
 28 largemouth bass, demonstrates the variation in mercury bioaccumulation over small spatial scales
 29 and seasonal time frames (Slotton et al. 2007). The fish were juveniles of predatory fish or were
 30 various short-lived, smaller species and exhibited high site fidelity; thus, they were good monitors of
 31 spatial patterns and short time exposure. These fish were also good indicators of short-term

1 seasonal or interannual exposure patterns. Biosentinel monitoring has been implemented at various
 2 locations within the watershed, a subset of which was incorporated into a Fish Mercury Project
 3 Ecosystem Restoration Program grant. However, funding to support such a program over the long
 4 term is not currently in place. To date, the ongoing biosentinel monitoring program (Slotton et al.
 5 2007) has made these key findings.

- 6 • Episodic, aperiodic, and nonroutine flooding (such as seasonal high flows, extremely high tides,
 7 and managed marsh flooding) of formerly dry sediments leads to enhanced methylmercury
 8 exposure in some areas.
- 9 • The general pattern of bioaccumulation was higher fish tissue mercury concentrations in Suisun
 10 Marsh, Cosumnes River, and Yolo Bypass but lower tissue concentrations in the central Delta
 11 (similar to sport fish results).
- 12 • Large differences occurred in fish tissue concentrations from year to year in Suisun Marsh,
 13 associated with large variations in the extent of annual flooding.

14 The current pattern of mercury bioaccumulation in fish in the Delta and Suisun Marsh demonstrates
 15 the response to enhanced sources of mercury and methylmercury from water, sediment, and dietary
 16 pathways. Larger, piscivorous fish almost uniformly exhibit greater tissue mercury concentrations
 17 than human diet consumption guidelines and are linked to sources of influent loading (Central
 18 Valley Water Board 2008b). Smaller, short-lived fish demonstrate clear spatial patterns of
 19 bioaccumulation and the effects of enhanced mercury exposure following the flooding of usually dry
 20 areas (Slotton et al. 2007).

21 Regulatory criteria with respect to mercury are as follows. Applicable water quality criteria for
 22 judging the degree of contamination and effects of future changes in concentrations include those
 23 following.

- 24 • The CTR contains criteria for human health protection of 50 ng/L for fresh water and 51 ng/L
 25 for saltwater, which are expressed in the total recoverable form of the metal.
- 26 • The national recommended water quality criterion for total mercury is 770 ng/L to protect
 27 freshwater aquatic life from chronic exposure and 940 ng/L to protect marine life (U.S.
 28 Environmental Protection Agency 2012b).
- 29 • The Delta methylmercury TMDL limit of methylmercury in water, protective of fish
 30 bioaccumulation, is 0.06 ng/L (Central Valley Water Board 2008b).
- 31 • The San Francisco Bay mercury TMDL limit of total mercury in water is 25 ng/L (4-day average).

32 A comparison to Table 8-15 shows that the total mercury criterion (25 ng/L) is exceeded in the
 33 Sacramento River at Freeport, the Calaveras River, Suisun Bay, and Delta exports. In contrast, many
 34 of the mean and maximum methylmercury concentrations in water exceed the suggested guidelines
 35 for aquatic life (0.06 ng/L) and human health (through fish consumption).

36 Sediment concentrations can be judged against the Section 303(d) list screening as used by the
 37 Central Valley Water Board, based on the consensus screening value of 1.06 mg Hg/kg dry weight
 38 (1,060 ng/g) (MacDonald et al. 2000). Note that all total mercury values in Table 8-16 are below this
 39 screening value. However, this does not account for the complicated exposure pathways and
 40 methylation, which drive uptake and bioaccumulation into the food chain (Figure 8-27) more than
 41 does the total mercury concentrations in bulk sediment. Instead, sediment concentrations of

1 mercury and methylmercury can serve as weights of evidence for differences among areas in
2 mercury exposure potential from in-place or resuspended sediments.

3 The Delta TMDL limit for small, whole-fish mercury content for protection of fish and wildlife is 0.03
4 mg Hg/kg wet weight (Central Valley Water Board 2008b). This is in comparison to 2005–2006
5 Mississippi silversides whole-body mercury concentrations of 0.03 to 0.06 mg Hg/kg wet weight in
6 the central Delta, 0.17 mg Hg/kg wet weight in the Yolo Bypass, and up to 0.20 mg Hg/kg wet weight
7 at the Cosumnes River site (Slotton et al. 2007). Most of these small fish from the Delta and Suisun
8 Marsh exceeded the recommended Delta TMDL small-fish guideline concentrations for mercury.

9 USEPA (2012a) has initiated a series of special, focused studies concerned with the control of
10 mercury methylation in marsh and wetland habitats of the Delta, with special emphasis on the
11 mitigation for enhanced methylation as may occur in new restoration wetland environments. As
12 part of their list of water quality challenges and action plan for the Delta, USEPA (2012a) lists the
13 need to “Restore aquatic habitats while managing methylmercury”. The plan cites specific ongoing
14 studies by USGS, the Central Valley Water Board, and the California Coastal Conservancy, in
15 conjunction with USEPA, to study treatment technologies that may be used to sequester
16 methylmercury.

17 Additionally, the Central Valley basin Plan requires all entities subject to controlling methylmercury
18 in the Delta and Yolo Bypass, including DWR and USBR, to participate in a program to reduce human
19 exposure to mercury through eating fish. Individually or collectively, these entities will submit a
20 mercury exposure reduction program strategy in 2013.

21 **8.2.3.10 Nitrate/Nitrite and Phosphorus**

22 **Background and Importance in the Study Area**

23 Nutrients, primarily nitrogen (N) and phosphorus (P), play a complex role in water quality
24 (ammonia-N is discussed in a previous section) and the health of aquatic ecosystems. Phosphorus is
25 generally considered a limiting nutrient in freshwater systems, while nitrogen is generally
26 considered a limiting nutrient in marine systems. A limiting nutrient is one that is in shorter supply
27 for organisms that depend on nutrients for growth relative to the other nutrients, and thus increases
28 or decreases in the limiting nutrient affect primary productivity. In freshwater rivers, phosphorus is
29 usually bound to particles, complexing with elements such as iron. When this freshwater enters
30 estuaries and becomes more saline, the P-iron complex disassociates and the phosphorus is released
31 in a form that can be readily absorbed by algae. Hence there is, in many instances, adequate
32 phosphorus available for algal growth in estuary conditions.

33 The beneficial uses most directly affected by nutrient concentrations include those relevant to
34 aquatic organisms (cold freshwater habitat, warm freshwater habitat, and estuarine habitat),
35 drinking water supplies (municipal and domestic supply), and recreational activities (water contact
36 recreation, noncontact water recreation), which can be indirectly affected by the nuisance
37 eutrophication effects of nutrients (Table 8-1). Aquatic life depends on the availability of nutrients;
38 however, elevated concentrations of nutrients can cause eutrophication, as discussed in the
39 previous sections (DO, ammonia, and turbidity and total suspended solids [TSS]).

40 There are presently no applicable water quality standards for P. Drinking water standards have
41 been set for nitrate (10 mg/L) and nitrite (1 mg/L) because nitrate and nitrite can compete with

1 oxygen for receptor sites on hemoglobin in the bloodstream, thereby interfering with normal
2 respiration and causing effects in humans such as blue-baby syndrome.

3 Nutrients in the Delta are derived from a variety of point sources, including municipal discharges,
4 and nonpoint sources, including agricultural and urban runoff. As discussed previously (see the
5 *Ammonia* section), nutrient concentrations in the Delta are high enough that they are probably not a
6 true limiting factor for algal growth. However, excessively high nutrient concentrations also can be
7 associated with algal blooms and decreased water quality, and it is unclear whether nutrient
8 concentrations are adversely affecting primary productivity, which may be a contributing factor to
9 pelagic organism decline (POD) (see the *Ammonia* section for more information on POD).

10 Aquatic life depends on the availability of nutrients; however, elevated concentrations of nutrients
11 such as nitrate can cause eutrophication, in which high algal and bacterial growth and subsequent
12 microbial respiration deplete oxygen, producing anoxic waters and sediments. Waters of the Delta
13 are not considered nutrient-limited; that is, algal growth rates are limited by availability of light, and
14 thus increases or decreases in nutrient levels are, in general, expected to have little effect on
15 productivity (Jassby et al. 2002). However, when waters of the Delta are exported into conveyance
16 canals, algae may no longer be light-limited, and thus increases in nutrient levels in Delta export
17 waters may increase phytoplankton growth in the canals. Algal blooms are problematic in that they
18 create biomass that can obstruct water conveyance facilities and clog filters, and they may also lead
19 to taste and odor problems for municipal supplies (State Water Project Contractors Authority
20 2007:3-69).

21 However, regarding the potential for taste and odor concerns, Jones-Lee (2008) summarized a
22 presentation by P. Hutton (Metropolitan Water District), given at the March 25, 2008, California
23 Water and Environmental Modeling Forum (CWEMF) Delta Nutrient Water Quality Modeling
24 Workshop, that stated:

25 “there is limited ability to relate nutrient loads or in-channel concentrations to domestic water
26 supply water quality. While there is some ability to model the relationship between the nutrient load
27 to a waterbody and the planktonic algal biomass that develops in the waterbody, it is not possible to
28 adequately model the relationship between nutrient load to a waterbody and the development of
29 benthic and attached algae in that waterbody (Jones-Lee 2008:6).”

30 This is important in that benthic and attached algae are potentially more important for taste and
31 odor concerns than is planktonic biomass generally (Juttner and Watson 2007:1-2, Taylor et al.
32 2006).

33 In addition, changes in ratios of nutrients may affect aquatic life by causing changes in the
34 proportions of algal species, macrophytes and higher species (Glibert et al. 2011). While the impact
35 of nutrient ratios on the proportions of algal species, macrophytes and higher species is unsettled
36 within the scientific community, some analyses demonstrate that the ratio of one nutrient to
37 another, nutrient stoichiometry, may influence primary productivity and community composition.
38 Glibert et al. (2011) analyzed over 30 years of Delta water quality data and conclude that numerous
39 aquatic organism population shifts were correlated with changes in the quality and quantity of
40 nutrients.

41 This relationship between nutrient ratios and organism population shifts is not unique to the Delta.
42 Studies in Hong Kong, Tunisia, Germany, Florida, Spain, Korea, Japan and Washington D.C.
43 (Chesapeake Bay), to name a few, have all concluded that nutrient stoichiometry influences
44 phytoplankton community composition (Ruhl and Rybicki 2010; Ibanez et al. 2008; Hodgkiss and

1 Ho 1997; and Glibert et al. 2004). Furthermore, studies by Glibert et al. (2004; 2006), Lomas and
2 Glibert (1999, and Dortch (1990) concluded that diatoms have a preference for nitrate while
3 dinoflagellates and cyanobacteria generally prefer more reduced forms of nitrogen. Hessen (1997)
4 found that a shift from calanoid copepods to *Daphnia* tracked N:P changes in Norwegian lakes.
5 Sterner and Elser (2002) found that zooplankton size, composition and growth rates changed as the
6 N:P ratio changed. Similar changes have been observed in the Delta, though these researchers did
7 not differentiate the form of N between nitrate and ammonium. Glibert et al. (2011) found
8 significant correlations between nutrient ratios and the dominant zooplankton in the Delta over the
9 last 30 years.

10 The beneficial uses most directly affected by nitrogen and phosphorus concentrations are aquatic
11 organisms (cold freshwater habitat, warm freshwater habitat, and estuarine habitat), drinking water
12 supplies (municipal and domestic supply), and recreational activities (water contact recreation,
13 non-contact water recreation), which can be indirectly affected by the nuisance eutrophication
14 effects of nutrients.

15 Existing Conditions in the Study Area

16 A conceptual model developed for the Central Valley Drinking Water Policy Workgroup (Tetra Tech
17 2006a) estimated nutrient concentrations across the Central Valley by averaging time series data at
18 many sampling locations. Results indicate that total nitrogen (TN) and total phosphorus (TP)
19 concentrations were typically higher in the San Joaquin River (approximately 1.6 mg/L and 0.16
20 mg/L, respectively) compared to the Sacramento River (approximately 0.4 mg/L and 0.08 mg/L,
21 respectively). TN was typically in the form of nitrate-N. TP composition varied from high to low
22 concentrations of particulate-phosphorus. TP concentrations showed little inter-seasonal variation
23 for these two rivers, but higher TN concentrations were seen in the Sacramento River during wet
24 months and in the San Joaquin River during dry months (Tetra Tech 2006a).

25 Overall, TN and TP concentrations in the San Joaquin River and the Delta are relatively high and are
26 at concentrations that would be classified as eutrophic waters. Given the abundance of nutrients,
27 primary productivity in the Delta is fairly low (Jassby et al. 2002), suggesting that factors other than
28 nutrients are limiting, specifically light limitation caused by turbidity levels. The San Joaquin River
29 exhibits symptoms of eutrophic conditions, notably low DO concentrations that impair migration of
30 cold and warm freshwater species (Jassby 2005). However, when waters from the Delta are pumped
31 out in aqueducts for transport, or stored in reservoirs along the way, other limiting factors may
32 disappear and high levels of algal growth may result (Tetra Tech 2006a).

33 Although effects on water quality usually are related to concentrations of constituents, load
34 estimates may facilitate identification of important sources. Tributary loads were found to vary
35 substantially between wet and dry years, with loads from the Sacramento River exceeding the San
36 Joaquin River loads by nearly a factor of two or greater, especially in dry years (Tetra Tech 2006a).
37 Forest/rangeland loads may dominate the overall nitrogen loads for the Sacramento Basin, and
38 agricultural loads may dominate in the overall nitrogen loads to the San Joaquin Basin, particularly
39 for wet years. Point source loads from wastewater discharges may contribute nearly half or more of
40 the overall nitrogen and phosphorus loads during dry years in both basins, and possibly during wet
41 years for phosphorus in the San Joaquin Basin. Current estimates for in-Delta contribution of
42 nutrients from agriculture on the Delta islands are small compared to tributary sources (Tetra Tech
43 2006a).

1 TN and TP are often subdivided into different chemical species. Filtered water samples consist of
2 dissolved organic nitrogen, nitrate-N ($\text{NO}_3\text{-N}$), nitrite-N ($\text{NO}_2\text{-N}$), ammonia ($\text{NH}_3\text{-N}$), dissolved
3 organic phosphorus, and ortho-phosphorus (ortho-P). Due in part to their immediate biological
4 availability to algae, chemical species typically analyzed by water quality monitoring programs
5 include $\text{NH}_3\text{-N}$ (see previous section), the combined $\text{NO}_3/\text{NO}_2\text{-N}$ fraction (because of ease of
6 analysis; in oxygenated waters the sample typically is dominated by $\text{NO}_3\text{-N}$), and ortho-P.

7 In the aquatic environment, nitrogen and phosphorus compounds may rapidly cycle between water,
8 organisms, and sediments. Nitrate also is formed in the process of nitrification from ammonia. It is
9 estimated that 75% of the ammonia present in the Sacramento River at Hood is converted to nitrate
10 by the time the water reaches Chipps Island (Central Valley Water Board 2010a:4).

11 Dissolved ortho-phosphate is the form of phosphorus that generally is considered to be available for
12 algal and plant uptake. Total phosphorus may be a better determinant of lake and reservoir
13 productivity because most phosphorus is tied up in plankton and organic particles during periods of
14 high productivity. Therefore, dissolved ortho-phosphate concentrations may be very low in highly
15 productive lakes and reservoirs (Tetra Tech 2006a:2-4). The dynamics and speciation of
16 phosphorus in flowing water bodies such as the Sacramento and San Joaquin Rivers is not as
17 straightforward because they continually receive phosphorus from upstream, groundwater, and
18 runoff. Because of this, the form in which phosphorus is delivered plays a role in determining which
19 form of phosphorus is a better predictor of productivity downstream (Tetra Tech 2006a:2-5). An
20 analysis of source waters to the Delta found that ortho-phosphate may make up from very little to
21 almost all of the TP at a location at any given time (Tetra Tech 2006a:3-25 to 3-26).

22 Nitrate/Nitrite

23 Most examined locations in the northern half of the Plan Area, as well as the export area of the Delta,
24 have had low concentrations of $\text{NO}_3/\text{NO}_2\text{-N}$ in recent years (water years 2001–2006), with mean
25 values typically ranging from 0.28 to 0.40 mg/L (Figure 8-29). Concentrations in the southern half of
26 the Delta, however, were typically higher. For example, the CCWD pumping plant #1 had a mean
27 value of 0.46 mg/L, and the Banks pumping plant had a mean value of 0.56 mg/L. The highest mean
28 values were seen at the San Joaquin River near Vernalis (1.34 mg/L) and San Joaquin River at
29 Buckley Cove (1.63 mg/L).

30 Mean values for the north-of-Delta area ranged from 0.6 mg/L at the Feather River at Oroville to
31 0.12 mg/L at the Sacramento River at Verona (Table 8-17). South-of-Delta mean values were higher
32 than north-of-Delta stations examined (0.62 to 0.64 mg/L), comparable to the mean at the Banks
33 headworks (0.56 mg/L) (Figure 8-29).

34 Time series data indicate that $\text{NO}_3/\text{NO}_2\text{-N}$ concentrations at the examined stations generally
35 fluctuate on an annual basis (Figure 8-30 and Figure 8-31). Higher values have tended to occur
36 during the months of November through March.

Table 8-17. Nitrate/Nitrite Concentrations at Selected North- and South-of-Delta Stations, Water Years 2001–2006^a

Location	Nitrate/Nitrite (mg/L as N)				
	Samples	Minimum	Maximum	Mean	Median
Sacramento River at Keswick	44	0.03	0.99	0.10	0.08
Sacramento River at Verona	19	0.02	0.34	0.12	0.09
Feather River at Oroville	40	0.01	0.20	0.06	0.04
American River at WTP	39	0.01	0.36	0.07	0.05
California Aqueduct at Check 13	27	0.18	1.50	0.62	0.59
California Aqueduct at Check 29	29	0.19	1.70	0.64	0.50

Notes: mg/L = milligrams per liter; WTP = water treatment plant.

^a Sample size represents water quality samples having values at or greater than the reporting limit.

Source: California Department of Water Resources 2009b.

Ortho-Phosphorus

Most examined locations have had low concentrations of ortho-P in recent years (water years 2001–2006), with mean values typically ranging from 0.04 to 0.08 mg/L (Figure 8-32). Exceptions include the Barker Slough pumps (mean 0.10 mg/L), the San Joaquin River near Vernalis (mean 0.11 mg/L), and San Joaquin River at Buckley Cove (0.16 mg/L).

Mean values for the north-of-Delta area were all 0.02 mg/L (Table 8-18). South-of-Delta mean values were higher than north-of-Delta and Plan Area stations examined, with mean values of 0.08 to 0.10 mg/L (Banks headworks: 0.07 mg/L) (Figure 8-32).

Table 8-18. Ortho-Phosphorus Concentrations at Selected North- and South-of-Delta Stations, Water Years 2001–2006^a

Location	Ortho-Phosphorus (mg/L)				
	Samples	Minimum	Maximum	Mean	Median
Sacramento River at Keswick	41	0.01	0.03	0.02	0.02
Sacramento River at Verona	18	0.01	0.05	0.02	0.02
Feather River at Oroville	7	0.01	0.05	0.02	0.01
American River at WTP	8	0.01	0.05	0.02	0.01
California Aqueduct at Check 13	27	0.05	0.15	0.08	0.07
California Aqueduct at Check 29	2	0.04	0.15	0.10	0.10

Notes: mg/L = milligrams per liter; WTP = water treatment plant.

^a Sample size represents water quality samples having values at or greater than the reporting limit.

Source: California Department of Water Resources 2009b.

Time series data indicate that ortho-P concentrations at the examined stations generally fluctuate on an annual basis (Figure 8-33 and Figure 8-34). However, some stations have seen higher values during the summer and fall months, while other stations have seen higher values during the winter and spring months.

1 Total Phosphorus

2 Most examined Delta locations have had low concentrations of TP in recent years (water
3 years 2001–2006), with mean values typically ranging from 0.08 to 0.11 mg/L (Figure 8-35). As
4 seen with ortho-P, exceptions include the Barker Slough pumps (mean 0.20 mg/L), the San Joaquin
5 River near Vernalis (mean 0.19 mg/L), and San Joaquin River at Buckley Cove (0.25 mg/L).

6 Mean values for the north-of-Delta area were between 0.06 and 0.08 mg/L, with the exception of a
7 lower value of 0.02 mg/L at the American River at WTP (Table 8-19). South-of-Delta mean values
8 were higher than north-of-Delta and Plan Area stations examined, with mean values (0.10 mg/L)
9 near those seen in the Plan Area.

10 **Table 8-19. Total Phosphorus Concentrations at Selected North- and South-of-Delta Stations,**
11 **Water Years 2001–2006^a**

Location	Total Phosphorus (mg/L)				
	Samples	Minimum	Maximum	Mean	Median
Sacramento River at Keswick	44	0.01	0.89	0.06	0.02
Sacramento River at Verona	19	0.02	0.20	0.06	0.04
Feather River at Oroville	36	0.01	1.80	0.08	0.02
American River at WTP	37	0.01	0.10	0.02	0.02
California Aqueduct at Check 13	27	0.06	0.21	0.10	0.10
California Aqueduct at Check 29	29	0.06	0.22	0.10	0.09

Notes:

mg/L = milligrams per liter.

WTP = water treatment plant.

^a Sample size represents water quality samples having values at or greater than the reporting limit.

Source: California Department of Water Resources 2009b.

12

13 Time series data indicate that TP concentrations at the examined stations generally did not fluctuate
14 in a consistent manner on an annual basis (Figures 8-36 and 8-37).

15 Regulatory criteria with respect to nitrogen and phosphorus are as follows. Regarding Basin Plan
16 narrative objectives, nitrogen and/or phosphorus could be considered biostimulatory substances
17 because they are plant nutrients. There are no numerical water quality criteria for nutrients in the
18 CTR or the Central Valley Water Board Basin Plan. The San Francisco Bay Water Board Basin Plan
19 has objectives of 30 mg/L NO₃ plus NH₄ as nitrogen for agricultural supply—irrigation, and 100
20 mg/L NO₃/NO₂-N for agricultural supply—livestock watering. The California drinking water MCL is
21 1 mg/L for NO₂-N and 10 mg/L for NO₃-N because it can compete with oxygen for receptor sites on
22 hemoglobin in the bloodstream, thereby interfering with normal oxygen transport by the blood and
23 causing effects in humans, particularly infants. Another threshold for nitrate-N is for irrigation water
24 as recommended by Ayers and Westcot (1994), who recommend a value of 5 mg/L NO₃-N for
25 sensitive crops (e.g., sugar beets, grapes, apricot, citrus, avocado, grains).

1 **8.2.3.11 Organic Carbon**

2 **Background and Importance in the Study Area**

3 In an aquatic system, organic carbon encompasses a broad range of compounds, all of which
4 fundamentally contain carbon in their structure. Organic carbon may be contributed to the aquatic
5 environment by degraded plant and animal materials, and from anthropogenic sources such as
6 domestic wastewater, urban runoff, and agricultural discharge. TOC represents the summation of
7 both particulate organic carbon (POC) and DOC.

8 Organic carbon is a critical part of the foodweb and sustains aquatic life in the Delta and Bay.
9 However, organic carbon and bromide, a naturally occurring salt found throughout the Delta, are
10 precursors that contribute to DBP formation risk at drinking water treatment plants that use
11 disinfection processes to treat Delta surface water sources. DBPs in municipal water supplies can be
12 harmful to humans when consumed at low levels over a lifetime, and thus organic carbon
13 concentrations are of primary concern for the municipal water supply beneficial use (Table 8-1).
14 Environmental concerns regarding DBPs are related primarily to the consumers (humans, animals)
15 of drinking water containing the DBPs HAAs (monochloroacetic acid, dichloroacetic acid,
16 trichloroacetic acid, monobromoacetic acid, and dibromoacetic acid) and THMs (chloroform,
17 bromodichloromethane, dibromochloromethane, and bromoform). THMs and HAAs are known to
18 cause liver, kidney, and central nervous system problems and an increased risk of cancer (U.S.
19 Environmental Protection Agency 2008c). The risk of DBP formation at drinking water treatment
20 plants that use Delta surface water sources has been, and will continue to be, a central focus of water
21 quality regulations for the Delta and the SWP/CVP Export Service Areas.

22 **DBP-Formation Potential**

23 The primary disinfectants currently used at municipal drinking water treatment plants to remove
24 microbial contaminants consist of chlorine, chloramines, ozone, and ultraviolet (UV) light.
25 Numerous DBPs can be formed by disinfectants reacting with various constituents in the source
26 water, particularly DOC, bromide, and nitrogenous compounds. Chlorine-based disinfectants are a
27 cause in the formation of many DBPs, including the THMs and HAAs. Modern disinfection methods
28 used instead of chlorine to reduce DBP formation include chloramines and chlorine dioxide, ozone,
29 and UV light. Ozone can substantially reduce THM formation, and UV light does not form DBPs;
30 however, ozone can cause formation of bromate if bromide is present in the water (see the *Bromide*
31 section for a detailed discussion of its effects on water quality). UV light disinfection system design
32 must account for potential reduced efficiency associated with elevated turbidity and suspended
33 solids (which can shield bacteria/viruses from radiation) and biological fouling of lamps. Ozone and
34 UV light disinfection processes leave no residual disinfectant in the treated water, so a chlorine
35 disinfectant generally must be added to finished water to provide a residual level of disinfection
36 effect from the drinking water treatment plant through the distribution system to a user's tap. The
37 potential for DBPs to form during drinking water disinfection is a function of source water quality,
38 influenced primarily by DOC concentration and bromide, and a function of treatment operational
39 factors such as disinfectant dose and reaction time, pH, and temperature (Sadiq and Rodriquez
40 2004). The potential formation of THMs, HAAs, and bromate has been extensively studied, and
41 models are able to predict their formation with reasonable accuracy (Sohn et al. 2004).

1 **Methods to Reduce DBP Formation Risk**

2 Identifying and developing dynamic strategies and options to reduce DBP formation requires
3 analysis of technical feasibility and economic considerations and is one element of the Equivalent
4 Level of Public Health Protection (ELPH) concept of a multibarrier approach to providing drinking
5 water and public health protection. Because organic/inorganic substances act as precursors for
6 DBPs, their removal prior to disinfection is effective in reducing DBP formation potential. Organic
7 matter can be partially removed using conventional coagulation, flocculation, sedimentation, and
8 filtration methods or with more advanced methods (e.g., enhanced coagulation, granular activated
9 carbon [GAC] filtration, and membrane filtration). The control of water treatment operational
10 factors such as pH or disinfection contact time may reduce the formation of DBPs. Ozonation and UV
11 light are the primary existing and alternative disinfection processes to reduce DBP formation that
12 have been considered or implemented by water purveyors that use Delta source waters (Chen et al.
13 2010). pH reduction can control bromate formation during ozonation; however, the process
14 requires increased ozone dosage and large amounts of acid to lower the pH and base addition to
15 raise pH after ozonation to prevent corrosion in the distribution system (TetraTech 2006a).

16 Our understanding of organic carbon dynamics in the Delta has advanced greatly in recent years,
17 due in part to intensive sampling efforts and research conducted by various institutions (e.g., Chow
18 et al. 2007; Deverel et al. 2007; Drexler et al. 2009a, 2009b; Eckard et al. 2007; Kratzer et al. 2004;
19 Kraus et al. 2008; Municipal Water Quality Investigations 2009; Saleh et al. 2007; Sickman et al.
20 2007; Spencer et al. 2007; Stepanauskas et al. 2005; U.S. Geological Survey 2003). Sources of organic
21 carbon in the study area include peat soils, upland, agricultural and urban runoff, wetlands, algae
22 production, and municipal wastewater discharges. DOC is present in all the streams and rivers
23 flowing into the Delta, and it is these upstream sources that supply the majority of the organic
24 carbon load to the Delta. It has been estimated that between 50 and 90% of the DOC load entering
25 the Delta arrives from upstream sources (CALFED Bay-Delta Program 2008a:6). There are also
26 sources internal to the Delta, such as agricultural drains and wetlands that, on an annual average
27 basis, provide nearly 25% of the DOC load. These upstream and internal loads, and their related
28 sources, vary by season. Related to particular in-Delta sources, loading of DOC from agricultural
29 drains is typically greatest in the winter, while loading from wetlands is greatest in the spring and
30 summer (Fleck et al. 2007:1,21; Deverel et al. 2007:18).

31 In the Delta, THM formation has been found to be strongly correlated to TOC concentrations, but
32 relationships to DOC depend on specific structural characteristics of the organic matter, and
33 research has focused on the sources of DOC as being a critical factor for THM formation potential
34 (TetraTech 2006a). A study assessing organic carbon, bromide, and THM formation potential in the
35 California Aqueduct found that TOC concentration was a good predictor of THM formation potential
36 at the Banks pumping plant, the Delta-Mendota Canal (which feeds the Jones pumping plant), and
37 several locations along the California Aqueduct (California Department of Water Resources 2005).
38 The study did not measure DOC. Data collected from August 1998 at various Delta locations
39 (Municipal Water Quality Investigations 2003a:62, Table 4-3) indicated a strong positive
40 relationship between DOC and HAA formation potential ($r^2 = 0.996$). In Delta waters, DOC typically
41 represents 85–90% of TOC (CALFED Bay-Delta Program 2007b:5–22).

42 The measurement of specific UV light absorbance at a wavelength of 254 nanometers (nm) (SUVA)
43 is a commonly used measure of the potential conversion of DOC compounds into compounds such as
44 THMs; however, SUVA has been found to be a generally poor predictor of THM formation potential
45 in Delta waters (TetraTech 2006a). THMs generally are anticipated to be the most abundant DBP

1 formed in treated Delta source water, with HAA formation generally expected to be less than 50% of
2 the DBP production.

3 Table 8-20 provides a summary of TOC concentrations at several Delta intakes and major
4 tributaries. In general, the highest average concentrations of organic carbon occur in the San Joaquin
5 River and in the Delta, while the lowest average concentrations occur in the Sacramento River.

6 **Table 8-20. Total Organic Carbon Concentrations at Delta Intakes and Major Tributaries**

Intake	Form	Period	Number of Samples (n)	Median TOC (mg/L)	Maximum TOC (mg/L)
Harvey O. Banks	TOC	1986–2006	252	3.20	16.3
C. W. Jones (Tracy)	TOC	1986–1999	29	3.30	5.0
CCWD Old River	TOC	1994–2006	176	3.00	14.0
CCC (Rock Slough)	TOC	1991–2006	169	3.60	40.0
North Bay Aqueduct (Barker Slough)	TOC	1988–2006	289	4.70	38.0
Sacramento River	TOC	1998–2006	595	1.75	8.6 (19.9) ^a
San Joaquin River at Vernalis	TOC	1986–2006	418	3.30	10.5

Notes:

CCC = Contra Costa Canal.

CCWD = Contra Costa Water District.

NBA = North Bay Aqueduct.

mg/L = milligrams per liter.

TOC = total organic carbon.

^a Maximum reported value is 19.9 mg/L, second highest is 8.6 mg/L; site: Hood/Greene's Landing.

Source: CALFED Bay-Delta Program 2007b.

7

8 Peak concentrations are important to municipal drinking water purveyors because of regulations
9 that require advanced treatment depending on TOC concentrations. Drinking water treatment
10 plants using North Bay Aqueduct water repeatedly have shut down, switched to blending operations
11 with better quality water, or alternative water sources to avoid seasonal precipitation-induced
12 spikes in DOC (Municipal Water Quality Investigations 2003b). DOC in the Delta typically peaks in
13 the winter months, when seasonal river and Delta agricultural drain DOC loading are their greatest
14 (Fleck et al. 2007:1,21; Deverel et al. 2007:18).

15 Existing Conditions in the Study Area

16 The lowest observed mean concentrations of DOC in the Delta during the waters years 2001–2006
17 ranged from 1.9 to 2.2 mg/L, with the lowest concentrations occurring in the Sacramento River at
18 Hood (Figure 8-38). Higher mean concentrations of DOC occurred in the southern Delta, ranging
19 from 3.3 mg/L at the Banks headworks location to 3.8 mg/L at the San Joaquin River near Vernalis.
20 The highest observed mean DOC concentration occurred at the North Bay Aqueduct pumping plant
21 on Barker Slough (5.7 mg/L). The quality of water in Barker Slough is substantially influenced by
22 local sources located in its immediate upland watershed. These local sources contribute a significant
23 organic carbon load to Barker Slough, particularly during winter months when concentrations of
24 DOC often exceed 10 mg/L (State Water Project Contractors Authority 2007: 3-19, 3-26).

1 DOC measured in the Sacramento River shows a trend of gradually increasing DOC with distance
 2 from Shasta Dam, where median concentrations of about 1 to 1.5 mg/L increase to about 1.5 mg/L
 3 to 2 mg/L at Hood (CALFED Bay-Delta Program 2007b:5–58). Major tributaries such as the Feather
 4 and American Rivers contain relatively low DOC as well, with median measured concentrations of
 5 1.5 mg/L–2 mg/L. DOC on the lower San Joaquin River is comparatively greater but generally
 6 decreases with downstream distance, where median concentrations at Stevinson are nearly 6 mg/L
 7 and median concentrations at Vernalis are about 3 mg/L (CALFED Bay-Delta Program 2007b:5–49).
 8 This decrease in DOC can be attributed to inputs from tributaries such as the Merced, Tuolumne, and
 9 Stanislaus Rivers, with median DOC concentrations of 2 mg/L. Mean values for the north-of-Delta
 10 area during water years 2001–2006 ranged from 1.5 mg/L at the Feather River at Oroville to
 11 2.0 mg/L at the Sacramento River at Veterans Bridge (Table 8-21). South-of-Delta mean values were
 12 higher than north-of-Delta stations examined (3.2 to 3.4 mg/L), and comparable to the mean at the
 13 Banks headworks (3.3 mg/L, Figure 8-38).

14 Time series data indicate that DOC concentrations at the examined stations generally fluctuate on an
 15 annual basis (Figure 8-39 and Figure 8-40). Higher values have tended to occur during the months
 16 of December through March at most locations, particularly the Sacramento River and in-Delta
 17 locations, whereas the San Joaquin River concentrations tend to be higher in the summer months as
 18 a result of irrigated agricultural drainage (Tetra Tech 2006b).

19 **Table 8-21. Dissolved Organic Carbon Concentrations at Selected North- and South-of-Delta**
 20 **Stations, Water Years 2001–2006^a**

Location	Dissolved Organic Carbon (mg/L as C)				
	Samples	Minimum	Maximum	Mean	Median
Sacramento River at Keswick	10	0.9	2.5	1.6	1.5
Sacramento River at Veterans Bridge	18	1.2	4.3	2.0	1.6
Feather River at Oroville	28	1.0	2.2	1.5	1.5
American River at WTP	156	1.1	3.7	1.6	1.5
California Aqueduct at Check 13	115	2.1	8.0	3.4	3.1
California Aqueduct at Check 29	86	1.8	7.4	3.2	3.0

Notes: mg/L = milligrams per liter; WTP = water treatment plant.

^a Sample size represents water quality samples having values at or greater than the reporting limit.

Sources: California Department of Water Resources 2009b; Sacramento Regional County Sanitation District 2004, 2005, 2006, 2007, 2008, 2009.

21

22 The lowest observed mean concentrations of TOC in the Delta during the water years 2001–2006
 23 ranged from 2.7 to 3.0 mg/L, occurring at the Sacramento River at Hood and in the Delta export
 24 region (Figure 8-41). Higher mean concentrations of TOC occurred in the southern Delta region,
 25 ranging from 3.8 mg/L at CCWD pumping plant #1 to 5.1 mg/L at the San Joaquin River near
 26 Vernalis. The highest observed mean TOC concentration occurred at the Barker Slough pump
 27 (7.8 mg/L).

28 Mean values for the north-of-Delta area ranged from 1.5 mg/L at the Sacramento River at Keswick to
 29 2.1 mg/L at the Sacramento River at Veterans Bridge (Table 8-22). South-of-Delta mean values were
 30 higher than north-of-Delta stations examined (3.9 to 4.2 mg/L) and slightly lower than the mean at
 31 the Banks headworks (4.3 mg/L, Figure 8-41).

1 Time series data indicate that TOC concentrations at the examined stations generally fluctuate on an
 2 annual basis (Figure 8-42 and Figure 8-43). Higher values have tended to occur during the months
 3 of December through March.

4 **Table 8-22. Total Organic Carbon Concentrations at Selected North- and South-of-Delta Stations,**
 5 **Water Years 2001–2006^a**

Location	Total Organic Carbon (mg/L as C)				
	Samples	Minimum	Maximum	Mean	Median
Sacramento River at Keswick	15	1.0	2.6	1.5	1.4
Sacramento River at Veterans Bridge	18	1.2	5.9	2.1	1.6
Feather River at Oroville	28	1.4	3.6	2.0	1.9
American River at WTP	162	1.2	4.8	1.8	1.6
California Aqueduct at Check 13	203	2.1	12.6	4.2	3.5
California Aqueduct at Check 29	158	1.9	14.5	3.9	3.5

Notes: mg/L = milligrams per liter; WTP = water treatment plant.

^a Sample size represents water quality samples having values at or greater than the reporting limit.
 Sources: California Department of Water Resources 2009b; Sacramento Regional County Sanitation
 District 2004, 2005, 2006, 2007, 2008, 2009.

6
 7 Organic carbon is not a priority pollutant; thus, the CTR has no criteria. There are no state or federal
 8 regulatory water quality objectives/criteria for organic carbon or any USEPA-recommended criteria.
 9 As a consequence, none of the water bodies in the affected environment are listed as impaired on
 10 the state's CWA Section 303(d) list because of elevated organic carbon. However, under USEPA's
 11 Disinfectants and Disinfection Byproducts Rule (63 FR 69390), municipal drinking water treatment
 12 facilities are required to remove specific percentages of TOC in their source water through enhanced
 13 treatment methods, unless the drinking water treatment system can meet alternative criteria.
 14 USEPA's action thresholds begin at 2–4 mg/L TOC and, depending on source water alkalinity, may
 15 require a drinking water utility to employ treatment to achieve as much as a 35% reduction in TOC.
 16 Where source water TOC is between 4 and 8 mg/L TOC, drinking water utilities may be required to
 17 achieve a 45% reduction in TOC. Existing Delta water quality regularly exceeds 2 mg/L TOC, and
 18 existing treatment plants already are obligated to remove some amount of TOC. Nevertheless,
 19 changes in source water quality at municipal intakes may trigger additional enhanced TOC removal,
 20 and associated increased treatment costs.

21 The CALFED Program established a goal to in addition to USEPA's Disinfectants and Disinfection
 22 Byproducts Rule, to achieve TOC of 3 mg/L as a long-term average as applied to municipal drinking
 23 water intakes drawing water from the Delta (CALFED Bay-Delta Program 2000). The goal was
 24 established based on a study prepared by California Urban Water Agencies (CUWA) recommending
 25 Delta source water quality targets sufficient to achieving DBP criteria in treated drinking water and
 26 sufficient to allow continued flexibility in treatment technology. Specifically, the goal of the CALFED
 27 Drinking Water Program is to:

28 achieve either: (a) average concentrations at Clifton Court Forebay and other southern and central
 29 Delta drinking water intakes of 50 µg/L bromide and 3.0 mg/L total organic carbon, or (b) an
 30 equivalent level of public health protection using a cost-effective combination of alternative source
 31 waters, source control, and treatment technologies.

32 The USEPA promulgated the Stage 1 Disinfectants and Disinfection Byproducts (D/DBP) Rule in
 33 1998 and the Stage 2 D/DBP Rule in 2006 under the Safe Drinking Water Act (SDWA) which

1 collectively establish the treatment standards for DBPs, tightened compliance monitoring
 2 requirements for DBPs, and strengthened public health protection related to DBP exposure in
 3 municipal water distribution systems. The Long Term 2 Enhanced Surface Water Treatment Rule
 4 focuses on reducing illness from cryptosporidium and other disease-causing microorganisms in
 5 drinking water distribution systems and requires water utilities to balance long-term and short-
 6 term health concerns posed by DBPs and pathogens, respectively. The compliance challenge for
 7 WTP operators is to provide adequate disinfection to protect against pathogens without forming
 8 DBPs. Development of the Delta Drinking Water Policy by the Central Valley Water Board was
 9 identified as a future need during the 1998 and 2001 triennial reviews of the Basin Plan, and by the
 10 CALFED process, with a goal of completing the policy and associated Basin Plan amendments in
 11 2013.

12 **8.2.3.12 Pathogens**

13 **Background and Importance in the Study Area**

14 The term *pathogens* refers to viruses, bacteria, and protozoa that pose human health risks.
 15 Pathogens of concern include bacteria, such as *Escherichia coli* and *Campylobacter*; viruses such as
 16 hepatitis and rotavirus; and protozoans such as *Giardia* and *Cryptosporidium*. Most data that exist
 17 regarding pathogens are for coliform bacteria, which are indicators of potential fecal contamination
 18 by humans or other warm-blooded animals because of their relative abundance and ease of
 19 measuring in water samples.

20 Sources of pathogens include wild and domestic animals, aquatic species, urban stormwater runoff,
 21 discharge from WTPs, and agricultural point and nonpoint sources such as confined feeding lots and
 22 runoff. Pathogens that have animal hosts can be transported from the watershed to source waters
 23 from natural lands or grazed lands and cattle operations; aquatic species such as waterfowl also
 24 contribute pathogens directly to water bodies. Stormwater runoff from urban or rural areas can
 25 contain pathogens carried in waste from domestic pets, birds, or rodents as well as sewage spills.
 26 Once in the ambient environment, pathogens often die, although in some instances they can survive
 27 and even reproduce in sediments.

28 The beneficial uses of surface waters in the affected environment that are affected by pathogens are
 29 municipal and domestic supply, water contact recreation, shellfish harvesting, and commercial and
 30 sport fishing. Of these beneficial uses, municipal and domestic supply and water contact recreation
 31 are the receptors most affected by pathogens because direct contact or ingestion affects human
 32 health, as shown in Table 8-1. Infections in humans may arise from pathogens that break through
 33 into treated drinking water or from external sources such as food ingestion and ingestion of
 34 untreated water during recreation.

35 Water treatment processes that are focused on the removal of particulates, such as filtration and
 36 membranes, are generally effective at removing pathogens. Disinfection of bacteria pathogens can
 37 be achieved effectively either through chemical oxidation using chlorine or ozone, or through
 38 exposure to UV light. Viruses also can be removed effectively through chlorine or ozone oxidation.
 39 The treatment of protozoans is more challenging, as cysts and oocysts of protozoans cannot be fully
 40 removed by sand filtration and are resistant to chemical disinfection; however, disinfection using UV
 41 light has been found to be effective (Tetra Tech 2007).

1 **Escherichia Coli**

2 *Escherichia coli* is an anaerobic bacterium that lives in the gastrointestinal tract of warm-blooded
3 animals. The presence of *E. coli* normally is beneficial to the host through the synthesis of vitamins
4 and the suppression of harmful bacteria. However, some strains of *E. coli* are pathogenic. Pathogenic
5 *E. coli* affect humans by generating toxins that can result in diarrhea, inflammation, fever, and
6 bacillary dysentery (U.S. Environmental Protection Agency 2009d). Certain strains of *E. coli* can be
7 severely toxic to some patients, particularly children, causing hemolytic uremic syndrome and
8 leading to destruction of red blood cells and occasional kidney failure (Tetra Tech 2007). The
9 presence of *E. coli* is an indicator of fecal contamination, either by human waste, wastewater, or
10 animal wastes.

11 **Campylobacter**

12 *Campylobacter* is a bacterium that can be found in natural waters throughout the year.
13 *Campylobacter jejuni* is commonly present in the gastrointestinal tract of cattle, pigs, and poultry
14 and is a leading cause of bacterial gastroenteritis in the United States. *Campylobacter* infection in
15 some rare cases may be followed by Guillain-Barré syndrome, a form of neuromuscular paralysis.
16 Strains of *Campylobacter* have developed resistance to antibiotics, resulting in the difficulties with
17 clinical treatment.

18 **Hepatitis**

19 Hepatitis is a virus that causes liver inflammation and sometimes leads to jaundice. Hepatitis Types
20 A and E are infectious and are transmitted through the fecal-oral route. Hepatitis A is a well-
21 documented waterborne disease and is widespread throughout the world.

22 **Rotavirus**

23 Rotaviruses are the most prevalent viruses that cause diarrhea worldwide. Rotavirus was estimated
24 to contribute to 30 to 50% of severe diarrhea disease in humans (Tetra Tech 2007). The virus can be
25 transmitted through fecal-oral route and through contaminated food and water.

26 **Giardia**

27 *Giardia* is a parasite found in the intestinal linings of a wide range of animals and their feces, and in
28 contaminated water. *Giardia* can survive a wide range of temperature—from ambient temperature of
29 fresh water to internal temperatures of animals. Among the many species of *Giardia*, *Giardia lamblia*
30 infects humans and causes diarrhea and abdominal pain. *Giardia lamblia* has been found in
31 wastewater and has been related to several outbreaks of waterborne disease around the world
32 (Tetra Tech 2007).

33 **Cryptosporidium**

34 *Cryptosporidia* are single-celled, intestinal parasites that infect humans and a variety of animals.
35 These parasites can infect epithelial cells of the intestinal wall and are excreted in feces as oocysts.
36 *Cryptosporidium* has a wide range of hosts, including domestic and wild animals. Symptoms of
37 cryptosporidiosis, a disease caused by ingestion of *Cryptosporidium*, include diarrhea, stomach
38 cramps, upset stomach, and slight fever; more serious symptoms can result in weakened immune
39 systems (U.S. Environmental Protection Agency 1999b). Cryptosporidiosis is a major cause of

1 gastrointestinal illness around the world, especially to individuals with compromised immune
2 systems. For these people, the symptoms can be more severe or life-threatening.

3 **Existing Conditions in the Study Area**

4 A conceptual model of pathogens and pathogen indicators was developed for the Central Valley
5 Drinking Water Policy Workgroup (Tetra Tech 2007). The pathogen and indicator data compiled for
6 the model consisted primarily of measurements of total and fecal coliforms and *E. coli*, some limited
7 data on other species of coliforms, and even more limited data on pathogens such as
8 *Cryptosporidium* and *Giardia*. Fecal indicator concentrations are highly variable both temporally and
9 spatially and can vary by orders of magnitude (Tetra Tech 2007). The variable nature of pathogen
10 and indicator concentrations in surface waters, and the rapid die-off of many of these organisms in
11 the ambient environment, makes it very difficult to quantify the importance of different sources on a
12 scale as large as the Central Valley, especially for coliforms that are widely present in water. A single
13 source close to the sampling location can dominate the coliform concentrations observed at a
14 location downstream of several thousand square miles of watershed.

15 Of the known sources of coliform discharges into the waters of the Central Valley, it was found that
16 wastewater total coliform concentrations for most plants were fairly low (<1,000 most probable
17 number per 100 milliliters [MPN/100 ml]), whereas the highest total coliform concentrations in
18 water (>10,000 MPN/100 ml) were observed near samples influenced by urban areas (Tetra Tech
19 2007). In fact, the regional water boards limit publicly owned treatment works discharges to
20 <23 MPN/100 ml in NPDES permits, with most plants limited to <2.2 MPN/100 ml. In the San
21 Joaquin River valley, comparably high concentrations of *E. coli* were observed for waters affected by
22 urban environments and intensive agriculture in the San Joaquin Valley (Tetra Tech 2007). Fecal
23 indicator data showed minimal relationships with flow rates, although most of the high
24 concentrations were observed during the wet months of the years, possibly indicating the
25 contribution of stormwater runoff (Tetra Tech 2007).

26 Regulatory criteria with respect to pathogens are as follows. The Central Valley Water Board Basin
27 Plan specifies water contact recreation criteria for fecal coliform bacteria not to exceed a geometric
28 mean of 200 organisms/100 ml in any 30-day period (based on a minimum of five samples), nor
29 more than 10% of the total number of samples taken during any 30-day period to exceed 400
30 organisms/100 ml. The Central Valley Water Board Basin Plan water quality objectives for
31 pathogens are detailed in Appendix 8A. The Stockton Deep Water Ship Channel and various sloughs
32 and creeks in the western and eastern Delta are on the state's CWA Section 303(d) list as impaired
33 because of pathogens, with sources identified as recreational and tourism activities [nonboating]
34 and urban runoff/storm sewers (State Water Resources Control Board 2011). A TMDL for the
35 Stockton Urban Waterbodies was approved by EPA on 13 May 2008. TMDLs for other listed water
36 bodies in the affected environment are proposed for completion in 2021 (State Water Resources
37 Control Board 2011).

38 USEPA's surface water treatment rules require that systems using surface water, or groundwater
39 under the direct influence of surface water, to: (1) disinfect water to destroy pathogens and (2) filter
40 water or meet criteria for avoiding filtration to remove pathogens, so that the following
41 contaminants are controlled at the following levels (U.S. Environmental Protection Agency 2009d).

- 42 • Total coliform: no more than 5% positive samples in a month (for water systems that collect
43 fewer than 40 routine samples per month, no more than one sample can be positive per month).
44 Every sample that has total coliform must be analyzed for either fecal coliforms or *E. coli*. If two

1 consecutive total coliform positive samples occur, and one is also positive for *E. coli*/fecal
2 coliforms, the system is deemed as having an acute MCL violation.

- 3 • Viruses: 99.99% removal/inactivation.
- 4 • *Giardia lamblia*: 99.9% removal/inactivation.
- 5 • *Cryptosporidium*: 99% removal.

6 **8.2.3.13 Pesticides and Herbicides**

7 **Background and Importance in the Study Area**

8 A pesticide is any substance or mixture of substances intended for preventing, destroying, repelling,
9 or mitigating any pest. Pesticides typically occur in the form of chemicals or biological agents (e.g.,
10 virus or bacterium) and are often formulated for specific pests such as weeds (herbicides), insects
11 (insecticides), and fungi (fungicides), among others. Pesticides may be described in two general
12 categories: current use pesticides and legacy pesticides.

13 Current use pesticides include carbamates (e.g., carbofuran), organophosphates (e.g., chlorpyrifos,
14 diazinon, methyl parathion, malathion), thiocarbamates (e.g., molinate, thiobencarb), and more
15 recently pyrethroids (e.g., permethrin, cypermethrin), a class of synthetic insecticides applied in
16 urban and agricultural areas. USEPA has begun to phase out certain uses of organophosphates
17 because of their potential toxicity in humans, which has led to the gradual replacement of
18 organophosphates by pyrethroids (Werner et al. 2008).

19 Legacy pesticides include primarily organochlorine pesticides like dichlorodiphenyltrichloroethane
20 (DDT) and Group A Pesticides (aldrin, dieldrin, chlordane, endrin, heptachlor, heptachlor epoxide,
21 hexachlorocyclohexane [including lindane], endosulfan, and toxaphene). These chemicals are highly
22 persistent in the environment and were banned in the 1970s because of their health and
23 environmental effects. Organochlorines are prone to accumulation in sediments.

24 Pesticides, including pyrethroids, organophosphates, carbamate insecticides, herbicides, and
25 fungicides are used extensively throughout the Central Valley. The critical pathways for pesticides
26 entering the rivers, streams, and the Delta include agricultural and urban stormwater runoff,
27 irrigation return water, drift from aerial or ground-based spraying, and periodic release of
28 agricultural return flows from rice production (Werner and Oram 2008). Agricultural inputs are
29 dominant, but urban inputs are also substantial in areas of high population density (CALFED Bay-
30 Delta Program 2008a) and appear to be a primary source of pyrethroid insecticides entering urban
31 creeks. For example, Weston and Lydy (2010) demonstrated that urban runoff produced pyrethroid
32 concentrations exceeding acutely toxic thresholds. The authors also found that the pyrethroids
33 passed through secondary treatment systems at wastewater treatment facilities, suggesting possible
34 sewer disposal of pyrethroids (e.g., household pesticides).

35 The timing of pesticide input to Delta waters is related to application rates, when pesticides are
36 applied to farmed land, runoff events, and other transport processes (Kuivila and Jennings 2007). In
37 agricultural applications, for example, diazinon and chlorpyrifos are applied during the dormant
38 season (December through February) and the irrigation season (March through November).
39 Dormant orchards (nuts and fruits) are sprayed to limit pest damage. Application totals for diazinon
40 (1999–2003 average) were 52% dormant season and 48% irrigation season (47,652 pounds total);

1 application totals for chlorpyrifos (1999–2003 average) were 3% dormant season and 97%
2 irrigation season (114,101 pounds total).

3 Concern about pesticides is primarily associated with nontarget-organism toxic effects; because
4 many pesticides have been developed to target insect pests (e.g., neurotoxins), these pesticides also
5 have the potential to harm other organisms. Pesticides have toxic effects on the nervous systems of
6 terrestrial and aquatic life, and some are toxic to the human nervous system U.S. Environmental
7 Protection Agency 2008d). Consequently, the beneficial uses most directly affected by pesticide
8 concentrations are aquatic organisms (cold freshwater habitat, warm freshwater habitat, and
9 estuarine habitat); rare, threatened, and endangered species; harvesting activities (shellfish
10 harvesting and commercial and sport fishing); and drinking water supplies (municipal and domestic
11 supply) (Table 8-1).

12 Toxicity of pesticides, like all toxins, is related to the dose an organism receives. For example, a
13 pesticide applied to a rice field in the Sacramento Valley may be diluted many times before it
14 reaches irrigation return canals and the Sacramento River. Aquatic herbicides are applied to control
15 invasive aquatic plants in irrigation canals and in the Delta (CALFED Bay-Delta Program 2008b). A
16 recent assessment of heavily used aquatic herbicides suggests that there is limited short-term and
17 no long-term toxicity directly attributable to their use (Siemering et al. 2008). However, acute
18 toxicity to algae (*Selenastrum capricornutum*) has been found in numerous studies and attributed to
19 the widely used agricultural herbicide diuron (de Vlaming et al. 2005). Ecological effects of pesticide
20 contamination (e.g., fish toxicity) reflect the cumulative influence of pesticides currently in use,
21 those used historically, and the constantly changing new pesticides introduced for agricultural
22 practices (CALFED Bay-Delta Program 2008b).

23 The Department of Pesticide Regulation, an agency within the California Environmental Protection
24 Agency (Cal/EPA), is charged with administering California's statewide pesticide regulatory
25 program, the largest of its kind in the nation. It administers the CCR Title 6 (Food and Agriculture),
26 which restricts the use of pesticides near water bodies and establishes Pesticide Management Zones
27 and reporting requirements for pesticide use. The Department of Pesticide Regulation also conducts
28 pesticide-monitoring activities. It and other agencies responsible for water quality, such as the State
29 Water Board, promote use of Best Management Practices (BMPs) and other preventive measures to
30 reduce pesticide contamination of water bodies. For example, rice growers are required to hold
31 water on their fields following application of rice pesticides to allow pesticides to degrade, reducing
32 concentrations contained in rice field runoff that enters waterways adjacent to treated fields
33 (Newhart 2002).

34 The fate and effects of pesticide mixtures in the Delta and the implications of pesticide mixtures for
35 populations of native species are not well understood (Werner and Oram 2008). Monitoring data for
36 pyrethroids in water and sediment are scarce or do not exist, confounding attempts to estimate
37 loads of pyrethroids transported to the Delta from the Central Valley (Werner and Oram 2008; TDC
38 Environmental 2010). Implementation of TMDLs has reduced concentrations of some pesticides in
39 the Delta (e.g., chlorpyrifos, diazinon); incidences of toxicity attributable to organophosphate
40 pesticides have declined substantially compared to observations in the early 1990s (CALFED Bay-
41 Delta Program 2008b). Organophosphates have been shown to be present at elevated
42 concentrations in tributaries and the Delta, and pyrethroids at toxic concentrations have been
43 detected in water bodies draining agricultural areas in the Central Valley, as well as urban creeks in
44 the Delta region (Werner et al. 2008; Weston and Lydy 2010).

1 Existing Conditions in the Study Area

2 Limited data and studies are available for characterizing the existing conditions of pesticide
3 concentrations in the study area. These are summarized below.

4 Monitoring efforts at the north-of-Delta stations since 2001 have resulted in no pesticide detections,
5 while monitoring at the south-of-Delta stations resulted in various detections. The California
6 Aqueduct at Check 13 had detections of chlorpyrifos (3/15/05, 0.02 µg/L), diazinon (3/20/01, 0.01
7 µg/L), and metolachlor (6/14/05, 0.1 µg/L) and of diuron (eight detections between 3/15/00 and
8 9/15/09, ranging from 0.27 to 3.2 µg/L) and simazine (13 detections between 3/15/00 and
9 9/15/09, ranging from 0.02 to 0.14 µg/L). The California Aqueduct at Check 29 had detections of
10 chlorpyrifos (9/20/05, 0.01 µg/L) and dacthal (9/19/07, 0.12 µg/L) and numerous detections of
11 diazinon (four detections between 3/20/01 and 6/22/06, ranging from 0.01 to 0.03 µg/L), diuron
12 (seven detections between 3/14/00 and 9/15/09, ranging from 0.29 to 1.2 µg/L) and metolachlor
13 (detections on 6/15/04 and 6/21/05, 0.01 and 0.01 µg/L).

14 Monitoring for diazinon suggests that higher concentrations occur in Delta back sloughs and small
15 upland drainages, with lower concentrations occurring in Delta island drains, main rivers, and
16 tributaries (Table 8-23). Monitoring for chlorpyrifos suggests that higher concentrations occur in
17 Delta back sloughs, Delta island drains, and small upland drainages, with lower concentrations
18 occurring in main rivers and tributaries (Table 8-24).

19 **Table 8-23. Diazinon Concentrations, by Water Body Category**

Water Body Type	Number of Samples	Median Concentration (ng/L)	90th Percentile Concentration (ng/L)	Maximum Concentration (ng/L)	Samples >160 ng/L ^a
Delta Back Sloughs	352	13	300	1,400	56 (16%)
Delta Island Drains	57	0	17	82	0 (0%)
Delta Rivers and Main Delta Waterways	774	0	97	797	31 (4%)
Major Delta Tributaries	2,056	0	80	1,700	106 (5%)
Small Upland Drainages	146	16	150	2,790	13 (9%)

Note: ng/L = nanograms per liter.

^a Acute toxicity water quality objective for diazinon to protect invertebrates.

Source: Central Valley Water Board 2006.

20

21 **Table 8-24. Chlorpyrifos Concentrations, by Water Body Category**

Water Body Type	Number of Samples	Median Concentration (ng/L)	90th Percentile Concentration (ng/L)	Maximum Concentration (ng/L)	Samples >25 ng/L ^a
Delta Back Sloughs	373	0	68	677	62 (17%)
Delta Island Drains	57	5	46	360	11 (19%)
Delta Rivers and Main Delta Waterways	722	0	0	76	7 (1%)
Major Delta Tributaries	1,887	0	7	700	32 (2%)
Small Upland Drainages	148	0	87	180	35 (24%)

Note: ng/L = nanograms per liter.

^a Acute toxicity water quality objective for chlorpyrifos to protect invertebrates.

Source: Central Valley Water Board 2006.

Pesticide data available for the Banks and Barker Slough pumping plants include the Group A Pesticides (aldrin, dieldrin, chlordane, endrin, heptachlor, heptachlor epoxide, lindane, endosulfan, and toxaphene), DDT products (p,p'-DDD, p,p'-DDE, and p,p'-DDT), atrazine, chlorpyrifos, diazinon, glyphosate, malathion, molinate, methyl parathion, permethrin, simazine, and thiobencarb. The monitoring program sampled for these analytes approximately 16 times during the water years 2001–2006 for each location. Detections were limited to those presented in Table 8-25. These detections generally occurred during the wet season during wet years. The exception is for molinate, which was detected during the early summer of a dry year (2004).

Table 8-25. Pesticide Concentrations at the Banks and Barker Slough Pumping Plants, Water Years 2001–2006

Pesticide	Harvey O. Banks	Barker Slough
Chlorpyrifos	0.03 µg/L (3/16/05)	—
Diazinon	0.01 µg/L (3/21/01)	0.01 µg/L (3/21/01)
Molinate	0.04 µg/L (6/16/04)	0.04 µg/L (6/15/04)
	0.12 µg/L (3/21/01)	0.02 µg/L (3/21/01)
Simazine	0.02 µg/L (3/20/02)	0.24 µg/L (3/16/05)
	0.11 µg/L (3/16/05)	0.02 µg/L (6/15/05)
	0.05 µg/L (3/15/06)	0.46 µg/L (3/15/06)

Notes: Data represent water quality samples having values at or greater than the reporting limit.

µg/L = micrograms per liter.

Source: Bay Delta and Tributaries Project 2009.

SFEI data for the Sacramento River above Point Sacramento and the San Joaquin River at Antioch, which has very low detection limits, have enabled the detection of many pesticides (Table 8-26). The samples were taken annually between late July and late August, which does not allow examination of wet versus dry season effects. The results suggest that many of the legacy pesticides are still present in the Sacramento River and San Joaquin River outflows during summer conditions, albeit at low concentrations. Chlorpyrifos, diazinon, and DDT median concentrations were higher than the other pesticides; median concentrations for nearly all pesticides were higher in the Sacramento River than in the San Joaquin River.

The Central Valley Water Board and San Francisco Bay Water Board Basin Plans contain narrative objectives for pesticides and toxicity. There are several pesticides with water quality criteria listed under the CTR, the Central Valley Water Board Basin Plan, the San Francisco Bay Water Board Basin Plan, and the California drinking water MCLs (Appendix 8A).

1 **Table 8-26. Pesticide Concentrations at the Mouths of the Sacramento and San Joaquin Rivers, Water Years 2001–2006**

Pesticide	Fraction	Sacramento River above Point Sacramento (pg/L)					San Joaquin River at Antioch Ship Channel (pg/L)				
		Samples	Min.	Max.	Mean	Median	Samples	Min.	Max.	Mean	Median
Aldrin	Dissolved	4	1	3	2	2	2	<1	2	1	1
Aldrin	Total	1	4	4	4	4	1	3	3	3	3
Chlorpyrifos	Dissolved	4	300	1,070	719	753	4	76	789	486	541
Chlorpyrifos	Total	4	332	1,070	727	753	4	90	789	490	541
Diazinon	Dissolved	3	511	765	599	520	4	229	1079	515	375
Diazinon	Total	3	511	765	599	520	4	229	1079	605	557
Dieldrin	Dissolved	7	56	110	85	82	5	49	81	68	73
Dieldrin	Total	7	60	117	89	84	6	52	87	74	77
Endosulfan I	Dissolved	5	11	57	32	31	2	13	13	13	13
Endosulfan I	Total	2	31	43	37	37	3	13	35	20	13
Endosulfan II	Dissolved	1	34	34	34	34	1	3	3	3	3
Endosulfan II	Total	0					1	3	3	3	3
Endrin	Dissolved	4	2	2	2	2	3	2	2	2	2
Endrin	Total	2	2	2	2	2	2	2	2	2	2
Heptachlor	Dissolved	4	<1	2	1	1	1	1	1	1	1
Heptachlor	Total	2	2	3	2	2	1	1	1	1	1
Heptachlor Epoxide	Dissolved	7	2	24	7	4	5	4	15	6	4
Heptachlor Epoxide	Total	6	2	24	7	4	4	3	15	6	4
Sum of Chlordanes	Dissolved	6	25	106	48	40	5	20	55	37	30
Sum of Chlordanes	Total	5	20	143	66	51	4	27	68	46	45
Sum of DDTs	Dissolved	7	153	227	188	194	5	93	144	124	131
Sum of DDTs	Total	7	266	546	368	366	6	175	257	214	210

Notes: Sample size represents water quality samples having values at or greater than the reporting limit. Values for “dissolved” may exceed “total” because of rejected laboratory samples.

DDT = dichlorodiphenyltrichloroethane; Max. = maximum; Min. = minimum.

Source: San Francisco Estuary Institute 2010.

2

1 Regions on the CWA Section 303(d) list for pesticides include the Central Valley Region (chlordane,
 2 chlorpyrifos, DDT, diazinon, dieldrin, and Group A pesticides) and the San Francisco Bay Region
 3 (chlordane, DDT, dieldrin). The Section 303(d) list of impaired water bodies identifies the entire
 4 Delta as impaired by one or more legacy pesticides (State Water Resources Control Board 2011).
 5 Chlorpyrifos and diazinon TMDL studies have been completed for Sacramento County urban creeks,
 6 the Feather River, the Sacramento River, the San Joaquin River, and the Delta; ongoing TMDL studies
 7 are occurring for organochlorine and other pesticides. There are many water bodies served by SWP
 8 South-of-Delta exports listed for pesticide impairment (State Water Resources Control Board 2011)
 9 including those listed by the Central Coast Water Board, the Los Angeles Water Board, the Santa Ana
 10 Water Board, and the San Diego Water Board.

11 A target list of pesticides has been developed by the Central Valley Water Board (2009d) to assess
 12 risk in the study area. The list was based on work by Urban Pollution Prevention Projects for the San
 13 Francisco Estuary Project (TDC Environmental 2008). Eight of the 38 pesticides considered highly
 14 toxic to aquatic organisms are pyrethroids, and the process has begun to establish water quality
 15 criteria for bifenthrin, lambda-cyhalothrin, and cyfluthrin (Central Valley Water Board 2010c).

16 **8.2.3.14 Polycyclic Aromatic Hydrocarbons**

17 **Background**

18 PAHs are toxic compounds formed primarily as products of incomplete combustion (burning) of
 19 substances such as gasoline, coal, oil, wood, garbage, grilled meat, and tobacco (Agency for Toxic
 20 Substances and Disease Registry 1995). Some PAHs are manufactured for specific uses such as
 21 asphalt, creosote, roofing tar, medicines, dyes, pesticides, and plastics. Mahler et al. (2005) suggest
 22 that parking lot sealcoat can be a major source of PAHs to urban water bodies. PAHs in the
 23 environment tend to be found together as complex mixtures rather than single compounds (Oros et
 24 al. 2007).

25 PAHs can lead to red blood cell damage, leading to anemia, suppressed immune system,
 26 developmental and reproductive effects, and possibly cancer over a lifetime of exposure (U.S.
 27 Environmental Protection Agency 2009e). Wildlife effects (e.g., mammals, birds, invertebrates,
 28 plants, amphibians, fish) also have been observed (Eisler 1987). The typical means of exposure to
 29 PAHs occurs through inhalation. Other exposure pathways are skin contact of PAH-containing
 30 products and ingestion of foods and liquids containing PAH compounds. Consequently, the beneficial
 31 uses most directly affected by PAHs are aquatic organisms (cold freshwater habitat, warm
 32 freshwater habitat, and estuarine habitat); rare, threatened and endangered species, if the
 33 community population level were to be reduced by exposure through the aquatic environment;
 34 harvesting activities that depend on aquatic life (shellfish harvesting and commercial and sport
 35 fishing); and drinking water supplies (municipal and domestic supply) (Table 8-1).

36 PAHs enter the environment mostly as releases to air from volcanoes, forest fires, residential wood-
 37 burning, and exhaust from automobiles and trucks (Agency for Toxic Substances and Disease
 38 Registry 1995). They also can enter surface water through discharges from industrial plants and
 39 WTPs and can be released to soils at hazardous waste sites if they escape from storage containers.

40 PAHs are present in air as vapors or adhere to the surfaces of small solid particles. They can travel
 41 long distances before they return to earth through rainfall or particle-settling. Some PAHs evaporate
 42 into the atmosphere from surface waters, but most stick to solid particles and settle to the bottoms

1 of rivers or lakes. The solubility of PAHs in water is often very low. PAHs stay adsorbed to soil
2 particles, although some tend to evaporate or contaminate groundwater.

3 PAHs can break down to longer-lasting products by reacting with sunlight and other chemicals in
4 the air, generally over a period of days to weeks. Breakdown in soil and water generally takes weeks
5 to months and is caused primarily by the actions of microorganisms.

6 Benzo[a]pyrene is an example of an environmental PAH that can behave as described above (U.S.
7 Environmental Protection Agency 2009e). Benzo[a]pyrene is expected to bioconcentrate in aquatic
8 organisms that cannot metabolize it. Reported bioconcentration factors include: oysters 3,000;
9 rainbow trout 920; bluegills 2,657; and zooplankton 1,000 to 13,000. The presence of humic acid in
10 solution has been shown to decrease bioconcentration. Organisms that lack a metabolic
11 detoxification enzyme system tend to accumulate these compounds. For example, bioconcentration
12 factors have been found to be very low (<1) for mudsuckers, sculpins, and sand dabs.

13 There are two major sources of PAHs in drinking water: contamination of raw water (untreated)
14 supplies from natural and human-made sources, and leachate from coal tar and asphalt linings in
15 water storage tanks and distribution lines. PAHs in raw water will tend to adsorb to any particulate
16 matter and be removed by filtration before reaching the drinking water supply. Background levels of
17 PAHs in drinking water range from 4 to 24 ng/L (U.S. Environmental Protection Agency 2009e).

18 The MCL for benzo[a]pyrene is 0.0002 mg/L. Potential health effects from exposure above the MCL
19 include reproductive difficulties and increased risk of cancer. The public health MCL goal (MCLG) is
20 a concentration of zero (U.S. Environmental Protection Agency 2009e).

21 **Importance in the Study Area**

22 Assessment of how human atmospheric emission sources of PAHs in the study area directly affect
23 the area would be difficult, given the complexity of area meteorology. Such sources would need to be
24 identified and undergo air transport modeling to determine deposition rates onto land and water in
25 the study area. Human activities related to PAH land and water emissions may be more easily
26 quantified. Land applications of PAHs in the study area may include unintended releases from
27 hazardous waste containers, while water sources may include industrial wastewaters, municipal
28 sewage, and stormwater runoff.

29 The Regional Monitoring Program for Water Quality in the San Francisco Estuary has monitored
30 PAHs and other pollutants in San Francisco Bay water, sediments, and bivalves since 1993 at several
31 locations, including the mouths of the Sacramento and San Joaquin Rivers near Antioch.

32 In an analysis of 1993–2001 data, Ross and Oros (2004) found the distribution of median total PAH
33 concentration by estuary segment was as follows.

- 34 ● Extreme South Bay (120 ng/L).
- 35 ● South Bay (49 ng/L).
- 36 ● North Estuary (29 ng/L).
- 37 ● Central Bay (12 ng/L).
- 38 ● Delta (7 ng/L).

39 These results suggest that the Delta is not a major contributor of PAHs to San Francisco Bay. Using
40 PAH isomer pair ratio analysis, Ross and Oros (2004) showed that PAHs in estuary waters were

1 derived primarily from combustion of fossil fuels/petroleum (possible PAH source contributors
2 include coal, gasoline, kerosene, diesel, No. 2 fuel oil, and crude oil) and biomass (possible
3 contributors include wood and grasses), with lesser amounts of PAH contributed from direct
4 petroleum input.

5 A modeling exercise of PAHs in San Francisco Bay ranked PAH loading pathways as stormwater
6 runoff (51%), tributary inflow (28%), WTP effluent (10%), atmospheric deposition (8%), and
7 dredged material disposal (2%) (Greenfield and Davis 2005; Oros et al. 2007). A study of PAH inputs
8 and sources along an urban tributary to the Sacramento River took place in 2004 and 2005 (Kim and
9 Young 2009).

10 Surface water concentrations varied from 192 to 3,784 ng/L for total PAHs and 18 to 48 ng/L for
11 dissolved PAHs. Precipitation concentrations varied from 77 to 236 ng/L for total PAHs and 15 to
12 66 ng/L for dissolved PAHs. The authors suggest that indirect deposition (i.e., washoff of
13 atmospheric particles previously deposited to land) of PAHs into surface water is a more likely
14 substantial input pathway for total PAHs than direct dry or wet deposition during the wet season.
15 They also assert that particulate matter carried by stormwater runoff was the major source of PAHs
16 in surface water in the early rainy season.

17 Existing Conditions in the Study Area

18 Recent monitoring efforts to assess PAHs are very limited with respect to locations selected. For
19 example, naphthalene had been sampled at three pumping plants (Banks, Barker Slough, CCWD #1)
20 and the San Joaquin River at Vernalis since the late 1990s with no laboratory detections.

21 The Sacramento River above Point Sacramento and the San Joaquin River at Antioch Ship Channel
22 were sampled for 24 different PAH compounds on an annual basis by SFEI as part of its monitoring
23 program (denoted as stations BG20 and BG30, respectively). The SFEI laboratory reporting limits
24 are on the order of pg/L, which are orders of magnitude more sensitive than the laboratory
25 reporting limits for the Banks and Barker Slough pumping plants. These very low detection limits
26 have enabled the detection of many PAHs examined in the current study, which are presented as the
27 sum of all PAHs in Table 8-27.

28 **Table 8-27. Sum of All Polycyclic Aromatic Hydrocarbons at the Mouths of the Sacramento and**
29 **San Joaquin Rivers, Water Years 2001–2006**

Sum of all PAHs	Samples	Minimum (pg/L)	Maximum (pg/L)	Mean (pg/L)	Median (pg/L)
Sacramento River above Point Sacramento					
Dissolved	7	2,240	17,444	8,962	9,359
Total	6	9,090	29,205	16,510	15,415
San Joaquin River at Antioch Ship Channel					
Dissolved	5	1,380	16,637	9,881	9,331
Total	6	6,472	21,972	14,117	15,017

Notes: All concentrations in picograms per liter (pg/L). Sample size represents water quality samples having values at or greater than the reporting limit.

PAH = polycyclic aromatic hydrocarbon.

Source: San Francisco Estuary Institute 2010.

30

1 The samples were taken between late July and late August, which does not allow examination of wet
2 versus dry season effects. The results indicate that PAHs are present in the Sacramento and San
3 Joaquin River outflows during summer conditions, albeit at low concentrations. Values for PAHs
4 were comparable between the two locations. No detections were reported in the data examined for
5 the north- and south-of-Delta sampling locations.

6 Regulatory criteria with respect to PAHs are as follows. There are no listings for PAHs on the
7 Section 303(d) list in the Delta. With regard to Basin Plan narrative objectives, PAHs might be
8 considered toxic at high concentrations. There are no numerical water quality objectives for the
9 Central Valley Water Board or San Francisco Bay Water Board Basin Plans. The CTR criteria for
10 benzo[a]pyrene is 0.0044 µg/L (Human Health: Water and Organisms) and 0.049 µg/L (Human
11 Health: Organisms Only). The California drinking water standard MCL for benzo[a]pyrene is 0.0002
12 mg/L. Data are inadequate to assess whether the sites examined in this study exceeded the CTR or
13 drinking water standard MCL.

14 **8.2.3.15 Selenium**

15 **Background**

16 Selenium is a constituent of concern in the Delta, the lower San Joaquin River, and San Francisco Bay
17 for potential effects on water quality, aquatic and terrestrial resources, and (indirectly) human
18 health. Because of the known effects of selenium bioaccumulation from aquatic organisms to higher
19 trophic levels in the foodchain, the wildlife habitat and rare, threatened, or endangered species
20 beneficial uses are the most sensitive receptors to selenium exposure. Examples of those effects
21 include reduced hatchability of fertile eggs and the development of severe, often lethal, embryo
22 deformities in fish and birds (Department of the Interior 1998; Ohlendorf 2003). Selenium also
23 affects other aquatic life beneficial uses, including warm freshwater habitat; cold freshwater habitat;
24 migration of aquatic organisms; spawning, reproduction, and/or early development; and estuarine
25 habitat. Additional nonhabitat beneficial uses that may be affected include freshwater
26 replenishment, municipal and domestic supply, and agricultural supply.

27 The State Water Board lists the western Delta as having impaired water quality for selenium (under
28 Section 303[d]) (State Water Resources Control Board 2011). The Central Valley Water Board
29 completed a TMDL for selenium in the lower San Joaquin River (downstream of the Merced River) in
30 2001 and Salt Slough in 1997/1999, and USEPA approved this in 2002 (Central Valley Water Board
31 2001, 2009c).

32 The Central Valley Water Board adopted amendments to the Basin Plan for the Sacramento River
33 and San Joaquin River basins to address selenium control in the San Joaquin River basin in
34 May 2010 (Central Valley Water Board 2010d), and the State Water Board approved the
35 amendments in October (State Water Resources Control Board 2010b, 2010c). The intent is to
36 modify the compliance time schedule for discharges regulated under waste discharge requirements
37 to meet the selenium objective or comply with a prohibition of discharge of agricultural subsurface
38 drainage to Mud Slough (north), a tributary to the San Joaquin River, in Merced County. The
39 proposed amendments and supporting staff report include environmental documentation required
40 under California Public Resources Code 21080.5 and 23 CCR 3775–3782. The environmental
41 documentation is informed by the environmental analysis conducted by Reclamation and the San
42 Luis and Delta Mendota Water Authority, dated December 21, 2009 (Bureau of Reclamation 2009c),
43 which was prepared in compliance with the same legal provisions with regard to the use of the

1 federally owned San Luis Drain. The environmental analysis concluded that, with the agreed-upon
2 mitigation measures, the amendments would have no significant effects on the environment. The
3 proposed Basin Plan amendments are administrative in nature and will not alter any water quality
4 objective, program goal, policy, or other scientific underpinning of the selenium control program for
5 the San Joaquin River.

6 The San Francisco Bay Water Board is conducting a new TMDL project to address selenium toxicity
7 in the North San Francisco Bay (North Bay), defined to include a portion of the Delta, Suisun Bay,
8 Carquinez Strait, San Pablo Bay, and the Central Bay (State Water Resources Control Board
9 2011). The North Bay selenium TMDL will identify and characterize selenium sources to the North
10 Bay and the processes that control the uptake of selenium by wildlife. The TMDL will quantify
11 selenium loads, develop and assign waste load and load allocations among sources, and include an
12 implementation plan designed to achieve the TMDL and protect beneficial uses.

13 **Importance in the Study Area**

14 Selenium is an essential trace element for human and other animal nutrition that occurs naturally in
15 the environment. In the Delta watershed, selenium is most enriched in marine sedimentary rocks of
16 the Coast Ranges on the western side of the San Joaquin Valley (Presser and Piper 1998). Because of
17 erosion of the selenium-enriched sedimentary rock and irrigation practices used in the Central
18 Valley, selenium concentrations in this watershed are high. It is also highly bioaccumulative and is of
19 greatest concern because it can cause chronic toxicity (especially impaired reproduction) in fish and
20 aquatic birds (Ohlendorf 2003; State Water Resources Control Board 2011). Bioaccumulation of
21 selenium in diving ducks has led to health advisories for local hunters. Monitoring of selenium in
22 ducks, fish, and invertebrates in the northern part of San Francisco Bay has revealed concentrations
23 that could cause health risks to people and wildlife. Although the entire Bay is listed as impaired by
24 selenium, separate TMDLs for selenium will be developed for the North Bay and South Bay, as the
25 primary selenium loading to the North Bay and the Suisun Bay area is from the Delta and the south
26 Bay is affected by local and watershed sources not associated with the Delta (Lucas and Stewart
27 2007).

28 Selenium concentrations in whole-body fish or fish eggs are most useful for evaluating risks to fish,
29 and concentrations in bird eggs are most useful for evaluating risks to birds (Skorupa and Ohlendorf
30 1991; Department of the Interior 1998; Ohlendorf 2003). Analyses of dietary items (such as benthic
31 [sediment-associated] or water-column invertebrates) also can be used for evaluating risks through
32 dietary exposure, although with less certainty than when using concentrations measured in fish or
33 birds. When data are not available for the target receptors (fish and birds) or for their diets,
34 concentrations can be estimated from selenium in water and suspended particulates. However, such
35 modeling further increases the uncertainties in predictions of risk.

36 For evaluation of risks to human health, analyses of fish fillets are most common, although the fish
37 should be analyzed in the form that people may eat (for example, for some species or ethnic groups,
38 whole-body analyses may be appropriate) (California Office of Environmental Health Hazard
39 Assessment 2008; see also Chapter 25, *Public Health*).

1 Existing Conditions in the Study Area

2 Water Concentrations

3 Selenium has been monitored most consistently at the mouth of the San Joaquin River at Vernalis
4 (Table 8-28) mainly because agricultural drainage in the San Joaquin Valley is the primary source of
5 selenium to the Delta (Cutter and Cutter 2004; Presser and Luoma 2006; Bureau of Reclamation
6 2006; Entrix 2008; Tetra Tech 2008).

7 Selenium also has been monitored frequently at selected locations north and south of the Delta and
8 occasionally at a few locations in the Delta. In addition, a CALFED study (Lucas and Stewart 2007)
9 provided results of several cruises in the study area during 2003–2004, focused primarily on the
10 waterways between Stockton, Rio Vista, and Benicia (Table 8-29 and Figure 8-44).

11 Total selenium concentrations measured on a weekly basis by the Central Valley Water Board's
12 Surface Water Ambient Monitoring Program at Vernalis (Airport Way monitoring station) show the
13 variation in concentrations by season and year (Figure 8-45).

14 Before implementation of the Grassland Bypass Project in September 1996, selenium concentrations
15 at Vernalis were commonly twice as high as those shown in Figure 8-45. Implementation of the
16 Grassland Bypass Project has led to a 60% decrease in selenium loads from the Grassland Drainage
17 Area in comparison to preproject conditions (Tetra Tech 2008). Cutter and Cutter (2004) reported a
18 decreased mean concentration of 0.68 µg/L at Vernalis from 1997 to 2000 in comparison to values
19 shown in Table 8-28 and data from a previous study from 1984 to 1988 (1.25 µg/L). It is likely that
20 the selenium concentration at Vernalis will continue to decrease with continued operation of the
21 Grassland Bypass Project and achievement of Basin Plan objectives in the amendment described
22 above (Central Valley Water Board 2010b; State Water Resources Control Board 2010b, 2010c).

23 Much less sampling has been conducted for selenium analysis in the Sacramento River. The most
24 recent available data for locations in or near the Delta are from Freeport (Table 8-28). A mean
25 concentration of 0.072 µg/L was reported for Freeport in 1984 to 1988 and 1997 to 2000 (years
26 combined, with no apparent difference between the two periods) (Cutter and Cutter 2004), but the
27 detailed data (e.g., min-max values and sample numbers) are not available for comparison to the
28 USGS data shown in the table. Because of the limited data from Freeport, additional values are
29 provided from the Sacramento River at Verona and Knights Landing (upstream from Sacramento
30 but reflecting quality of water that may enter the Yolo Bypass during flooding). The maximum
31 selenium concentration at those locations was 1.0 µg/L, and the mean concentrations were all less
32 than 0.5 µg/L. Only limited selenium data are available for other major tributaries to the eastern
33 Delta.

1 **Table 8-28. Selenium Concentrations in Surface Water in the Study Area**

Site	No. of Samples	Selenium Concentration (µg/L)			Years	Source
		Min.	Max.	Mean		
Selenium Concentrations North of the Delta						
Sacramento River at Keswick	86	0.061	0.40	0.21	2003–2008	DWR 2010
Sacramento River at Keswick ^a	80	0.090	0.40	0.19	2004–2008	DWR 2010
Feather River at Oroville	31	0.033	0.37	0.19	2003–2008	DWR 2010
Feather River at Oroville ^a	30	0.052	0.28	0.16	2003–2008	DWR 2010
Selenium Concentrations for Inflows to the Delta						
Sacramento River at Verona	24	0.061	0.39	0.21	2003–2009	DWR 2010
Sacramento River at Verona ^a	21	0.15	0.29	0.20	2004–2009	DWR 2010
Sacramento River at Knights Landing	13	0.19	1.0	0.45	2003, 2004, 2007, 2008	DWR 2009
Sacramento River at Freeport ^a	62	0.044	1.0	0.32	1996–2001, 2007–2010	USGS 2010
San Joaquin River at Vernalis (Airport Way) ^c	105 ^d	0.20	2.3	0.83	1999–2007	Bureau of Reclamation 2009d
San Joaquin River at Vernalis (Airport Way)	201	0.40	2.8	0.98	1999–2002	BDAT 2009
San Joaquin River at Vernalis (Airport Way) ^c	453	0.40	2.8	0.84	1999–2007	SWAMP 2009
Selenium Concentrations within/near the Delta						
North: Cache Slough near Ryer Island Ferry	7	0.05	0.24	0.12	1999–2000	BDAT 2009
South: Old River at Tracy Boulevard	1	0.61	0.61	0.61	2002	BDAT 2009
South: Old/Middle River	6	1.0	1.0	1.0	1999	DWR 2009
South: Old/Middle River ^a	6	1.0	2.0	1.6	1999	DWR 2009
Central-West: Sacramento River near Mallard Island (BG20)	11	0.06	0.45	0.11	2000–2008	SFEI 2010
Central-West: Sacramento River near Mallard Island (BG20) ^a	12	0.03	0.44	0.09	2000–2008	SFEI 2010
Central-West: San Joaquin River near Mallard Island (BG30)	11	0.03	0.40	0.11	2000–2008	SFEI 2010
Central-West: San Joaquin River near Mallard Island (BG30) ^a	11	0.03	0.45	0.09	2000–2008	SFEI 2010
Suisun Bay	38	0.02	0.21	0.12	2000–2008	SFEI 2010
Suisun Bay ^a	38	0.02	0.44	0.10	2000–2008	SFEI 2010
Selenium Concentrations for the Delta's Major Outputs						
Banks Pumping Plant ^a	71	1.0	2.0	1.0	2001–2007	MWQI 2003, 2005, 2006, 2008

Notes: Data include detected concentrations and reporting limits for undetected concentrations. Means are geometric means.

Max. = maximum; µg/L = micrograms per liter; Min. = minimum

^a Dissolved selenium concentration.

^b Includes data collected from Colusa Basin Drain near Knights Landing and Sacramento River below Knights Landing.

^c Not specified whether total or dissolved selenium.

^d Represents the number of months with an average concentration of selenium, not total samples collected.

Sources: Bay Delta and Tributaries Project (BDAT) 2009; Department of Water Resources 2009b; Municipal Water Quality Investigations (MWQI) 2003a, 2005, 2006, 2008; Bureau of Reclamation 2009d; San Francisco Estuary Institute 2010; Surface Water Ambient Monitoring Program (SWAMP) 2009; U.S. Geological Survey 2010.

1 **Table 8-29. Selenium Concentrations in Surface Water Reported by CALFED Bay-Delta Program**

Site	Number of Samples	Dissolved Selenium (µg/L)			Particulate Selenium (µg/L)			Total Selenium (µg/L)		
		Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean
San Joaquin River at Stockton	5 ^a	0.52	1.01	0.73	0.005	0.04	0.02	0.55	1.03	0.76
Calaveras River	2 ^a	0.55	0.72	0.63	0.005	0.03	0.01	0.56	0.75	0.65
Fourteen Mile Slough	6 ^a	0.35	0.94	0.59	0.01	0.03	0.01	0.36	0.95	0.61
McDonald-Empire	5 ^a	0.09	0.91	0.17	0.005	0.03	0.01	0.10	0.94	0.18
Mildred Island South	1 ^a	0.12	0.12	0.12	0.02	0.02	0.02	0.14	0.14	0.14
Mildred Island Center	1 ^a	0.11	0.11	0.11	0.01	0.01	0.01	0.13	0.13	0.13
Mildred Island North	1 ^a	0.09	0.09	0.09	0.01	0.01	0.01	0.10	0.10	0.10
Venice	1 ^a	0.12	0.12	0.12	0.01	0.01	0.01	0.12	0.12	0.12
Franks Tract South	1	0.10	0.10	0.10	0.00	0.00	0.00	0.10	0.10	0.10
Franks Tract East	1	0.10	0.10	0.10	0.002	0.002	0.002	0.10	0.10	0.10
Franks Tract West	1 ^a	0.12	0.12	0.12	0.01	0.01	0.01	0.14	0.14	0.14
Mokelumne River	6 ^a	0.09	0.22	0.13	0.01	0.01	0.01	0.10	0.23	0.14
Three Mile Slough	6 ^a	0.09	0.13	0.11	0.01	0.02	0.01	0.10	0.15	0.13
Sacramento River at Rio Vista	4	0.10	0.14	0.12	0.01	0.01	0.01	0.11	0.15	0.13
Antioch	5	0.08	0.17	0.12	0.01	0.03	0.02	0.10	0.19	0.14
Pittsburg East	2	0.07	0.15	0.10	0.01	0.01	0.01	0.08	0.16	0.11
Pittsburg West	2	0.11	0.12	0.11	0.02	0.03	0.02	0.13	0.14	0.14
Suisun East	2	0.10	0.14	0.12	0.01	0.01	0.01	0.11	0.15	0.13
Suisun Center	2	0.12	0.14	0.13	0.02	0.02	0.02	0.14	0.15	0.15
Suisun West	3	0.13	0.19	0.15	0.01	0.05	0.02	0.15	0.23	0.17
Grizzly Bay East	1	0.12	0.12	0.12	0.02	0.02	0.02	0.14	0.14	0.14
Grizzly Bay Center	3	0.10	0.17	0.13	0.010	0.017	0.013	0.11	0.18	0.14
Grizzly Bay West	1	0.16	0.16	0.16	0.011	0.011	0.011	0.17	0.17	0.17
Benicia	4	0.11	0.16	0.14	0.01	0.02	0.02	0.13	0.18	0.16

Notes: Data collected within 1 mile of sample stations were compiled in the same data location. Means are geometric means.

Max. = maximum, µg/L = micrograms per liter, Min. = minimum.

^a One sample each station was collected during July 2000; all other data are from January 2003 to January 2004.

Source: Lucas and Stewart 2007.

1 Sporadic sampling has been conducted at a few locations in the Delta (Tables 8-26 and 8-27). The
2 only two locations at which sampling was conducted over several recent years are in the
3 Sacramento and San Joaquin Rivers just upstream of Mallard Island (near the western limit of the
4 Delta). Observed total selenium concentrations at these stations are considered more representative
5 of generalized Delta concentrations than of the individual rivers (Tetra Tech 2008). Total and dissolved
6 selenium concentrations were somewhat lower at those locations during low flow in a dry year
7 (<0.1 µg/L in August 2001) than during high flow (>0.1 µg/L in February 2001) (Tetra Tech 2008).
8 Cutter and Cutter (2004) reported similar flow-related patterns for those locations. The maximum
9 selenium concentration found in the Delta was 2 µg/L at an Old/Middle River location in the south
10 subarea of the Delta. Except for that location, the available data show mean concentrations well
11 below 1 µg/L.

12 As noted in Table 8-28, inflow originating from the San Joaquin River has selenium concentrations
13 several times higher than those from the Sacramento River, but flows in the San Joaquin River at
14 Vernalis are usually only about 10–15% of the inflow from the Sacramento River at Freeport (Tetra
15 Tech 2008). Therefore, on an annual basis, selenium loads from both rivers to the Delta are large,
16 but selenium processes in the Delta are not well characterized. Besides the processes of settling and
17 mixing, a large portion of the water in the Delta is exported for agricultural and urban uses in other
18 parts of California. The relative contribution of the Sacramento and San Joaquin Rivers to the overall
19 outflow from the Delta to the North Bay changes with tidal cycles and season, as well as operations
20 of SWP/CVP reservoir release and related Delta water supply operations. The contribution from the
21 San Joaquin River potentially can increase during the drier months of September through
22 November (Presser and Luoma 2006; Tetra Tech 2008).

23 Regulatory criteria with respect to selenium are as follows. A TMDL for selenium in the San Joaquin
24 River was completed by the Central Valley Water Board and approved by USEPA in March 2002. The
25 TMDL is implemented through: (1) prohibitions of discharge of agricultural subsurface drainage
26 water adopted in a Basin Plan Amendment for the Control of Subsurface Drainage Discharges (State
27 Water Resources Control Board Resolution 96-078), with an effective date of January, 10 1997; and
28 (2) load allocations in waste discharge requirements (Central Valley Water Board 2009c). As
29 mentioned above, the Central Valley Water Board adopted a Basin Plan amendment in May 2010 to
30 modify the compliance time schedule for regulated discharges to Mud Slough (north), which is a
31 tributary to the San Joaquin River.

32 The water quality objective for the lower San Joaquin River at Vernalis is 5 µg/L as a 4-day average
33 for above normal and wet water-year types, and 5 µg/L as a monthly mean for dry and below
34 normal water-year types (Central Valley Water Board 2001, 2007). Selenium criteria were
35 promulgated for all San Francisco Bay and Delta waters in the NTR (San Francisco Bay Water Board
36 2007). The NTR criteria specifically apply to San Francisco Bay upstream to and including Suisun
37 Bay and the Delta. The NTR values are 5.0 µg/L (4-day average) and 20 µg/L (1-hour average). By
38 comparison, the available data show that the maximum concentration at Vernalis has not exceeded
39 3 µg/L since implementation of the Grassland Bypass Project, and the mean is less than 1 µg/L for
40 the period from 1999 through 2007. The CTR criteria for aquatic life protection in saltwater are
41 substantially higher than the freshwater criteria (i.e., chronic = 71 µg/L; acute = 290 µg/L).

42 Selenium concentrations in water exported from the Delta via Banks pumping plant ranged from 1
43 to 2 µg/L, with a mean of 1.02 µg/L for 2003–2007. Drinking water standards for selenium are
44 average concentrations of 50 µg/L, both as the MCL—the enforceable standard that defines the

1 highest concentration of a contaminant allowed in drinking water—and the MCLG—a
 2 nonenforceable health goal set at a level at which no known or anticipated adverse effect on human
 3 health would result, while allowing an adequate margin of safety (U.S. Environmental Protection
 4 Agency 2009f). On April 2, 2010, the California Office of Environmental Health Hazard Assessment
 5 (OEHHA) proposed establishing a public health goal of 30 µg/L in drinking water, based on data
 6 from adverse effects of selenium in a human population, with a 45-day comment period (California
 7 Office of Environmental Health Hazard Assessment 2010). Public health goals are developed for use
 8 by DPH in establishing primary drinking water standards (state MCLs). All concentrations that have
 9 been measured in the Delta, or in tributary streams immediately upgradient of the Delta, as well as
 10 those at Banks pumping plant and in the California Aqueduct, are less than 10% of the MCL and the
 11 MCLG (Table 8-28 and Table 8-29).

12 Sediment and Fish Tissue Concentrations

13 Very little information is available for selenium concentrations in sediment or biota from in the
 14 Delta (Table 8-30, Table 8-31, and Table 8-32) that would be useful for evaluating risks for fish,
 15 wildlife, or the people consuming them. Selenium concentrations in sediment usually are not closely
 16 related to effects on fish or wildlife resources, although screening-level values such as those
 17 provided by the U.S. Department of the Interior (DOI) are sometimes used for comparison to
 18 background or potential effect levels (U.S. Department of the Interior 1998). Background selenium
 19 concentrations in freshwater environments are typically <1 mg/kg dry weight. Consequently, the
 20 concentrations reported for the Sacramento and San Joaquin Rivers near Mallard Island and in
 21 Suisun Bay (Table 8-31) are consistent with background levels. They are well below the
 22 concentrations associated with effects on fish and bird populations (2.5 mg/kg). Selenium analyses
 23 of clams from the Mallard Island locations are consistent with other bivalves in the Bay-Delta
 24 (Linville et al. 2002; Stewart et al. 2004). Whole-body fish from the San Joaquin River near Manteca
 25 had selenium concentrations within the range of background (<1–4 mg/kg, typically <2 mg/kg),
 26 although the mean was slightly higher than typical background (Table 8-32). Selenium
 27 concentrations in delta smelt from Chipps Island also were consistent with background.

28 **Table 8-30. Selenium Concentrations in Delta and Suisun Bay Sediment**

Site	Number of Samples	Selenium Concentration (mg/kg)			Year Collected	Source
		Min.	Max.	Mean		
Central-West: Sacramento River near Mallard Island (BG20)	9	0.031	0.24	0.083	2000–2008	SFEI 2010
Central-West: San Joaquin River near Mallard Island (BG30)	9	0.087	0.34	0.21	2000–2008	SFEI 2010
Suisun Bay	69	0.016	0.58	0.17	2000–2008	SFEI 2010

Notes: Data include detected concentrations and reporting limits for nondetected concentrations. Means are geometric means.

Max. = maximum, mg/kg = milligrams per kilogram, dry weight concentration, Min. = minimum.

Source: San Francisco Estuary Institute (SFEI) 2010.

29

1 **Table 8-31. Selenium Concentrations in Biota in or near the Delta**

Site	Number of Samples	Selenium Concentration (mg/kg)			Common Name	Year Collected	Source
		Min.	Max.	Mean			
Central-West: Sacramento River near Mallard Island (BG20)	5	4.0	19	8.1	Clam	1999–2001, 2008	SFEI 2010
Central-West: San Joaquin River near Mallard Island (BG30)	5	4.1	26	9.1	Clam	1999–2001, 2008	SFEI 2010
Chippis Island ^a	41	0.70	2.3	1.5	Delta Smelt	1993, 1994	Bennett et al. 2001
San Joaquin River, Dos Reis State Park and Mossdale Sites ^b	13	1.6	3.4	2.6	Silversides	May–July 1995	Bennett et al. 2001

Notes: Means are geometric means.

Max. = maximum, mg/kg = milligrams per kilogram, dry weight concentration, Min. = minimum.

^a Most of the fish were collected at Chippis Island but included some fish (fewer than 5) from Garcia Bend (near Sacramento).

^b Near Manteca.

Sources: Bennett et al. 2001; San Francisco Estuary Institute (SFEI) 2010.

2

3 **Table 8-32. Selenium Concentrations in Largemouth Bass**

Site	Number of Samples	Selenium Concentrations in Fish Fillets (mg/kg, wet weight)			Selenium Concentrations in Whole-Body Fish (mg/kg, dry weight)			Years
		Min.	Max.	Mean	Min.	Max.	Mean	
Sacramento River at Veterans Bridge	3	0.40	0.81	0.56	1.7	2.9	2.2	2005
Sacramento River at River Mile 44 ^a	9	0.27	0.72	0.46	1.2	2.7	1.9	2000, 2005, 2007
Sacramento River near Rio Vista	9	0.30	0.80	0.44	1.3	3.2	1.9	2000, 2005, 2007
San Joaquin River at Vernalis	8	0.15	0.63	0.40	0.77	2.5	1.7	2000, 2005, 2007
Old River near Tracy	3	0.45	0.69	0.55	2.0	2.9	2.4	2005
San Joaquin River at Potato Slough	9	0.22	0.89	0.38	1.1	3.5	1.6	2000, 2005, 2007
Middle River at Bullfrog	6	0.37	0.58	0.47	1.6	2.3	2.0	2005, 2007
Franks Tract	8	0.15	0.70	0.37	0.79	3.0	1.7	2000, 2005, 2007
Big Break	9	0.15	0.82	0.38	0.81	3.1	1.6	2000, 2005, 2007
Discovery Bay	3	0.32	0.41	0.37	1.5	1.7	1.6	2005
Whiskey Slough	2	0.35	0.47	0.41	1.6	1.9	1.7	2005

Notes: Means are geometric means.

Max. = maximum, mg/kg = milligrams per kilogram, Min. = minimum.

^a Near Clarksburg.

Source: Foe 2010.

1 A large number of fish tissue samples were collected from the Sacramento and San Joaquin River
2 watersheds and the Delta between 2000 and 2007 for mercury analysis. As part of the Strategic
3 Workplan for Activities in the San Francisco Bay/Sacramento–San Joaquin Delta Estuary (State
4 Water Resources Control Board 2008), archived largemouth bass samples were analyzed for
5 selenium to determine the primary source of the selenium being bioaccumulated in bass in the Delta
6 and whether selenium concentrations in bass were above recommended criteria for the protection
7 of human and wildlife health (Foe 2010). Results of this study are the most relevant biota data from
8 the Delta, and they are summarized in Table 8-32.

9 There were no differences in selenium concentrations in largemouth bass caught in the Sacramento
10 River between Veterans Bridge and Rio Vista in 2005, and there was no difference in selenium
11 concentration on the San Joaquin River between Fremont Ford (not shown in Table 8-32) and
12 Vernalis (Foe 2010). Also, there was no difference in bass selenium concentrations in the
13 Sacramento River at Rio Vista and in the San Joaquin River at Vernalis in 2000, 2005, and 2007. The
14 lack of a difference in bioavailable selenium between the two river systems was unexpected because
15 the San Joaquin River is considered a significant source of selenium to the Delta. Selenium
16 concentrations were unexpectedly higher in both river systems in 2007 than in other years, and the
17 reasons for this difference are unknown.

18 The Central Valley appeared to be the dominant source of bioavailable selenium to bass in the Delta
19 because tissue concentrations generally decreased seaward (Foe 2010). Selenium concentrations in
20 bass were highest in a dry water-year type (2007), consistent with predictions of the Presser and
21 Luoma (2006) bioaccumulation model.

22 Selenium concentrations in the bass were compared to criteria recommended for the protection of
23 human health (based on fillets; 2 mg/kg, wet weight) and wildlife health (based on whole-body fish;
24 concern threshold of 4–9 mg/kg, dry weight) (Foe 2010). Average and maximum concentrations
25 were always less than the criteria.

26 Selenium concentrations in the livers of two of 86 Sacramento splittail collected from Big Break,
27 Nurse Slough, and Sherman Island exceeded the concentration (>27 mg/kg) (Teh et al. 2004) at
28 which growth, survival, and histopathology effects were observed in long-term laboratory studies of
29 juvenile splittail (Greenfield et al. 2008). Mean selenium concentrations ranged from 11.8 to
30 16.3 mg/kg in 2001 and from 8.36 to 8.84 mg/kg in 2002, with the highest mean concentrations
31 occurring in fish from Nurse Slough (in Suisun Marsh). Other field and laboratory studies have been
32 conducted with splittail (Deng et al. 2007, 2008) and with white sturgeon (Tashjian and Hung 2006;
33 Tashjian et al. 2006, 2007) and other fish (Linville et al. 2002; Stewart et al. 2004), but no other
34 analytical data for field-collected fish from in the Delta were found.

35 Species to be considered for linkage of waterborne or foodweb selenium to fish and birds will
36 include those identified by the U.S. Fish and Wildlife Service (USFWS) as being at risk from selenium
37 exposure in the San Francisco estuary, insofar as possible (U.S. Fish and Wildlife Service 2008a).
38 However, species-specific and Delta-specific bioaccumulation and trophic transfer factors for those
39 species are not available, so assessment focus on largemouth bass, which have been sampled at
40 various locations in the Delta.

41 Current ambient water quality criteria are based on waterborne selenium concentrations, but
42 USEPA published a draft ambient water quality criterion for selenium in 2004 that was based on
43 selenium concentrations in whole-body fish (U.S. Environmental Protection Agency 2009g; State
44 Water Resources Control Board 2010a). The recommendations were intended to protect aquatic life

1 under the CWA. They incorporated the latest scientific information available to the agency at that
2 time and reflect an improved approach to measuring this bioaccumulative pollutant in the aquatic
3 environment. In October 2008, USEPA released a technical report describing the results from
4 additional testing of the toxicity of selenium to juvenile bluegill sunfish under winter temperature
5 conditions and also provided references for data obtained since 2004 (73 FR 63706).

6 Recent preliminary information concerning USEPA's pending revision of the draft chronic ambient
7 water quality criterion suggests that the agency will propose a two-part criterion: selenium
8 concentration in fish egg/ovary coupled with a water screening value (Delos pers. comm.). If the
9 latter is exceeded, the former either must be measured or may be estimated using whole-body
10 concentrations. It is expected the water screening value will be conservative (so that if the value is
11 not exceeded, there will be no problem), and that it will be lower than the current 5 µg/L USEPA
12 water criterion. The number for egg/ovary selenium will be driven by the available trout, bluegill,
13 and largemouth bass studies. EC₁₀ values (concentration at which 10% of offspring are affected) for
14 those species range from about 18 to 23 mg/kg dry weight based on egg/ovary data. Consistent with
15 USEPA's criterion calculation methods, the egg/ovary criterion is likely to be extrapolated
16 downward from the lowest observed value and is, thus, expected to be in the range of 15 to 18
17 mg/kg.

18 USEPA's Action Plan for Water Quality Challenges in the San Francisco Bay/Sacramento-San Joaquin
19 Estuary (U.S. Environmental Protection Agency 2012a) identifies selenium as one of seven priority
20 items for action. The plan indicates that USEPA will draft new site-specific numeric selenium criteria
21 by December 2012 to protect aquatic and terrestrial species dependent on the aquatic habitats of
22 the Bay Delta Estuary. This planned action continues a long-term effort responding to scientific
23 evidence that the current selenium water quality standards do not adequately protect sensitive
24 species. USFWS and NMFS drafted a Biological Opinion in 2000 that found jeopardy under ESA for
25 the selenium criteria that USEPA proposed in the California Toxics Rule. To avoid a final jeopardy
26 opinion, USEPA agreed to develop site-specific water quality criteria for selenium, beginning in the
27 Bay Delta Estuary. USEPA is using an ecosystem-based model created by the USGS with advice from
28 the USFWS and NMFS. The model reflects the food web in the Bay Delta Estuary, the diet of sensitive
29 species and their use of habitats, and hydrological conditions. (Note: this same modeling approach is
30 used in estimating selenium bioaccumulation in this EIR/EIS.) More stringent selenium water
31 quality criteria will require actions that decrease allowable concentrations of selenium in surface
32 waters of the Bay Delta Estuary and may set allowable levels of selenium in the tissue of fish and
33 wildlife. The new criteria would reduce the chronic (long-term) exposure of sensitive species to
34 selenium.

35 Following the development of the Bay Delta selenium criteria, USEPA plans to develop site-specific
36 criteria for other parts of California, including the San Joaquin Valley watershed (U.S. Environmental
37 Protection Agency 2012a). USEPA also is engaged in other efforts to minimize selenium discharges
38 to the San Joaquin River and the Bay Delta Estuary, including the Grasslands Bypass Project and the
39 North San Francisco Bay TMDL.

40 **8.2.3.16 Other Trace Metals**

41 **Background and Importance in the Study Area**

42 Trace metals such as arsenic, cadmium, chromium, copper, iron, lead, manganese, nickel, silver, and
43 zinc occur naturally in the environment. Sources of these metals include natural crustal material

1 such as soils, and enriched ore deposits. Because of their industrial and commercial utility, trace
2 metals also can be found in urban and agricultural stormwater runoff, landfill and mine leachate,
3 and industrial and municipal wastewater discharges.

4 Many trace metals are necessary for healthy biological function, where deficiencies in certain trace
5 metals can result in disease and ailment. At elevated levels, trace metals can be toxic to humans and
6 aquatic life, where the concentration of concern in surface waters is specific to each metal and each
7 receptor (human or aquatic life). Thus, the beneficial uses of Delta waters most affected by trace
8 metal concentrations are aquatic life uses (cold freshwater habitat, warm freshwater habitat, and
9 estuarine habitat), harvesting activities that depend on aquatic life (shellfish harvesting, commercial
10 and sport fishing), and drinking water supplies (municipal and domestic supply) (Table 8-1).

11 Trace metal contamination demonstrates the magnitude of effect that human activities have had on
12 the Delta. Sediment transport to the Bay increased by nearly an order of magnitude during the mid-
13 1800s to early 1900s as a result of hydraulic gold mining operations; these sediments carried high
14 concentrations of metal contaminants, which persist today (Van Geen and Luoma 1999b). The effect
15 of these residual metals in the water column is exacerbated by the decreased river inflows into the
16 Delta in recent years, as well as the continued discharge of contaminants from stormwater runoff
17 and other urban activities.

18 Hayward et al. (1996), in an evaluation of metals concentrations in the San Joaquin River, found that
19 concentrations of trace metals were uniformly low, with a few isolated exceptions related to specific
20 point sources (e.g., elevated zinc near boat docks in the Stockton Harbor). However, relatively low
21 concentrations in water can have effects on aquatic life. A 2006 study of sediment toxicity in the San
22 Francisco estuary identified toxic hotspots where metals were found to cause sediment toxicity in
23 bivalve embryos (Anderson et al. 2007).

24 Alpers et al. (2000:2) evaluated metals concentrations in the Sacramento River (Shasta Dam to Delta
25 region) from July 1996 to June 1997, encompassing both low-flow and flood conditions. Their study
26 showed that cadmium, copper, and zinc were transported primarily in dissolved form upstream of
27 major agricultural activities but primarily in colloidal form downstream. Iron and lead were
28 transported primarily in colloidal form at all mainstem Sacramento River sites.

29 Additional background for arsenic, cadmium, chromium, copper, iron, lead, manganese, nickel,
30 silver, and zinc is provided below.

31 **Arsenic**

32 Arsenic is a semi-metal element that is tasteless and odorless and highly toxic to humans. Long-
33 term, chronic exposure to arsenic has been linked to cancer of the bladder, lungs, skin, kidneys,
34 nasal passages, liver, and prostate (U.S. Environmental Protection Agency 2009h). Short-term
35 exposure to high doses of arsenic can cause acute symptoms such as skin damage, circulatory
36 system dysfunction, stomach pain, nausea and vomiting, diarrhea, numbness in hands and feet,
37 partial paralysis, and blindness (U.S. Environmental Protection Agency 2009h).

38 Sources of arsenic contamination in water supplies include erosion of natural deposits, agricultural
39 runoff, and runoff or wastewater from industrial point sources. Arsenic commonly is found in
40 volcanic rocks and metal oxides, and is commonly associated with sulfide minerals and organic
41 carbon (Saracino-Kirby 2000). Arsenic also is found in certain pesticides, fertilizers, and feed
42 additives used in commercial agricultural operations (Saracino-Kirby 2000; U.S. Environmental
43 Protection Agency 2009h). Approximately 90% of the industrial arsenic used in the United States is

1 used as wood preservative; industry practices such as copper smelting, mining, and coal burning
2 also contribute arsenic to the environment (U.S. Environmental Protection Agency 2009h).

3 **Cadmium**

4 Cadmium can be toxic to humans. Long-term, chronic exposure to cadmium has been linked to blood
5 damage and several forms of cancers; short-term exposure to high concentrations of cadmium may
6 cause nausea, vomiting, diarrhea, muscle cramps, salivation, sensory disturbances, liver injury,
7 convulsions, shock, and renal failure (U.S. Environmental Protection Agency 2009i). Some aquatic
8 species (e.g., Chinook salmon, Sacramento sucker, threespine stickleback) tend to bioaccumulate
9 cadmium, while others do not (U.S. Environmental Protection Agency 2009i; Saiki et al. 1995). The
10 toxicity of cadmium to aquatic life varies with the total hardness of the water, exhibiting generally
11 lower toxicity as hardness increases.

12 Cadmium occurs naturally in zinc, lead, copper, and other ores, which may erode and release
13 cadmium into water bodies, especially in soft, acidic waters (U.S. Environmental Protection
14 Agency 2009i). Cadmium is used in a variety of industrial activities and applications, including metal
15 plating and coating operations, machinery and baking enamels, photography, and nickel-cadmium
16 and solar batteries (U.S. Environmental Protection Agency 2009i). Cadmium can enter water bodies
17 through urban or industrial wastewater, leaching from landfills, and from corrosion of some
18 galvanized plumbing and water mains (Van Geen and Luoma 1999a; U.S. Environmental Protection
19 Agency 2009i).

20 Regulation of industrial and urban wastewater has led to a steady reduction in metal discharges to
21 water bodies over the past two decades; however, these contaminants persist in sediments. A study
22 of cadmium concentrations in San Francisco Bay revealed that coastal upwelling of cadmium-rich
23 sediment contributes to seasonal peaks in those levels in the Bay. Surface samples collected
24 throughout the Bay confirmed an internal cadmium source unrelated to river discharge. The results
25 of the study suggested that concentrations of cadmium and other metals in the Delta and Bay water
26 column are sensitive to river inflow and may have increased in response to reduced inflows in
27 recent years. (Van Geen and Luoma 1999a.)

28 **Copper**

29 Copper is found primarily in the form of ores with other elements. Copper occurs in both organic
30 and inorganic forms; organic copper is an essential micronutrient for animals, while exposure to
31 high concentrations of inorganic copper can be toxic (Buck et al. 2006; U.S. Environmental
32 Protection Agency 2009j). In humans, short-term exposure to copper can cause nausea and
33 vomiting; long-term exposure can cause liver or kidney damage (U.S. Environmental Protection
34 Agency 2009j).

35 Sources of copper contamination include natural deposits, industrial and urban wastewater, and
36 urban stormwater runoff (Buck et al. 2006; U.S. Environmental Protection Agency 2009j). Historical
37 copper contamination from industrial development and mining operations persists in sediments in
38 the Delta and Bay (Buck et al. 2006). Dissolved copper tends to bind with organic matter, resulting
39 in a strong correlation between concentrations of dissolved copper and organic carbon (Buck et al.
40 2006). This binding of copper with organic carbon has reduced concentrations of the toxic form of
41 copper in San Francisco Bay to concentrations that do not pose a threat to aquatic life; without the
42 copper-binding organic matter, it is likely that copper concentrations in the Bay would be toxic to
43 most aquatic microorganisms (Buck et al. 2006).

1 The most common source of copper contamination in drinking water is corrosion of household
2 copper plumbing materials. This contamination cannot be directly detected or removed with
3 conventional drinking water treatment methods; thus, USEPA requires drinking water suppliers to
4 control the corrosiveness of their water to minimize copper contamination at the tap. (U.S.
5 Environmental Protection Agency 2009j.)

6 **Lead**

7 Lead is a metal found in natural deposits as ores with other elements. Short-term exposure to lead
8 can cause a variety of health effects, including problems with blood chemistry, mental and physical
9 development in babies and young children, and increases in blood pressure in some adults. Long-
10 term exposure to lead has the potential to cause stroke, kidney disease, and cancer. (U.S.
11 Environmental Protection Agency 2009k.)

12 Sources of lead contamination include natural deposits, mining, and smelting operations (U.S.
13 Environmental Protection Agency 2009k). Lead is sometimes used in household plumbing materials
14 or in water distribution systems. Lead is regulated in drinking water systems via the USEPA's Lead
15 and Copper rule.

16 **Nickel**

17 Recent work has shown that the most substantial sources of nickel are in the South Bay; the next
18 largest source is in the Delta (Yee et al. 2007). Nickel sources in the region originate from natural
19 and human sources such as natural rock erosion, urban runoff, and WTPs (Yee et al. 2007). Total
20 nickel concentrations from samples in the Delta averaged 3.5 µg/L in the dry season, and 5.1 µg/L in
21 the wet season. Davis et al. (2000) estimated nickel loads were 975,000 kg/yr from San Francisco
22 Bay bottom sediments, 410,000 kg/yr from the Delta, 49,000 kg/yr from Bay tributaries, 4,800
23 kg/yr from effluent, and 580 kg/yr from atmospheric deposition.

24 **Silver**

25 Silver is present in San Francisco Bay sediments, which can have toxic effects on biota (Flegal et
26 al. 2007). Most fluxes of silver in the Bay are from past industrial activities and wastewater
27 treatment sources. Delta waters entering the Bay have some of the lowest river silver
28 concentrations reported.

29 **Zinc**

30 Zinc potentially can have toxic effects on biota, although it is an essential element in the diet of these
31 plants and animals. Zinc is used to make tires, so it is generally found at higher concentrations near
32 highways. It is also used in manufacturing processes.

33 **Existing Conditions in the Study Area**

34 In 2000, the Association of California Water Agencies conducted a study to summarize arsenic data
35 from across the state and to assess the effect of USEPA's arsenic standard on California's drinking
36 water programs (Saracino-Kirby 2000). Sampling data collected by USGS in 1990 and 2000,
37 California Department of Health, DWR, Reclamation, and other sources were analyzed. The study
38 found that the statewide average concentration of arsenic in groundwater measured between 1990
39 and 2000 was 9.8 µg/L, and that 22% of the 4,513 sampling stations recorded arsenic
40 concentrations of 10 µg/L or higher during this time period (Saracino-Kirby 2000) (Table 8-33). The

1 study found no noticeable trend in arsenic concentrations through time (Saracino-Kirby 2000).
2 Thirty percent of the state's groundwater basins were found to have average arsenic concentrations
3 of 10 µg/L or higher at some point between 1990 and 2000 (Saracino-Kirby 2000). The Association
4 of California Water Agencies study also analyzed samples from 188 sampling stations on surface
5 water bodies and found that the statewide average concentration of arsenic in surface water
6 between 1990 and 2000 was 42 µg/L; however, this average was influenced by a small number of
7 data points with very high values—91% of the sampling locations recorded average concentrations
8 less than 10 µg/L during the same time period (Saracino-Kirby 2000).

9 There was a large monitoring effort from 1988 to 1993 to assess metals in the Delta. Results for San
10 Joaquin River at Buckley Cove, Sacramento River at Hood (actually collected at Greene's Landing),
11 Sacramento River above Point Sacramento, San Joaquin River at Antioch Ship Channel, Old River at
12 Rancho Del Rio, Suisun Bay at Bulls Head Point near Martinez, and Franks Tract are shown in Table
13 8-33. Analysis of the monitoring results indicated that most metal median values were similar
14 between locations, with zinc median values being the highest of all the metals.

15 Results from recent monitoring efforts for trace metals at the Banks pumping plant and Barker
16 Slough pumping plant are shown in Table 8-34. Analytes examined in the present effort for the
17 Banks and Barker Slough pumping plants include arsenic, cadmium, copper, lead, nickel, silver, and
18 zinc. The monitoring program sampled for each of these analytes approximately 72 times during the
19 water years 2001 to 2006 at each location. Arsenic, copper, and nickel were detected in almost all
20 sampling events for each location. Median values for these metals were similar at the two locations.
21 Elevated values for these metals occurred primarily between January and March, although the
22 copper maxima occurred during May. There were one detection of lead and three detections of zinc
23 at the Banks pumping plant. There were no detections of cadmium or silver at either station, and no
24 detections of lead or zinc at the Barker Slough pumping plant. Cadmium values matched the MCL of
25 0.005 mg/L at several locations during the 1988–1993 study, but there were no detections at either
26 the Banks or Barker Slough pumping plants during water years 2001–2006.

27 SFEI data for the Sacramento River above Point Sacramento and the San Joaquin River at Antioch,
28 which have very low detection limits, are presented in Table 8-35. The samples were taken between
29 late July and late August, which does not allow examination of wet versus dry season results. The
30 samples indicate that all selected metals are still present in the Sacramento and San Joaquin River
31 outflows during summer conditions, albeit at low concentrations. Values for all metals were
32 comparable for the two locations. For both locations, copper, nickel, and zinc occurred at higher
33 concentrations than the other metals.

34 Monitoring efforts in the north Delta areas (water years 2001–2006) indicate that mean values for
35 metals at the Feather River at Oroville tended to be lower than those for the Sacramento River sites,
36 with the exception of cadmium and silver (Table 8-36).

37 Arsenic, cadmium, chromium, copper, lead, nickel, silver and zinc are among the 126 priority
38 pollutants identified by the USEPA. Iron and manganese are identified as non-priority pollutants by
39 USEPA. Federal water quality criteria contained in the CTR, state water quality objectives contained
40 in the Region 2 and Region 5 Water Quality Control Plans, and drinking water MCLs are listed in
41 Appendix 8A. Based on water quality criteria and objectives, and typical levels in surface waters, it is
42 generally the case that arsenic, iron, and manganese are of primary concern for drinking water,
43 while cadmium, chromium, copper, lead, nickel, silver, and zinc are of concern because of potential
44 toxicity to aquatic organisms.

1 **Table 8-33. Median Metal Concentrations for Selected Sites, May 1988–September 1993**

Location	Arsenic Dissolved (µg/L)	Arsenic Total (µg/L)	Cadmium Dissolved (µg/L)	Cadmium Total (µg/L)	Copper Dissolved (µg/L)	Copper Total (µg/L)	Lead Dissolved (µg/L)	Lead Total (µg/L)	Zinc Dissolved (µg/L)	Zinc Total (µg/L)
San Joaquin River at Buckley Cove	3	3	5	5	5	5	5	5	6	10
Sacramento River at Green's Landing	2	2	5	5	5	5	5	5	6	8
Sacramento River above Point Sacramento	2	3	5	5	5	7	5	5	5	10
San Joaquin River at Antioch Ship Channel	2	2	5	5	5	6	5	5	5	11
Old River at Rancho Del Rio	2	2	5	5	5	5	5	5	5	8
Suisun Bay at Bulls Head Point near Martinez	2	3	5	5	5	7	5	5	6	15
Franks Tract	2	2	5	5	5	5	5	5	5	7
San Joaquin River at Vernalis	—	—	—	—	—	—	—	—	10	—

Notes: Units are in micrograms per liter. Sample sizes are 10 to 12 (exception: San Joaquin River at Vernalis, with a sample size of 15). Sample size represents water quality samples having values at or greater than the reporting limit.

Source: Bay Delta and Tributaries Project 2009.

2 **Table 8-34. Metals Concentrations at the Harvey O. Banks and Barker Slough Pumping Plants, Water Years 2001–2006**

Metal	Harvey O. Banks Pumping Plant (µg/L)					Barker Slough Pumping Plant (µg/L)				
	Samples	Minimum	Maximum	Mean	Median	Samples	Minimum	Maximum	Mean	Median
Arsenic	71	1	3	2	2	72	1	5	2	2
Cadmium	no detections					no detections				
Copper	71	1	9	2	2	72	1	8	3	2
Lead	one detection: 7 µg/L (11/19/03)					no detections				
Nickel	67	1	2	1	1	72	1	7	2	2
Silver	no detections					no detections				
Zinc	15 µg/L (1/16/02), 5 µg/L (9/17/03), 6 µg/L (10/15/03)					no detections				

Notes: Metals measured as dissolved. All units are in micrograms per liter (µg/L). Sample size represents water quality samples having values at or greater than the reporting limit.

Source: Bay Delta and Tributaries Project 2009.

3
4

1 **Table 8-35. Metals Concentrations at the Mouths of the Sacramento and San Joaquin Rivers, Water Years 2001–2006**

Metal	Fraction	Sacramento River above Point Sacramento (µg/L)					San Joaquin River at Antioch Ship Channel (µg/L)				
		Samples	Minimum	Maximum	Mean	Median	Samples	Minimum	Maximum	Mean	Median
Arsenic	Dissolved	8	0.800	2.270	1.729	1.758	7	1.190	2.310	1.861	1.900
Arsenic	Total	8	0.800	2.420	2.039	2.253	7	1.250	2.500	2.014	2.130
Cadmium	Dissolved	7	0.007	0.016	0.011	0.010	7	0.006	0.015	0.010	0.011
Cadmium	Total	7	0.015	0.032	0.027	0.026	6	0.013	0.033	0.022	0.020
Copper	Dissolved	8	1.253	3.539	1.738	1.468	7	1.410	1.888	1.654	1.606
Copper	Total	8	2.534	4.613	3.418	3.257	7	2.435	4.811	3.028	2.729
Lead	Dissolved	8	0.019	0.091	0.043	0.034	7	0.017	0.196	0.055	0.027
Lead	Total	8	0.427	1.035	0.663	0.580	7	0.263	0.950	0.530	0.445
Nickel	Dissolved	8	0.766	2.641	1.218	1.006	7	0.727	1.470	1.059	0.975
Nickel	Total	8	2.410	6.503	3.970	3.933	7	2.034	6.726	3.157	2.523
Silver	Dissolved	4	0.001	0.002	0.001	0.001	5	0	0.001	0.001	0.001
Silver	Total	7	0.001	0.009	0.004	0.003	5	0.001	0.005	0.002	0.002
Zinc	Dissolved	8	0.160	1.410	0.711	0.595	7	0.253	1.818	0.712	0.510
Zinc	Total	8	2.283	7.022	4.291	3.924	7	1.983	7.055	3.321	2.705

Note: All units in micrograms per liter. Sample size represents water quality samples having values at or greater than the reporting limit.

Source: San Francisco Estuary Institute 2010.

2

1 **Table 8-36. Metals Concentrations at Selected North- and South-of-Delta Stations, Water Years 2001–2006**

Metal	Sacramento River at Keswick (µg/L)				Sacramento River at Verona (µg/L)				Feather River at Oroville (µg/L)				Check 13 (µg/L)				Check 29 (µg/L)								
	Samples	Minimum	Maximum	Mean	Median	Samples	Minimum	Maximum	Mean	Median	Samples	Minimum	Maximum	Mean	Median	Samples	Minimum	Maximum	Mean	Median	Samples	Minimum	Maximum	Mean	Median
Arsenic (d)	25	0.81	1.93	1.27	1.22	8	0.87	1.48	1.18	1.24	22	0.38	0.67	0.52	0.51	69	1	3	2	2	62	1	4	2	2
Arsenic (t)	28	0.84	1.94	1.36	1.30	11	0.92	1.91	1.29	1.20	23	0.47	0.99	0.60	0.56										
Cadmium (d)	8	0.007	0.036	0.021	0.023	1		0.009			1		0.023												
Cadmium (t)	14	0.008	0.095	0.028	0.019	2	0.010	0.020	0.010	0.010	2	0.029	0.033	0.031	0.031										
Copper (d)	25	0.49	3.18	1.40	1.06	8	0.62	4.22	1.55	1.33	22	0.42	1.54	0.70	0.61	69	1.00	5.00	2.00	2.00	81	1.00	4.00	2.00	2.00
Copper (t)	28	0.71	4.30	1.72	1.23	11	0.85	6.54	2.62	1.91	23	0.47	2.82	1.00	0.88										
Lead (d)	13	0.000	0.113	0.026	0.009	6	0.010	0.170	0.080	0.070	9	0.003	0.077	0.019	0.006										
Lead (t)	21	0.008	1.560	0.139	0.040	11	0.090	1.150	0.340	0.130	20	0.001	0.300	0.050	0.015										
Nickel (d)	25	0.49	2.49	1.39	1.32	8	0.58	2.57	1.27	1.13	22	0.40	1.38	0.89	0.88	67	1.00	3.00	1.00	1.00	79	1.00	3.00	1.00	1.00
Nickel (t)	28	0.50	2.73	1.56	1.47	11	0.99	8.94	2.80	1.71	23	0.79	1.93	1.12	1.05										
Silver (d)	1		0.015			1		0.005			2	0.020	0.030	0.030	0.030										
Silver (t)	4	0.003	0.091	0.037	0.027						3	0.020	0.070	0.040	0.040										
Zinc (d)	25	0.31	7.84	2.28	1.91	7	0.16	1.37	0.63	0.30	18	0.04	2.41	0.46	0.27						1		5.00		
Zinc (t)	28	1.02	11.90	3.44	2.38	11	0.53	8.18	2.68	1.16	23	0.13	2.66	0.79	0.48										

Notes: All units in micrograms per liter. Sample size represents water quality samples having values at or greater than the reporting limit.

d = dissolved.

t = total.

Source: Bay Delta and Tributaries Project 2009.

2

1 The CTR contains criteria for protection of freshwater aquatic life, saltwater aquatic life, and human
 2 health from consumption of water (drinking water) and organisms (eating fish and shellfish) and
 3 consumption of organisms only. For waters in which the salinity is equal to or less than 1 part per
 4 thousand 95% or more of the time, the applicable CTR criteria are the freshwater criteria. For
 5 waters in which the salinity is equal to or greater than 10 parts per thousand 95% or more of the
 6 time, the applicable CTR criteria are the saltwater criteria. For waters in which the salinity is
 7 between 1 and 10 parts per thousand, the applicable CTR criteria are the more stringent of the
 8 freshwater or saltwater criteria.

9 CWA Section 303(d) listings in the affected environment include cadmium, copper, and zinc in Lake
 10 Shasta and Keswick Reservoir; copper and zinc in the Mokelumne River (eastern portion of Delta
 11 waterways); copper in Bear Creek (eastern portion of Delta waterways); and many listings in the
 12 Central Coast, Los Angeles, Santa Ana, and San Diego Regions, which include the SWP and CVP
 13 Export Service Areas (State Water Resources Control Board 2011).

14 **8.2.3.17 Turbidity and Total Suspended Solids**

15 **Background and Importance in the Study Area**

16 TSS is a measure of the particulate matter that is suspended in the water column, consisting of
 17 organic materials (e.g., decaying vegetation) and inorganic materials (e.g., inorganic components of
 18 soil). Turbidity is a measure of the optical property of water that causes light to be scattered and
 19 absorbed rather than transmitted through the water column. The scattering and absorption of light
 20 is caused by: (1) water itself; (2) suspended particulate matter (colloidal to coarse dispersions); and
 21 (3) dissolved chemicals. Although suspended solids are only one of the factors affecting turbidity,
 22 they are often the dominant one. Thus, there is typically, but not always, a good relationship
 23 between turbidity and TSS, but this relationship will vary spatially and seasonally.

24 Sensitive receptors that have the potential to be affected by elevated concentrations of turbidity and
 25 TSS (Table 8-1) are municipal and industrial water supply uses (municipal and domestic
 26 supply/industrial service supply), aquatic life beneficial uses (warm freshwater habitat, cold
 27 freshwater habitat, migration of aquatic organisms and spawning, reproduction, and/or early
 28 development), and estuarine habitat because of habitat and other physiological effects. In the Delta,
 29 a declining turbidity trend, which has been attributed to a declining sediment supply and invasive
 30 submerged aquatic vegetation, is believed to have caused, at least in part, changes in Delta ecology
 31 and the decline of delta smelt (Hestir et al. 2013). The filtering of phytoplankton by invasive clams
 32 may also be contributing to reduced turbidity in the Delta (Appendix 11A, section 11A.1.6 Threats
 33 and Stressors).

34 Turbidity is a critical measurement for drinking water treatment plants because the constituents
 35 suspended in the water affect the filtration systems used to remove disease-causing microorganisms
 36 such as viruses, parasites, and some bacteria (e.g., fecal coliforms). Turbidity also can reduce the
 37 efficiency of disinfection techniques; disinfectants do not selectively target microbes, but rather
 38 react with many constituents within the water matrix (CALFED Bay-Delta Program 2008b).

39 Monitoring in the San Francisco estuary has used turbidity as a proxy for TSS, which in turn has
 40 been correlated to contaminant concentrations such as metals, PAHs, and organochlorine pesticides
 41 (Schoellhamer et al. 2007a). One study by Anderson et al. (2007) collected sediment samples
 42 between 1994 and 2001 from the mouths of the Sacramento and San Joaquin Rivers; all the samples

1 collected were found to be toxic to mussels. These results suggest that the greatest concern for
2 human health is not TSS itself but rather the contaminants associated with the solids and sediment,
3 which can bioaccumulate up the aquatic food chain and be consumed by humans (e.g., fish,
4 shellfish).

5 Elevated levels of turbidity and TSS limit light penetration into the water column, altering
6 photosynthesis, primary production, and fish behavior (Schoellhamer et al. 2007b). After runoff
7 events, TSS can settle to cover streambed spawning sites for fish and also alter macroinvertebrate
8 habitat.

9 A major historical source of TSS in central California was hydraulic mining for precious metals in the
10 late 1800s and early 1900s. The majority of this mining sediment has passed through the Delta
11 system, although mine tailings remain in many watersheds. The construction and operation of dams
12 in the Sacramento and San Joaquin River system have the effect of reducing TSS concentrations
13 downstream because sediments become trapped in the reservoirs. Floodplain management in the
14 form of levees can contribute to instream erosion by confining the flow to the channel and
15 increasing streambed shear stress, but channels for flood management are often lined to protect the
16 channel and minimize erosion (Schoellhamer et al. 2007b).

17 Given that the dam and levee systems in place are unlikely to be removed, the human activity that
18 most likely affects sediment delivery to the Delta is soil erosion associated with agricultural and
19 urban land uses. These activities are pertinent because they occur downstream from the major dams
20 on the system (Schoellhamer et al. 2007b). Examples include crop production, livestock production,
21 and construction activities. Stormwater runoff and overland flow are the likely mechanisms
22 delivering sediment to streams and larger rivers, although erosion control practices may be
23 implemented to minimize this contribution (Schoellhamer et al. 2007b).

24 Maintenance of the islands and wetlands in the Delta depends on replenishment of their sediments
25 from upstream sources. At the same time, erosion in Delta channels may expose previously
26 contaminated sediments that can negatively affect biota and drinking water supplies. The Delta also
27 has been identified as a source of toxic sediments to the San Francisco estuary (Anderson et al.
28 2007).

29 Some aquatic species, such as the delta smelt, tend to prefer turbid waters (CALFED Bay-Delta
30 Program 2008b). Moreover, relatively turbid Delta waters limit light penetration, thereby limiting
31 the frequency and magnitude of nuisance algal blooms.

32 TSS concentrations in the Delta range from 10 to 50 mg/L but can exceed 200 mg/L during flood
33 events (Schoellhamer et al. 2007b). The size of suspended particles in Delta waters is typically less
34 than 63 microns. These are silts and clays that tend to remain suspended in the water column
35 (Schoellhamer et al. 2007b). Particulates in the water column play an important role in chemical
36 adsorption and the transport of pollutants. The most sediment is supplied to the Delta during high
37 flows (Wright and Schoellhamer 2005; McKee et al. 2006).

38 The average annual Delta sediment budget for 1999–2002 as presented by Schoellhamer et al.
39 (2007b) is shown in Figure 8-46. The Sacramento River supplies the greatest input of sediment
40 (66%), followed by the Yolo Bypass (19%), the San Joaquin River (13%), and the eastside tributaries
41 (2%). The largest contributor of sediment to San Francisco Bay from the Delta is the Sacramento
42 River–Yolo Bypass system.

1 Existing Conditions in the Study Area

2 The cost-effectiveness and simplicity of sampling for turbidity rather than TSS have resulted in
3 fewer TSS data in recent years. Hence, turbidity data are examined here.

4 Most examined locations in the Delta have had low mean values of turbidity in recent years (water
5 years 2001–2006), with mean values typically ranging from 8 to 13 nephelometric turbidity units
6 (NTU) (Figure 8-47). The exceptions include the major system inputs (Sacramento River at Hood [18
7 NTU]) and the San Joaquin River near Vernalis (23 NTU), natural outflows (Sacramento River above
8 Point Sacramento [19 NTU] and San Joaquin River at Antioch Ship Channel [18 NTU]), and the
9 Barker Slough pumps (40 NTU).

10 Mean values for the north-of-Delta area were typically 5 NTU, with the exception of 19 NTU at the
11 Sacramento River at Verona (Table 8-37). South-of-Delta mean values were typically 6 NTU.

12 Time series data indicate that turbidity values at the examined stations generally fluctuate on an
13 annual basis (Figure 8-48 and Figure 8-49), with higher values during the months of December
14 through March.

15 **Table 8-37. Turbidity Concentrations at Selected North- and South-of-Delta Stations, Water Years**
16 **2001–2006^a**

Location	Turbidity (NTU)				
	Samples	Minimum	Maximum	Mean	Median
Sacramento River at Keswick	17	9	33	5	3
Sacramento River at Verona	18	4	68	19	12
Feather River at Oroville	5	2	10	5	4
American River at WTP	119	1	146	5	2
California Aqueduct at Check 13	69	1	23	6	6
California Aqueduct at Check 29	74	2	21	6	5

Notes:

NTU = nephelometric turbidity unit.

WTP = water treatment plant.

^a Sample size represents water quality samples having values at or greater than the reporting limit.

Source: California Department of Water Resources 2009b.

17

18 There are no numeric criteria for TSS. Because TSS and turbidity are not priority pollutants, there
19 are no criteria established for these parameters in the NTR or CTR. The San Francisco Bay Water
20 Board Basin Plan objectives for turbidity are associated with waste dischargers such that turbidity
21 relatable to such discharge shall not increase receiving water by more than 10% in areas where
22 natural turbidity is greater than 50 NTUs. Central Valley Water Board Basin Plan objectives are
23 more restrictive. Applicable objectives are detailed in Appendix 8A. None of the water bodies in the
24 affected environment have been listed as impaired on the state's CWA Section 303(d) list due to
25 elevated TSS or turbidity (State Water Resources Control Board 2011).

26 The current CALFED turbidity goal is 50 NTU for the purposes of reducing turbidity variability
27 (CALFED Bay-Delta Program 2007b).

1 USEPA’s Surface Water Treatment Rules require systems using surface water or groundwater under
 2 the direct influence of surface water to implement the appropriate disinfection and/or filtration
 3 techniques to minimize turbidity in treated drinking water (U.S. Environmental Protection Agency
 4 2006a). At no time can turbidity go above 5 NTU; systems that use filtration must ensure that the
 5 turbidity go no higher than 1 NTU (0.5 NTU for conventional or direct filtration) in at least 95% of
 6 the daily samples in any month. As of January 1, 2002, turbidity may never exceed 1 NTU, and must
 7 not exceed 0.3 NTU in 95% of daily samples in any month.

8 8.3 Regulatory Setting

9 Numerous federal, state and local acts, rules, plans, policies, and programs define the framework for
 10 regulating water quality in California. The following discussion focuses on water quality
 11 requirements that are applicable to the BDCP. The federal and state agencies responsible for
 12 regulating water quality in the study area are:

- 13 • USEPA.
- 14 • State Water Board.
- 15 • San Francisco Bay Water Board.
- 16 • Central Valley Water Board.

17 USEPA provides guidance and oversight to California in regulating water quality, as it does for other
 18 states and for tribes. As in other states across the country, USEPA delegates various authorities for
 19 establishing water standards and regulating controllable factors affecting water quality to the state.
 20 In California, this authority is delegated to the State Water Board. The State Water Board, in turn,
 21 delegates authority to its nine regional water boards to implement the state’s water quality
 22 management responsibilities in the nine geographic regions. Although the state generally takes the
 23 lead on developing and adopting water quality standards for California, USEPA must approve new or
 24 modified standards. Thus, USEPA, the State Water Board, and the two Regional Water Boards cited
 25 above have worked together to establish existing water quality standards for the study area. Water
 26 quality standards have three components: (1) the beneficial uses of the water to be protected; (2)
 27 the water quality criteria (referred to as *objectives* in California) that must be met to protect the
 28 beneficial uses; and (3) an antidegradation policy to protect and maintain water quality when it is
 29 better than the criteria/objectives. Additionally, CDFW, USFWS, NMFS and the Federal Energy
 30 Regulatory Commission impose water quality standards such as DO and temperature in the study
 31 area.

32 8.3.1 Federal Plans, Policies, and Regulations

33 8.3.1.1 Clean Water Act

34 The federal CWA (33 U.S.C. § 1251 et seq.) places primary reliance for developing water quality
 35 standards on the states (e.g., water quality objectives). The CWA established the basic structure for
 36 regulating point and nonpoint discharges of pollutants into the waters of the United States and gave
 37 USEPA the authority to implement pollution control programs, such as setting wastewater
 38 standards for industry. The statute employs a variety of regulatory and nonregulatory tools to
 39 sharply reduce direct pollutant discharges into waterways, finance municipal wastewater treatment

1 facilities, and manage polluted runoff. The CWA authorizes USEPA to delegate many permitting,
2 administrative, and enforcement aspects of the law to state governments. However, USEPA still
3 retains oversight responsibilities. In California, such responsibility has been delegated to the state,
4 which administers the CWA through the Porter-Cologne Water Quality Control Act (Porter-Cologne
5 Act) (Wat. Code, § 13000 et seq.). Under the Porter-Cologne Act, the State Water Board oversees
6 nine Regional Water Boards that regulate the quality of waters within their regions.

7 **Section 303(d)**

8 If the CWA's permit program fails to clean up a river or river segment, states are required to identify
9 such waters and list them in order of priority. Thus, under CWA Section 303(d), states, territories,
10 and authorized tribes are required to develop a ranked list of water quality-limited segments of
11 rivers and other water bodies under their jurisdiction. Listed waters are those that do not meet
12 water quality standards, even after point sources of pollution have installed the minimum required
13 levels of pollution control technology. The law requires that action plans, or TMDLs, be developed to
14 monitor and improve water quality. *TMDL* is defined as the sum of the individual waste load
15 allocations from point sources, load allocations from nonpoint sources and background loading, plus
16 an appropriate margin of safety. A TMDL defines the maximum amount of a pollutant that a water
17 body can receive and still meet water quality standards. TMDLs can lead to more stringent NPDES
18 permits (CWA Section 402).

19 **Section 401**

20 Under CWA Section 401, applicants for a federal permit or license to conduct activities that may
21 result in the discharge of a pollutant into waters of the United States must obtain certification from
22 the state in which the discharge would originate or, if appropriate, from the interstate water
23 pollution control agency with jurisdiction over affected waters at the point where the discharge
24 would originate. Therefore, all projects that have a federal component and may affect state water
25 quality (including projects that require federal agency approval [such as issuance of a CWA Section
26 404 permit] must comply with CWA Section 401. In California, the authority to grant water quality
27 certification has been delegated to the State Water Board, and applications for water quality
28 certification are typically processed by the Regional Water Board with local jurisdiction. Water
29 quality certification requires evaluation of potential effects in light of water quality standards and
30 CWA Section 404 criteria governing discharge of dredged and fill materials into waters of the United
31 States. For the BDCP, water quality certifications may be obtained from either the State Water Board
32 (e.g., for large scale authorizations for BDCP actions such as a Section 404 Regional General Permit),
33 or the Central Valley Water Board or San Francisco Bay Water Board for individual facility
34 construction elements of BDCP in each agency's jurisdictional area.

35 **Section 402**

36 Under CWA Section 402, point- and nonpoint-source discharges to surface waters are regulated
37 through the NPDES program. In California, the State Water Board oversees the NPDES program,
38 which is administered by the Regional Water Boards. The NPDES program provides both general
39 permits (those that cover a number of similar or related activities) and individual permits.

40 The NPDES Wastewater Program has responsibility for regulating wastewater discharges to surface
41 waters. Primary program activities include: (1) issuing NPDES permits (new and renewals); (2)
42 monitoring discharger compliance with permit requirements (review of discharger self-monitoring

1 reports and compliance inspections); (3) taking enforcement action as appropriate; (4) investigating
2 spills and illegal discharges; and (5) handling petitions and litigation.

3 The NPDES Stormwater Program regulates municipal (Municipal Separate Storm Sewer Systems),
4 construction, industrial, and California Department of Transportation stormwater discharges. BMPs
5 to control sediment erosion typically are used as part of this program. In general, the stormwater
6 program differs from many other programs in that it uses general permits adopted by the State
7 Water Board. Dischargers that desire coverage under these permits must submit a Notice of Intent
8 to the State Water Board indicating the intent to be covered under the general permit and comply
9 with its requirements. Exceptions to this process include Phase I Municipalities and the California
10 Department of Transportation. Beginning in March 2003, all construction activities with 1 acre of
11 soil disturbance or greater are required to obtain coverage under the General Construction Permit.

12 **Section 404**

13 Under CWA Section 404, a program was established to regulate the discharge of dredged and fill
14 material into waters of the United States, including some wetlands, via the issuance of NPDES
15 permits. USACE is authorized to issue Section 404 permits. Activities in waters of the United States
16 that are regulated under this program include fills for development, water resource projects (e.g.,
17 dams and levees), infrastructure development (e.g., highways and airports), and conversion of
18 wetlands to uplands for farming and forestry. Under Section 404(b)(1) of the CWA, the Least
19 Environmentally Damaging Practicable Alternative (LEDPA) must be identified from among those
20 alternatives considered in detail in the Environmental Impact Statement (EIS)/Environmental
21 Impact Report (EIR). If a federal agency is a partner in the implementation of a project, the proposed
22 action/project must be recognized as the LEDPA. A Section 404(b)(1) evaluation will be included
23 with the project's Final EIS/EIR pursuant to the CWA, to provide required information on the
24 potential effects of project activities regarding water quality and to provide rationale in support of
25 identifying the LEDPA. The Draft EIR/EIS will be reviewed by concerned members of the public and
26 stakeholders while given the opportunity to provide comments on project alternatives and
27 documentation.

28 Construction for the water conveyance facilities and several other conservation measures associated
29 with the BDCP would be subject to regulation under Sections 401, 402, and 404 of the CWA.

30 **8.3.1.2 Rivers and Harbors Act Section 10**

31 Section 10 of the Rivers and Harbors Act of 1899 requires authorization from the USACE for the
32 construction of any structure in or over navigable waters of the United States, the
33 excavation/dredging or deposition of material in these waters, or any obstruction or alteration in
34 navigable water.

35 Construction for the water conveyance facilities and several other conservation measures associated
36 with the BDCP would be subject to regulation under Section 10 of the Rivers and Harbors Act.

37 **8.3.1.3 Federal Antidegradation Policy**

38 The federal antidegradation policy is designed to provide the level of water quality necessary to
39 protect existing uses and provide protection for higher quality and national water resources. The
40 federal policy directs states to adopt a statewide policy that includes the following primary
41 provisions (40 CFR 131.12).

1 Existing instream water uses and the level of water quality necessary to protect the existing uses
2 shall be maintained and protected.

- 3 1. Where the quality of waters exceed levels necessary to support propagation of fish, shellfish,
4 and wildlife and recreation in and on the water, that quality shall be maintained and protected
5 unless the state finds, after full satisfaction of the intergovernmental coordination and public
6 participation provisions of the state's continuing planning process, that allowing lower water
7 quality is necessary to accommodate important economic or social development in the area in
8 which the waters are located.
- 9 2. Where high quality waters constitute an outstanding national resource, such as waters of
10 national and state parks and wildlife refuges and waters of exceptional recreational or
11 ecological significance, that water quality shall be maintained and protected.

12 **8.3.1.4 National Toxics Rule**

13 In 1992, pursuant to the CWA, USEPA promulgated the NTR to establish water quality criteria for
14 12 states and two territories, including California, that had not complied fully with Section
15 303(c)(2)(B) of the CWA (57 FR 60848). As described in the preamble to the final NTR, when a state
16 adopts and USEPA approves water quality criteria that meet the requirements of Section
17 303(c)(2)(B) of the CWA, USEPA will issue a rule amending the NTR to withdraw the federal criteria
18 for that state. If the state's criteria are no less stringent than the promulgated federal criteria, USEPA
19 will withdraw its criteria without notice and comment rules because additional comment on the
20 criteria is unnecessary (65 FR 19659). However, if a state adopts criteria that are less stringent than
21 the federally promulgated criteria, but in USEPA's judgment fully meet the requirements of the CWA,
22 USEPA will provide an opportunity for public comment before withdrawing the federally
23 promulgated criteria (57 FR 60860, December 22, 1992). Amendments to the NTR occurred in May
24 1995 and November 1999. The CTR (described in a subsequent section) subsequently was
25 promulgated in 2000 and carried forward the established criteria of the NTR, thereby providing a
26 single regulation containing California's adopted and applicable water quality criteria for priority
27 pollutants.

28 **8.3.1.5 Safe Drinking Water Act**

29 The SDWA was established to protect the public health and quality of drinking water in the United
30 States, whether from aboveground or underground sources. The SDWA directed USEPA to set
31 national standards for drinking water quality. It required USEPA to set MCLs for a wide variety of
32 potential drinking water pollutants (Appendix 8A). The owners and operators of public water
33 systems are required to comply with primary (health-related) MCLs and encouraged to comply with
34 secondary (nuisance- or aesthetics-related) MCLs.

35 SDWA drinking water standards apply to treated water as it is served to consumers. All surface
36 waters require some form of treatment in order to meet drinking water standards. The degree of
37 treatment needed depends on the quality of the raw water. The highest quality raw surface waters
38 need only to be disinfected before being served to consumers. More typically, raw water is treated in
39 a conventional WTP that includes sedimentation, filtration, and disinfection processes. Municipal
40 water suppliers prefer raw water sources of high quality because their use minimizes risk to public
41 health and because their use minimizes the cost and complexity of treatment to meet SDWA
42 drinking water standards.

1 Some constituents of Delta water are of particular concern to municipal contractors because they
 2 are either not removed, only partially removed, or are transformed by the treatment process into
 3 hazardous substances by community-used water treatment processes. Constituents of concern
 4 include TDS, chlorides, bromides, and organic compounds. These substances can be removed from
 5 raw water by advanced water treatment processes, but to do so substantially increases the cost
 6 borne by municipalities.

7 **8.3.1.6 Surface Water Treatment Rule**

8 The Federal Surface Water Treatment Rule is implemented by the California Surface Water
 9 Treatment Rule, which satisfies three specific requirements of the SDWA by: (1) establishing criteria
 10 for determining when filtration is required for surface waters; (2) defining minimum levels of
 11 disinfection for surface waters; and (3) addressing *Cryptosporidium* spp., *Giardia lamblia*, *Legionella*
 12 spp., *E. coli*, viruses, turbidity, and heterotrophic plate count by setting a treatment technique. A
 13 treatment technique is set in lieu of an MCL for a contaminant when it is not technologically or
 14 economically feasible to measure that contaminant. The Surface Water Treatment Rule applies to all
 15 drinking water supply activities in California; its implementation is overseen by DPH.

16 **8.3.1.7 Stage 1 and Stage 2 Disinfectants and Disinfection Byproducts** 17 **Rule and Long-Term 1 and Long-Term 2 Enhanced Surface Water** 18 **Treatment Rule**

19 The Stage 1 D/DBP Rule established maximum residual disinfectant level goals and maximum
 20 residual disinfectant levels for chlorine, chloramines, and chlorine dioxide. It also set MCLGs and
 21 MCLs for THMs, five HAAs, chlorite, and bromate. The primary purpose of the Long-Term 1
 22 Enhanced Surface Water Treatment Rule is to improve microbial control, especially of
 23 *Cryptosporidium*.

24 Water systems that use surface water and conventional filtration treatment are required to remove
 25 specified percentages of organic materials, measured as TOC, which may react with disinfectants to
 26 form DBPs. Removal is to be achieved through a treatment technique (e.g., enhanced coagulation or
 27 enhanced softening), unless the system meets alternative criteria.

28 USEPA adopted the Stage 2 Microbial and Disinfection Byproducts Rules in January 2006. The Rules
 29 include both the Stage 2 D/DBP Rule and Long-Term 1, and Long-Term 2 Enhanced Surface Water
 30 Treatment Rule. These rules include revised and new requirements, such as water systems having to
 31 meet DBP MCLs at each monitoring site in the distribution system, rather than averaging multiple
 32 sites. The rules also contain a risk-targeting approach to better identify monitoring sites where
 33 customers are exposed to high levels of DBPs. The rules include new requirements for treatment
 34 efficacy and *Cryptosporidium* inactivation/removal, as well as new standards for DBPs, disinfectants,
 35 and potential contaminants.

36 The overall goal of this group of regulations is to balance the risks from microbial pathogens with
 37 those from carcinogenic DBPs. All domestic water suppliers must follow the requirements of these
 38 rules, which are overseen by DPH.

1 **8.3.2 State Plans, Policies, and Regulations**

2 **8.3.2.1 Porter-Cologne Water Quality Control Act of 1969**

3 Under the Porter-Cologne Act, water quality objectives are limits or levels of water quality
 4 constituents or characteristics established for the purpose of protecting beneficial uses. The act
 5 requires the Regional Water Boards to formulate and adopt WQCPs, commonly called *Basin Plans*,
 6 that designate the beneficial uses of the water to be protected, and establish water quality objectives
 7 and a program to meet the objectives. Water quality objectives means the limits or levels of water
 8 quality constituents or characteristics that are established for the reasonable protection of beneficial
 9 uses of water or the prevention of nuisance in a specific area. Therefore, the water quality objectives
 10 form the regulatory references for meeting state and federal requirements for water quality control.

11 A change in water quality is allowed only if the change is consistent with the maximum beneficial
 12 use of the waters of the state, would not unreasonably affect the present or anticipated beneficial
 13 uses, and would not result in water quality lower than that specified in applicable Basin Plans
 14 (Central Valley Water Board 2009a). The BDCP is subject to the Porter-Cologne Act.

15 **8.3.2.2 State Water Resources Control Board** 16 **Water Rights Decisions, Water Quality Control Plans, and Water** 17 **Quality Objectives**

18 The preparation and adoption of Basin Plans is required by the California Water Code (Section
 19 13240) and supported by the CWA. Section 303 of the CWA requires states to adopt water quality
 20 standards that “consist of the designated uses of the navigable waters involved and the water quality
 21 criteria for such waters based upon such uses.” According to Section 13050 of the California Water
 22 Code, Basin Plans consist of a designation or establishment for the waters within a specified area of
 23 beneficial uses to be protected, water quality objectives to protect those uses, and a program of
 24 implementation needed for achieving the objectives. Beneficial uses are defined in Water Code
 25 Section 13050(f) as including domestic, municipal, agricultural, and industrial supply; power
 26 generation; recreation; aesthetic enjoyment; navigation; and the preservation and enhancement of
 27 fish, wildlife, and other aquatic resources or preserves. Because beneficial uses, together with their
 28 corresponding water quality objectives, can be defined per federal regulations as water quality
 29 standards, the Basin Plans are regulatory references for meeting the state and federal requirements
 30 for water quality control. One substantial difference between the state and federal programs is that
 31 California’s Basin Plans establish standards for groundwater in addition to surface water. Adoption
 32 or revision of surface water standards is subject to the approval of USEPA.

33 The State Water Board is responsible for protecting, where feasible, the state’s public trust
 34 resources, including fisheries, and has the authority under Article X, Section 2, of the California
 35 Constitution and Water Code Section 100 to prevent the waste or unreasonable use, unreasonable
 36 method of use, or the unreasonable method of diversion of all waters of the state.

37 The State Water Board Water Rights Division has primary regulatory authority over water supplies
 38 and issues permits for water rights—specifying amounts, conditions, and construction timetables—
 39 for diversion and storage facilities. Water rights decisions implement the objectives adopted in the
 40 Delta WQCP and reflect water availability, recognize prior water rights and flows needed to
 41 preserve instream uses (such as water quality and fish habitat), and whether the diversion of water
 42 is in the public interest.

1 Basin Plans adopted by Regional Water Boards are implemented primarily through the NPDES
 2 permitting system and issuance of waste discharge requirements to regulate waste discharges so
 3 water quality objectives are met. Basin plans provide the technical basis for determining waste
 4 discharge requirements and authorize the Regional Water Boards to take regulatory enforcement
 5 actions if deemed necessary.

6 **8.3.2.3 Water Quality Control Plan for the San Francisco** 7 **Bay/Sacramento–San Joaquin Delta Estuary**

8 The current WQCP in effect in the Delta is the *2006 Water Quality Control Plan for the San Francisco*
 9 *Bay/Sacramento–San Joaquin Delta Estuary* (Bay-Delta WQCP) (State Water Resources Control
 10 Board 2006). The Bay-Delta WQCP identifies beneficial uses of water in the Delta to be protected,
 11 water quality objectives for the reasonable protection of beneficial uses, and an implementation
 12 program to achieve the water quality objectives.

13 The 2006 Bay-Delta WQCP adoption did not involve substantial changes to the prior 1995 Bay-Delta
 14 WQCP. The 1995 Bay-Delta WQCP was developed as a result of the December 15, 1994, Bay Delta
 15 Accord, which committed SWP and CVP to new Delta habitat objectives. In 1999, the State Water
 16 Board, through a water rights decision (D-1641), assigned responsibilities to entities holding certain
 17 water rights to help meet the objectives of the WQCP. One key feature of the 1995 Bay-Delta WQCP
 18 is the estuarine habitat objectives (X2) for Suisun Bay and the western Delta. The X2 standard refers
 19 to the position at which 2 ppt salinity occurs in the Delta estuary and is designed to improve
 20 shallow-water fish habitat in the spring of each year. The X2 standard requires specific daily or 14-
 21 day salinity, or 3-day averaged outflow requirements, to be met for a certain number of days each
 22 month from February through June. D-1641 also implemented the Vernalis salinity objective and
 23 directed the Regional Board to adopt salinity objectives and an implementation program for the
 24 lower San Joaquin River. (See 8.2.2.12 below.)

25 Other elements of the Bay-Delta WQCP include export-to-inflow ratios intended to reduce
 26 entrainment of fish at the export pumps, Delta Cross Channel gate closures, minimum Delta outflow
 27 requirements, and San Joaquin River salinity and flow standards.

28 **8.3.2.4 Water Quality Control Plan (Basin Plan) for the Sacramento and** 29 **San Joaquin River Basins**

30 The Basin Plan for the Central Valley Water Board covers an area including the entire Sacramento
 31 and San Joaquin River basins, involving an area bound by the crests of the Sierra Nevada on the east
 32 and the Coast Range and Klamath Mountains on the west. The area covered in this Basin Plan
 33 extends some 400 miles, from the California-Oregon border southward to the headwaters of the San
 34 Joaquin River. The BDCP will be required to meet the water quality objectives in the Basin Plan for
 35 the Sacramento and San Joaquin River basins, which was designed to protect the beneficial uses of
 36 the Sacramento and San Joaquin Rivers and their tributaries and was last amended in 2009 (Central
 37 Valley Water Board 2009a).

38 **8.3.2.5 San Francisco Bay Basin Water Quality Control Plan (Basin Plan)**

39 This Basin Plan covers 1,100 square miles of the 1,600–square mile San Francisco Bay estuary and
 40 includes coastal portions of Marin and San Mateo Counties, from Tomales Bay in the north to
 41 Pescadero and Butano Creeks in the south. The Bay system functions as the only drainage outlet for

1 waters of the Central Valley. It also marks natural topographic separation between the northern and
 2 southern coastal mountain ranges. The region's waterways, wetlands, and bays form the centerpiece
 3 of the fourth-largest metropolitan region in the United States, and the region includes all or major
 4 portions of Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and
 5 Sonoma Counties.

6 **8.3.2.6 State Water Board Resolution No. 68-16—Statement of Policy** 7 **with Respect to Maintaining High Quality Waters in California** 8 **(State Antidegradation Policy)**

9 The goal of State Water Board Resolution No. 68-16 (Statement of Policy with Respect to
 10 Maintaining High Quality Waters in California) is to maintain high quality waters where they exist in
 11 the state. State Board Resolution No. 68-16 states, in part:

- 12 1. Whenever the existing quality of water is better than the quality established in policies as of the
 13 date on which such policies become effective, such existing high quality will be maintained until
 14 it has been demonstrated to the state that any change will be consistent with maximum benefit
 15 to the people of the state, will not unreasonably affect present and anticipated beneficial use of
 16 such water, and will not result in water quality less than that prescribed in the policies.
- 17 2. Any activity that produces or may produce a waste or increased volume or concentration of
 18 waste and that discharges or proposes to discharge to existing high quality waters will be
 19 required to meet waste discharge requirements that will result in the best practicable
 20 treatment or control of the discharge necessary to ensure that (a) a pollution or nuisance will
 21 not occur and (b) the highest water quality consistent with maximum benefit to the people of
 22 the state will be maintained.

23 The State Water Board has interpreted Resolution No. 68-16 to incorporate the federal
 24 antidegradation policy, which is applicable if a discharge that began after November 28, 1975, will
 25 lower existing surface water quality.

26 **8.3.2.7 State Water Resources Control Board Sources of Drinking Water** 27 **Policy (Resolution No. 88-63)**

28 The Sources of Drinking Water Policy established state policy that all waters, with certain
 29 exceptions, should be considered suitable or potentially suitable for municipal or domestic supply.
 30 Under the policy, unless otherwise designated, Regional Water Boards must consider all surface
 31 water and groundwater as suitable, or potentially suitable, for municipal or domestic water supply.
 32 The policy defines the following three categories of waters potentially eligible for an exception from
 33 the designation and protection of a water source for municipal/domestic supply.

- 34 • Water bodies with high salinity (defined as TDS >3,000 mg/L), that either have naturally high
 35 contaminant levels that cannot reasonably be treated using either BMPs or best economically
 36 achievable treatment practices, or produce too low yield (<200 gallons per day).
- 37 • Waters designed or modified to treat wastewaters (domestic or industrial wastewater, process
 38 water, stormwater, mining discharges, or agricultural drainage), provided that such systems are
 39 monitored to ensure compliance with all relevant water quality objectives.

- Groundwater aquifers regulated as geothermal energy-producing sources or aquifers that have been exempted administratively by federal regulations for the purpose of underground injection of fluids associated with the production of hydrocarbon or geothermal energy.

8.3.2.8 Policy for Implementation and Enforcement of the Nonpoint-Source Pollution Control Program (Water Code Section 13369[a][2][B])

Agricultural return flows include flows from tile drains and irrigation and stormwater runoff. These discharges can affect water quality by transporting pollutants, including pesticides, sediments, and nutrients, from cultivated fields into surface water. Many surface water bodies are impaired because of pollutants from agricultural sources. Groundwater bodies in California's agricultural areas also have suffered pesticide, nitrate, and salt contamination.

Historically, most Regional Water Boards regulated these discharges under waivers, as authorized by Water Code Section 13269, and other administrative tools were seldom used. Section 13269 allows the Regional Water Boards to waive the requirement for waste discharge requirements if it is in the public interest. Although waivers were always conditional, the historical waivers had few conditions. In general, they required that discharges not cause violations of water quality objectives but did not require water quality monitoring.

In May 2004, the State Water Board adopted a new policy regulating nonpoint-source pollution, known as the Policy for Implementation and Enforcement of the Nonpoint Source Pollution Control Program, fulfilling the requirements of Water Code Section 13369(a)(2)(B). This policy affects landowners and operators throughout the state engaged in agricultural production, timber harvest operations, and other potential sources of nonpoint source pollution.

The 2004 policy generally expects nonpoint-source dischargers to use management practices that do not impair surface water quality and charges each landowner a fee to cover increased regulatory oversight. Consequently, implementation programs for nonpoint-source pollution control have expanded beyond waivers and now may be developed by a Regional Water Board, the State Water Board, individual dischargers, or by a coalition of dischargers in cooperation with a third-party representative, organization, or government agency. The latter programs are collectively known as *third-party programs*, and the third-party role is restricted to entities that are not actual dischargers under Regional Water Board/State Water Board point-discharge permitting and enforcement jurisdiction.

8.3.2.9 California Toxics Rule

As a result of a court-ordered revocation of California's statewide objectives for priority pollutants in September 1994, USEPA initiated efforts to promulgate additional numeric water quality criteria for California. In May 2000, USEPA issued the CTR that promulgated numeric criteria for priority pollutants not included in the NTR. The CTR documentation (65 FR 31682, May 18, 2000) carried forward the previously promulgated standards of the NTR, thereby providing a single document listing California's adopted and applicable water quality criteria for priority pollutants.

8.3.2.10 Policy for the Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California

In March 2000, the State Water Board adopted the Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California (SIP), which implemented criteria for priority toxic pollutants contained in the CTR as well as other priority toxic pollutant criteria and objectives. The SIP applies to discharges of toxic pollutants into inland surface waters, enclosed bays, and estuaries of California subject to regulation under the state's Porter-Cologne Act (Division 7 of the Water Code) and the federal CWA. Such regulation may occur through the issuance of NPDES permits or other relevant regulatory approaches. The goal of this policy is to establish a standardized approach for permitting discharges of toxic pollutants to nonocean surface waters in a manner that promotes statewide consistency. As such, SIP is a tool to be used in conjunction with watershed management approaches and, where appropriate, the development of TMDLs to ensure achievement of water quality standards (water quality criteria or objectives and the beneficial uses they are intended to protect, as well as the state and federal antidegradation policies).

SIP established: (1) implementation provisions for priority pollutant criteria promulgated by USEPA through the NTR and CTR and for priority pollutant objectives established by Regional Water Boards in their WQCPs; (2) monitoring requirements for 2,3,7,8-TCDD equivalents; and (3) chronic toxicity control provisions. In addition, the SIP includes special provisions for certain types of discharges and factors that could affect the application of other provisions in the policy.

8.3.2.11 Department of Public Health Safe Drinking Water Act Implementation

DPH is designated by USEPA as the primary agency to administer and enforce requirements of the federal SDWA in California. Public water systems are required to monitor for regulated contaminants in their drinking water supply. California's drinking water standards (e.g., MCLs) are the same or more stringent than the federal standards and include additional contaminants not regulated by USEPA. Like the federal MCLs, California's primary MCLs address health concerns, while secondary MCLs address aesthetics, such as taste and odor. The California SDWA is administered by DPH primarily through a permit system.

8.3.2.12 State Water Resources Control Board Decision 1641

The Bay-Delta WQCP (discussed previously) outlines current water quality objectives for the Delta. State Water Resources Control Board D-1641 contains the current water right requirements, applicable to DWR and Reclamation's operations of the SWP and CVP facilities, respectively, to implement the Bay-Delta water quality objectives. Objectives included in D-1641 include those related to salinity and dissolved oxygen, spring outflow (i.e., X2) objectives, export pumping, Delta cross-channel operations, and flow objectives in the Sacramento and San Joaquin Rivers.

Regarding X2, D-1641 specifies that, from February through June, the location of X2 must be west of Collinsville and additionally must be west of Chippis Island or Port Chicago for a certain number of days each month, depending on the previous month's Eight River Index. D-1641 specifies that compliance with the X2 standard may occur in one of three ways: (1) the daily average EC at the compliance point is less than or equal to 2.64 millimhos/cm; (2) the 14-day average EC is less than or equal to 2.64 millimhos/cm; or (3) the 3-day average Delta outflow is greater than or equal to the corresponding minimum outflow.

1 In D-1641, the State Water Board assigned responsibilities to Reclamation and DWR for meeting
2 these requirements on an interim basis. These responsibilities required that SWP and CVP be
3 operated to meet water quality objectives in the Delta, pending a water rights hearing to allocate the
4 obligation to meet the water quality and flow-dependent objectives among all users of the
5 Sacramento and San Joaquin River basins with appropriate water rights with post-1914 priority
6 dates. However, in lieu of this hearing, the San Joaquin River Agreement and Sacramento Valley
7 Water Management Agreement are settlements between Reclamation and DWR with water users
8 upstream of the Delta, in which SWP and CVP committed to continue to meet the D-1641 water
9 quality requirements in return for other commitments by major upstream water-rights holders.
10 After these agreements were executed, the State Water Board cancelled the water rights hearing to
11 allocate that responsibility.

12 In February 2006, the State Water Board issued a Cease and Desist Order (CDO, Water Rights Order
13 No. 2006-0006) to DWR and Reclamation that established actions and a compliance schedule for
14 implementation of the requirements contained in D-1641, in particular to ensure compliance with
15 the salinity objectives for the interior southern Delta. The CDO also revised the previously issued
16 (July 1, 2005) Water Quality Response Plan approval governing Reclamation's and DWR's Joint Point
17 of Diversion (JPOD) operations (i.e., use of the other agency's respective point of diversion in the
18 southern Delta). The CDO specified that the agencies may conduct JPOD operations provided that
19 both agencies are in compliance with all of the conditions of their respective water right permits and
20 licenses at the time that the JPOD operations would occur. The CDO was amended in January 2010
21 (Water Rights Order No. 2010-0002) to modify the time schedule of actions to follow the State
22 Water Board's next review of the 2006 Bay-Delta WQCP and separate hearings completed in 2010
23 for the consideration of changes to the interior southern Delta salinity objectives.

24 D-1641 also established the Vernalis Adaptive Management Plan, (VAMP), a 12-year
25 experimental/adaptive management program to assess effects of changes in flows and aquatic
26 habitat resources on juvenile Chinook salmon migrating from the San Joaquin River through the
27 Delta. This 12-year experimental/adaptive management program concluded in 2011. No formal
28 plans for its continuation have been adopted.

29 **SWP and CVP Coordinated Operations Agreement**

30 SWP and CVP are relatively independent projects that use a common water supply. However, the
31 SWP and CVP operations are linked by the requirement that they meet Delta flow and water quality
32 standards and are linked by joint operations south of the Delta at the San Luis complex and the joint-
33 use San Luis Canal. In 1986, Public Law 99-546 authorized the Coordinated Operations Agreement
34 (COA) between Reclamation and DWR, intended to define the rights and responsibilities of SWP and
35 CVP with respect to use of that common water supply and provide an infrastructure to monitor
36 those rights and responsibilities. Specifically, the COA defines the project facilities and their water
37 supplies, sets forth procedures for coordination of operations, identifies formulas for sharing joint
38 responsibilities for meeting Delta flow and water quality standards and other legal uses of water,
39 identifies how unstored flow will be shared, sets up a framework for exchange of water and services
40 between the projects, and provides for periodic review every 5 years (Bureau of Reclamation 2004).

41 **SWP and CVP Project Water Acceptance Criteria**

42 In consultation with SWP contractors and DHS, DWR developed acceptance criteria to govern the
43 water quality of nonproject water conveyed through the California Aqueduct. Non-project water

1 with chemical concentrations less than the acceptable criteria is routinely accepted by DWR. Non-
 2 project water with chemical concentrations greater than the criteria is managed on a case-by-case
 3 basis.

4 **8.3.2.13 Central Valley Water Board Drinking Water Policy**

5 A commitment of the CALFED Bay-Delta Program process and Record of Decision was the
 6 development of a new drinking water policy for Delta waters. Currently, both the Bay-Delta WQCP
 7 and the Sacramento–San Joaquin Basin Plan lack numeric water quality objectives for several known
 8 drinking water constituents of concern, such as organic carbon and pathogens (CALFED Bay-Delta
 9 Program 2008b). In response to the CALFED commitment, the Central Valley Water Board is in the
 10 process of a multiyear effort to develop a drinking water policy for surface waters in the Central
 11 Valley (Central Valley Water Board 2011a). Existing policies and plans lack water quality objectives
 12 for several known drinking water constituents of concern, including DBP precursors and pathogens,
 13 and also lack implementation strategies to provide effective source water protection. The new policy
 14 will culminate in the incorporation of new requirements into a Basin Plan amendment, anticipated
 15 to be completed in 2013. The Central Valley Water Board Drinking Water Policy will apply to Delta
 16 waters and any activities, such as discharges, that affect Delta water quality.

17 **8.3.3 Nonregional and Local Plans, Policies, and Regulations**

18 The boundaries of Contra Costa, Sacramento, San Joaquin, Solano, and Yolo Counties include water
 19 bodies that would be most directly affected by implementation of BDCP alternatives. The respective
 20 general plans for these counties include goals and policies regarding water resources and
 21 stormwater management, and overall water quality management, designed for protection of
 22 beneficial uses of importance within the Delta and elsewhere. Cities and counties also have
 23 developed numerous ordinances, policies, and other regulatory mechanisms for controlling
 24 stormwater drainage and related contaminant discharges to surface water bodies. General plan
 25 policies and local regulations, and potential consistency of BDCP alternatives with such policies and
 26 regulations, are described below.

27 **8.3.3.1 General Plan Goals and Policies**

28 **Contra Costa County General Plan**

29 A comprehensive update to the Contra Costa County General Plan was adopted on January 18, 2005,
 30 to guide future growth, development, and resource conservation through 2020. Goal 8-T reflects the
 31 principal relevant water quality goal of the Contra Costa County General Plan, which states: “To
 32 conserve, enhance and manage water resources. Protect their water quality, and assure an adequate
 33 long-term supply of water for domestic, fishing, industrial and agricultural use.” Accompanying
 34 policy 8-75 states, “Preserve and enhance the quality of surface and groundwater quality.”

35 **Sacramento County General Plan**

36 The Sacramento County General Plan, amended on November 9, 2011, provides for growth and
 37 development in the unincorporated area through 2050. The principal goal of the Sacramento County
 38 General Plan pertaining to water resources states: “Ensure that a safe, reliable water supply is
 39 available for existing and planned urban development and agriculture while protecting beneficial

1 uses of Waters of the state of California, including important associated environmental resources.”
 2 Supporting policies include those following.

- 3 • **CO-21.** Support protection and restoration of the Sacramento River Delta.
- 4 • **CO-24.** Comply with the Sacramento Areawide National Pollutant Discharge Elimination System
 5 Municipal Stormwater Permit (NPDES Municipal Permit) or subsequent permits, issued by the
 6 Central Valley Water Board to the County, and the Cities of Sacramento, Elk Grove, Citrus
 7 Heights, Folsom, Rancho Cordova, and Galt (collectively known as the Sacramento Stormwater
 8 Quality Partnership [SSQP]).
- 9 • **CO-27.** Support surface water quality monitoring programs that identify and address causes of
 10 water quality degradation.
- 11 • **CO-28.** Comply with other water quality regulations and NPDES permits as they apply to County
 12 projects or activities, such as the State’s Construction General Permit and Aquatic Pesticides
 13 Permit.
- 14 • **CO-29.** Continue to support the County’s participation in regional NPDES Municipal Permit
 15 compliance activities through collaborative efforts such as the Sacramento Stormwater Quality
 16 Partnership.
- 17 • **CO-30.** Require development projects to comply with the County’s stormwater
 18 development/design standards, including hydromodification management and low impact
 19 development standards, established pursuant to the NPDES Municipal Permit.

20 **San Joaquin County General Plan**

21 The “Resources” section of the San Joaquin County General Plan that addresses objectives and
 22 policies for water resources management was last updated in 1992 (San Joaquin County 1992). The
 23 General Plan contains the following four objectives that are directly or indirectly address protection
 24 of water quality conditions for the county:

- 25 • **Objective 1.** To ensure adequate quantity and quality of water resources for municipal and
 26 industrial uses, agriculture, recreation, and fish and wildlife.
- 27 • **Objective 2.** To obtain sufficient water supplies to meet all municipal and agricultural water
 28 needs.
- 29 • **Objective 4.** To prevent and eliminate contamination of surface and groundwater resources.
- 30 • **Objective 5.** To recognize the surface water resources of San Joaquin County as resources of the
 31 State and national significance for which environmental and scenic values must be protected

32 The General Plan further contains the following three specific water quality policies:

- 33 • **Policy 1.** Water quality shall meet the standards necessary for the uses to which the water
 34 resources are put.
- 35 • **Policy 2.** Surface water and groundwater quality shall be protected and improved when
 36 necessary.
- 37 • **Policy 3.** The use and disposal of toxic chemicals, the extraction of resources, and the disposal of
 38 wastes into injection wells shall be carefully controlled and monitored to protect water quality.

1 Solano County General Plan

2 The Solano County General Plan was adopted on August 5, 2008. The general plan is the guide for
3 both land development and conservation in the unincorporated portions of the county and contains
4 the policy framework necessary to fulfill the community’s vision for Solano County in 2030. Relevant
5 policies of the Solano County General Plan pertaining to water resources are described below.

6 The primary water resources goal (Goal RS.G-9) states: “Protect, monitor, restore and enhance the
7 quality of surface and groundwater resources to meet the needs of all beneficial uses.” Supporting
8 polices include those following.

- 9 • **RS.P-64:** Identify, promote, and seek funding for the evaluation and remediation of water
10 resource or water quality problems through a watershed management approach. Work with the
11 regional water quality control board, watershed-focused groups, and stakeholders in the
12 collection, evaluation and use of watershed-specific water resource information.
- 13 • **RS.P-73:** Use watershed planning approaches to resolve water quality problems. Use a
14 comprehensive stormwater management program to limit the quantity and increase the water
15 quality of runoff flowing to the county’s streams and rivers.

16 Yolo County General Plan

17 The Yolo County 2030 Countywide General Plan was adopted on November 10, 2009, and provides
18 for growth and development in the unincorporated area through 2030. Among all the county
19 general plans in the Primary Zone of the Delta, Yolo County contains the most specific policies
20 relating to protection of water resources. Relevant water resource policies and actions of the Yolo
21 County general plan are listed below.

- 22 • **Policy CO-5.1:** Coordinate with water purveyors and water users to manage supplies to avoid
23 long-term overdraft, water quality degradation, land subsidence and other potential problems.
- 24 • **Policy CO-5.6:** Improve and protect water quality for municipal, agricultural, and
25 environmental uses.
- 26 • **Policy CO-5.7:** Support mercury regulations that are based on good science and reflect an
27 appropriate balancing of sometimes competing public values including health, food chain,
28 reclamation and restoration of Cache Creek, sustainable and economically viable Delta
29 agriculture, necessary mineral extraction, flood control, erosion control, water quality, and
30 habitat restoration.
- 31 • **Policy CO-5.21:** Encourage the use of water management strategies, biological remediation, and
32 technology to address naturally occurring water quality problems such as boron, mercury, and
33 arsenic.
- 34 • **Policy CO-5.23:** Support efforts to meet applicable water quality standards for all surface and
35 groundwater resources.

36 8.3.3.2 Local Regulations

37 The principal regulatory requirements for surface water quality protection at the local
38 governmental agency level consist primarily of stormwater management programs to implement
39 responsibilities under the statewide NPDES stormwater permits for Municipal Separate (MS) Storm
40 Sewer Systems adopted by the State Water Board. Larger entities such as the core municipal areas of

1 Sacramento and Stockton are regulated under individual permits (MS1 permits), whereas smaller
 2 cities and unincorporated county areas typically are regulated by the State Water Board's MS4
 3 permit. Entities must prepare Storm Water Management Plans (SWMPs) for the stormwater NPDES
 4 permits that outline the agency actions that will be conducted to reduce the discharge of pollutants
 5 from storm drainage systems. The SWMPs must address urban runoff and construction site runoff.
 6 Additional city and county code and regulations for water quality protection typically may include
 7 grading permits, erosion and sediment control ordinances, and stormwater drainage facility design
 8 and management requirements.

9 **8.3.3.3 Policy Consistency**

10 The implementation of the selected alternative by the project proponent will comply with applicable
 11 stormwater management programs. In particular, as part of the Environmental Commitments
 12 (Appendix 3B) for each alternative, project construction activities will be conducted in compliance
 13 with the State Water Board's *NPDES Stormwater General Permit for Stormwater Discharges*
 14 *Associated with Construction and Land Disturbance Activities* (Order No. 2009-0009-DWQ/NPDES
 15 Permit No. CAS000002). This General Construction NPDES Permit requires the preparation and
 16 implementation of Stormwater Pollution Prevention Plans (SWPPPs) that outline the temporary
 17 construction-related BMPs to prevent and minimize erosion, sedimentation, and discharge of other
 18 construction-related contaminants, as well as permanent post-construction BMPs to minimize
 19 adverse long-term stormwater related–runoff water quality effects. Therefore, implementation of
 20 the alternatives would be anticipated to be consistent with local plans and regulations for
 21 stormwater management.

22 Although the state and federal project proponents and decision-makers are not required to comply
 23 with county general plans and policies, it is important for CEQA and NEPA compliance purposes to
 24 identify any relevant local land use plans, policies, and regulations that are adopted for the purpose
 25 of avoiding or mitigating an environmental effect. Potential inconsistencies with such enactments do
 26 not *per se* translate into adverse environmental effects under either CEQA or NEPA. Even where a
 27 lead agency is subject to an environmentally protective policy, the mere fact of inconsistency (a
 28 “paper” phenomenon) is not by itself an adverse effect on the environment. Such paper
 29 inconsistencies sometimes indicate, however, that a proposed physical activity might harm the
 30 environmental resource intended to be protected by the plans, policies, or regulations at issue.
 31 Potential adverse effects on such resources (e.g., water quality) are addressed in the *Environmental*
 32 *Consequences* section of this chapter, where the extent and significance of such effects are addressed.

33 **8.4 Environmental Consequences**

34 This section describes potential direct (both temporary construction-related and permanent
 35 operations-related) and indirect effects on water quality within the affected environment that would
 36 result from implementation of each alternative. For the purposes of this chapter, temporary impacts
 37 refer to those effects that are caused directly or indirectly through implementation of some
 38 temporary or intermittent activity associated with the proposed project, and thus ultimately the
 39 effect ceases to exist. Given the large scale of the potential temporary activities associated with the
 40 project, such as construction activities, it should be noted that temporary impacts may still occur
 41 over a relatively extended time period of many months or years at some project locations. An
 42 analysis of the consistency of the alternatives with applicable state water quality standards, plans,

1 and policies, including the federally promulgated NTR and CTR, is provided for the Upstream of the
 2 Delta Region, Delta Region, and the SWP and CVP Export Service Areas Region of the affected
 3 environment. The impact analysis separates temporary construction-related impacts from those
 4 associated with long-term facilities operations for the alternatives. Each of the alternatives'
 5 proposed features are divided into two categories: physical/structural components associated with
 6 the new conveyance facilities (CM1) and their operations and maintenance, which are project-level
 7 features, and restoration actions or Conservation Measures 2–22 (CM2–CM22), which are
 8 programmatic features.

9 **8.4.1 Methods for Analysis**

10 Each Alternative would consist of two broad categories of actions, which are: (1) temporary
 11 construction activities associated with construction of the various conservation measures (CM1–
 12 CM22), and (2) non-construction-related actions associated with the numerous conservation
 13 measures. The non-construction-related actions associated with the conservation measures are
 14 further characterized by the following four major components.

- 15 1. New north Delta diversion and conveyance facilities to be operated in conjunction with SWP
 16 and CVP existing facilities (collectively called *conveyance*).
- 17 2. Detailed criteria that will govern the operations of the new SWP conveyance facilities and other
 18 in-Delta facilities across a range of hydrological conditions (collectively called operations).
 19 Number 1 and 2 together are referred to as conservation measure (CM) 1.
- 20 3. Habitat Restoration: each action alternative would include a range of tidal marsh, floodplain,
 21 riparian, and upland transition habitat activities within the Plan Area. (CM2–CM11).
- 22 4. Actions to address and control contaminants, nonnative invasive species, and predation, and to
 23 address other potentially important non-conveyance and non-habitat-related stressors on
 24 covered species (collectively called *other stressors*) (CM12–CM22).

25 Implementation of the alternatives would result in changes to SWP and CVP operations, Delta
 26 habitats, channel flows, and Delta hydrodynamics (i.e., how water moves through the Delta).
 27 Implementation of conservation measures also could directly affect water quality positively or
 28 negatively at certain locations. Thus, the components of the Alternatives could collectively result in
 29 complex water quality changes within the affected environment (see Section 8.1). For the purposes
 30 of this assessment, the study area is divided into the three regions (Figure 1-4).

- 31 ● Plan Area, including the Yolo Bypass, SWP North Bay Aqueduct service area, and Suisun Marsh.
- 32 ● Upstream of the Delta (including the Sacramento and San Joaquin River watersheds).
- 33 ● SWP/CVP Export Service Area (south of the Delta, areas served by the California Aqueduct, Delta
 34 Mendota Canal, and South Bay Aqueduct [SBA]).

35 The two key questions to be addressed by this surface water quality impact assessment are as
 36 follows.

- 37 1. Would implementation of the Alternatives result in water quality changes to the Plan Area,
 38 Upstream of the Delta, or SWP/CVP Export Service Areas that would result in exceedances of
 39 water quality criteria/objectives, or substantially degrade water quality, of/by sufficient
 40 frequency, magnitude, and geographic extent as to cause or substantially contribute to

1 significant adverse effects on the beneficial uses of water in these areas of the affected
2 environment?

3 2. Would implementation of the Alternatives result in beneficial effects on water quality in these
4 areas?

5 Appropriately addressing these questions is a complex task because:

- 6 • The full effects of the Alternatives would occur in the future, and “project effects” on water
7 quality involve numerous constituents of interest (many having adopted water quality
8 objectives/criteria and some without adopted objectives/criteria).
- 9 • Multiple beneficial uses could be affected by changes in water quality.
- 10 • Numerous locations of interest are found throughout the large affected environment.

11 Moreover, models available for use in addressing such questions have been previously developed
12 for the effects of operations of the SWP-CVP facilities for only a few water quality parameters (e.g.,
13 EC, DOC, and temperature) in defined portions of the affected environment (i.e., the Delta), and are
14 poorly developed or not developed at all for nearly all other water quality parameters and locations,
15 nor for most of the conservation measures proposed for implementation. Consequently, the
16 methodology developed for assessing water quality impacts differed for each of the three areas of
17 the affected environment because:

- 18 • The beneficial uses of water in each area are affected differently by the Alternatives.
- 19 • Each area has different constituents of concern and different historical data availability for those
20 constituents.
- 21 • The availability of models that can be used to support quantitative assessments differs in each
22 area.

23 Hence, a combination of both quantitative and qualitative analyses (as appropriate) was performed
24 to estimate the changes in water quality attributable to implementation of the Alternatives within
25 the three areas of the affected environment. Depending on the constituent and location, these
26 changes could be significant/adverse (e.g., increase in concentration or mass loading of harmful
27 constituents), insignificant, or beneficial.

28 In general, the fewest water quality changes of importance are expected to occur Upstream of the
29 Delta, followed by the SWP/CVP Export Service Areas, with the greatest number and magnitude of
30 water quality changes expected for the Plan Area. The Plan Area was analyzed in the greatest detail
31 for the following reasons.

- 32 • Its water quality would be most affected by the BDCP action alternatives.
- 33 • It has complex hydrodynamic characteristics.
- 34 • Models are available to simulate hydrodynamic and water quality changes within the Delta
35 region.
- 36 • Delta water quality is critically important to the water supplies of California residents that use
37 water within the Delta and in the SWP/CVP Export Service Areas.

38 All constituents for which data were compiled were run through an initial screening analysis that
39 determined the appropriate levels of analysis needed for each constituent, and whether further

1 analysis beyond that provided by the screening analysis itself, if needed, would be qualitative or
2 quantitative. The details of the screening analysis are discussed later in this section.

3 The constituents of concern in the affected environment included both physically and chemically
4 conservative and non-conservative parameters. The concentrations of conservative constituents
5 tend to not be affected substantially by physical, chemical, or biological mechanisms that would
6 result in a loss of the constituent from the system. Thus, the concentrations of conservative
7 constituents can be reasonably estimated and changes assessed with mass-balance accounting of the
8 mixing of known volumes and concentrations of different water sources. Non-conservative
9 constituents can be affected by mechanisms that result in loss from the water such as physical (e.g.,
10 settling, volatilization), chemical (e.g., adsorption, oxidation-reduction, complexation), or biological
11 (e.g., uptake, decay) mechanisms such that mass-balance accounting becomes much more complex.
12 Historical monitoring data for the majority of these constituents were collected and reviewed from
13 various locations of interest within the affected environment.

14 Conservative parameters were evaluated using available models used for SWP-CVP planning and
15 operations (i.e., California Water Resources Simulation Model [CALSIM II, Delta Simulation Model 2
16 [DSM2], and Reclamation's Temperature Model) wherever applicable, as well as constituents
17 directly addressed by these models, and included EC, DOC, and temperature. It should be noted that
18 because aquatic life beneficial uses are the only uses expected to be affected by temperature changes
19 under the various Alternatives, the water quality chapter cross-references to Chapter 11, *Fish and*
20 *Aquatic Resources*, for all impact assessments for temperature.

21 These models produce detailed estimates of existing and future flow and water quality conditions
22 for the major reservoir, river, Delta, and constructed features such as agricultural diversions,
23 municipal diversions, and associated conveyance facilities within the study area. As such, the
24 CALSIM and DSM2 model outputs also were used to support quantitative mass-balance assessments
25 for several other constituents that exhibit generally conservative characteristics. Non-conservative
26 parameters were evaluated qualitatively. Detailed discussion on when and where qualitative or
27 quantitative analyses were performed is included later in this section.

28 Mercury and selenium were analyzed in detail because of their bioaccumulative properties.
29 Bioaccumulation refers to the uptake of a constituent by a biological organism which exceeds the
30 excretion or loss from the organism, such that concentrations within the organism are increased
31 over time. The specific methodologies used to evaluate these two parameters are discussed
32 separately in this section. Various models used in analyzing these constituents of interest and their
33 interrelationship have also been discussed in detail.

34 Based on the components of the Alternatives (described previously in this section), three categories
35 of potential changes in water quality conditions are described, as follows.

- 36 ● Changes attributable to construction-related conservation measure activities (CM1–CM22).
- 37 ● Changes attributable to operations and maintenance of new conveyance facilities and new SWP
38 and CVP operational criteria (CM1).
- 39 ● Changes attributable to non-construction related actions associated with implementation of
40 other defined conservation measures (CM2–CM22).

41 It was determined that the action alternatives would result in all three categories of potential water
42 quality effects within the Plan Area. However, based on the description of BDCP alternatives (see
43 Chapter 3, *Description of Alternatives*) for construction activities or other conservation measures in

1 the Upstream of the Delta and the SWP/CVP Export Service Area, water quality changes were
 2 expected to be minimal and, hence, are not addressed in as much detail. For those Alternatives that
 3 include specific CM1 measures in the Plan Area, however, a project specific level of analysis is
 4 included.

5 The frequency, magnitude, and geographic extent of any change in specific water quality
 6 constituents, or change in mass loading, is of primary importance in determining effects on
 7 beneficial uses (aquatic biology, municipal and domestic supply, agricultural uses, recreation, etc.).
 8 Consequently, findings regarding estimated concentrations at each assessment location for
 9 individual constituents of concern under the alternatives were compared to thresholds of
 10 significance (Section 8.3.2) for the purposes of making California Environmental Quality Act (CEQA)
 11 and National Environmental Policy Act (NEPA) impact determinations. Thresholds of significance
 12 define the criteria used to define the level at which an impact would be considered significant in
 13 accordance with CEQA and NEPA. Thresholds were based on the checklist in Appendix G of the
 14 CEQA Guidelines (CCR, Title 14, Division 6, Chapter 3), scientific information and data, and
 15 regulatory standards. These thresholds take into account the factors under NEPA to determine the
 16 significance of an action in terms of the context and intensity of its effects (40 CFR 1508.27).

17 If the estimated water quality conditions for a constituent under an Alternative triggers one or more
 18 of the five water quality conditions defined as effects assessment criteria (NEPA) and thresholds of
 19 significance (CEQA) (see Section 8.3.2.3) at one or more of the assessment locations, then that
 20 Alternative was determined to have an adverse water quality effect (under NEPA) and a significant
 21 impact on water quality (under CEQA) for that water quality constituent or parameter.
 22 Improvements to water quality conditions, where modeled or estimated to occur, also were
 23 generally identified as beneficial if considered to reflect a substantial change.

24 In summary, the impact assessment methodology includes the following:

- 25 1. Addresses all constituents of concern based on available information and the current science
 26 regarding concentrations/levels that would affect beneficial uses of waters within the affected
 27 environment.
- 28 2. Quantitatively evaluates constituents of primary concern where modeling tools were
 29 developed and were available for doing so, and qualitatively assesses effects where appropriate
 30 modeling tools were unavailable.
- 31 3. Evaluates the overall effect of the Alternatives on beneficial uses in a comparative manner
 32 throughout the affected environment, during three distinct time frames (see Section 8.3.1),
 33 which address climate change considerations.

34 The details of this methodological approach are discussed below. In the following sections, the
 35 specific methodologies used to assess water quality impacts within the three distinct areas of the
 36 affected environment (i.e., Upstream of the Delta, Plan Area, and SWP/CVP Export Service Areas) are
 37 discussed.

38 **8.4.1.1 Models Used and Their Linkages**

39 The models used in support of the quantitative water quality analyses were: (1) Reclamation's and
 40 DWRs' CALSIM II hydrologic model; and (2) DWR's DSM2. A brief description of each model is
 41 provided below, followed by a discussion of how the results from these models were used to

1 quantify changes in water quality constituent concentrations/parameter levels. More information
2 on these models and the assumptions included in their application is described in Appendix 5A.

3 The CALSIM II model, which has been jointly developed and maintained by DWR and Reclamation to
4 provide hydrologic-based information for planning, managing, and operating the integrated SWP
5 and CVP system, was used to simulate system operations and resulting hydrologic conditions under
6 the Alternatives. CALSIM II operates on a monthly time step from water year 1922 through 2003
7 using historical rainfall and runoff data which have been adjusted for changes in water and land use
8 that have occurred or are projected to occur in the future. In the model, the reservoirs and pumping
9 facilities of the SWP and CVP are operated to ensure the flow and water quality requirements for
10 these systems are met. The model assumes that facilities, land use, water supply contracts, and
11 regulatory requirements are constant throughout the 82-year hydrologic period of record, thus
12 providing a simulation representing a fixed level of development.

13 Among other output, CALSIM II provides mean monthly output for reservoir storage levels,
14 reservoir releases, flows at various locations along the major rivers, X2 location, Delta inflow, and
15 Delta outflow for an 82-year hydrologic period of record. The primary linkage of these models is for
16 CALSIM II output to serve as input to the DSM2 model and the Reclamation temperature models, as
17 shown in Figure 8-50. Input assumption details for each scenario modeled using CALSIM II are
18 provided in Appendix 5A.

19 DSM2 is a one-dimensional mathematical model for dynamic simulation of hydrodynamics, water
20 quality, and particle tracking throughout the Delta. DSM2 can be used to calculate stages, flows,
21 velocities, mass transport processes for conservative constituents, and transport of individual
22 particles. The model runs on a 15-minute time step for a 16-year (1976–1991) hydrologic period of
23 record. DSM2 currently consists of three modules: HYDRO, QUAL, and PTM. HYDRO simulates one-
24 dimensional hydrodynamics including flows, velocities, depth, and water surface elevations. HYDRO
25 provides the flow input for QUAL and PTM. QUAL simulates one-dimensional fate and transport of
26 conservative water quality constituents given a flow field simulated by HYDRO. PTM simulates
27 pseudo three-dimensional transport of neutrally buoyant particles based on the flow field simulated
28 by HYDRO. Input assumption details for each scenario modeled are provided in Appendix 5A, and a
29 discussion of uncertainty and model validation is also included in Appendix 5A.

30 CALSIM II output provides the hydrologic input to the temperature models for an 82-year
31 hydrologic period of record (1922–2003). The temperature models consist of two basic model
32 types: a reservoir model and a river model. Reclamation developed reservoir temperature models
33 for Trinity Lake, Whiskeytown Reservoir, Shasta Lake, Folsom Lake, New Melones Lake, and Tulloch
34 Reservoir. The reservoir models are used to simulate one-dimensional, vertical distribution of
35 reservoir water temperature using monthly input data on initial storage and temperature
36 conditions, inflow, outflow, evaporation, precipitation, radiation, and average air temperature.
37 Temperatures in the downstream regulating reservoirs—Lewiston, Keswick, Natomas, and
38 Goodwin—are computed from equilibrium temperature decay equations in the reservoir models,
39 which are similar to the river model equations.

40 **8.4.1.2 Upstream of the Delta Region**

41 Water quality changes in the affected environment upstream from the north-Delta boundary, which
42 includes the Sacramento River to Shasta Lake, the Feather River to Lake Oroville, and the American
43 River to Folsom Lake, were primarily assessed qualitatively. Assessment of water quality changes

1 was limited to operations-related water quality changes and the implementation of CM2–CM22.
2 Conveyance facility construction-related effects are not anticipated upstream of the Delta.

3 The assessment of water quality changes in water bodies upstream of the Delta relied, in part, on
4 making determinations as to how reservoir storage and releases would be changed. Specific changes
5 in reservoir storage and releases were determined from CALSIM II modeling of the SWP and CVP
6 system (Appendix 5A describe the CALSIM II modeling performed in support of this assessment).
7 Reservoir storage and river flow changes were then evaluated to make determinations regarding the
8 capacity for the affected water bodies to provide dilution of watershed contaminant inputs. Also, if a
9 particular parameter was found to be correlated to seasonal reservoir levels or river flows, how the
10 parameter would be altered seasonally by operational changes in reservoir levels or river flows was
11 assessed.

12 **8.4.1.3 Plan Area**

13 Water quality changes in the Delta were assessed quantitatively to the extent that data and models
14 were available to do so; otherwise, water quality changes were assessed qualitatively. Using the
15 methodology described below, changes in boron, bromide, chloride, mercury, methylmercury,
16 nitrate, organic carbon, and selenium, within the Delta were determined quantitatively at
17 11 assessment locations (Figure 8-7), while electrical conductivity and chloride were assessed at D-
18 1641 compliance locations.

19 Operations-related water quality changes (i.e., CM1 under the BDCP Alternatives) would be partly
20 driven by geographic and hydrodynamic changes resulting from restoration actions (i.e., altered
21 hydrodynamics attributable to new areas of tidal wetlands (CM4), for example). There is no way to
22 disentangle the hydrodynamic effects of CM4 and other restoration measures from CM1, since the
23 Delta as a whole is modeled with both CM1 and the other conservation measures implemented. To
24 the extent that restoration actions alter hydrodynamics within the Delta region, which affects mixing
25 of source waters, these effects were included in the modeling assessment of operations-related
26 water quality changes (CM1 under the BDCP Alternatives). Other effects of CM2-22 not attributable
27 to hydrodynamics, for example, additional loading of a water quality constituent to the Delta, are
28 discussed within the impact heading for CM2-22.

29 Methodologies to determine the effects attributable to construction activities and actions to address
30 the other stressors are discussed later in this section.

31 **Constituent Screening Analysis**

32 Constituents assessed in the water quality chapter were identified based on the following
33 considerations.

- 34 ● Availability of historical monitoring data.
- 35 ● Constituents having adopted federal water quality criteria or state water quality objectives.
- 36 ● Constituents on the state's CWA Section 303(d) list in the Delta.
- 37 ● Constituents identified in public scoping comments.
- 38 ● Constituents deserving assessment based on professional judgment.

39 A constituent *screening analysis* was conducted on 182 water quality constituents/parameters. The
40 screening analysis determined which constituents had no potential to exceed the thresholds of

1 significance by implementation of the Alternatives and, thus, did not warrant further assessment.
2 This analysis identified a list of “constituents of concern” that were further analyzed as part of
3 assessing their potential water quality related impacts under the Alternatives. For a detailed
4 description of the approach employed in the constituent screening analysis, see Appendix 8C.

5 **Determining Whether Assessment is Qualitative or Quantitative**

6 For many constituents, lack of adequate representative data precluded a quantitative assessment.
7 Tables SA-8 and SA-9 of Appendix 8C identify the types of constituents that were carried forward for
8 detailed analysis and were automatically determined to be assessed qualitatively. For constituents
9 for which at least one data point in the representative data set was a detected value (see Table SA-7,
10 Appendix 8C), the assessment was either quantitative or qualitative, depending on three factors:
11 (1) adequacy of data to perform a quantitative assessment, (2) adequacy of modeling tools, relative
12 to the physical/chemical properties of the constituent, to perform a quantitative assessment, and
13 availability of these tools, and (3) whether a quantitative analysis was necessary to perform the
14 assessment.

15 Available tools were considered appropriate for modeling only those constituents that could be
16 assumed to be conservative. Other gain/loss mechanisms were accounted for and addressed
17 qualitatively within the quantitative modeling-based assessment. Constituents of concern that could
18 not be analyzed through quantitative modeling were carried forward for qualitative analysis.
19 Appendix 8C, Table SA-11 contains a list of water quality constituents for which individual
20 assessments were performed and denotes the constituents that were assessed quantitatively
21 through modeling and those that were assessed qualitatively.

22 **Quantitative Assessments**

23 Using the methodology described below, changes in water quality were determined at
24 11 assessment locations across the Delta (Figure 8-7) for each of the constituents assessed
25 quantitatively, with the exception of EC. Assessment locations for EC aligned with D-1641
26 compliance locations contained in the Sacramento-San Joaquin Delta WQCP (Bay-Delta WQCP) and
27 are described in further detail below. Chloride was also assessed at D-1641 compliance locations, in
28 addition to the 11 other assessment locations.

29 **Calculation of Changes in Constituent Levels**

30 Output from DSM2 was used to calculate changes in constituent concentrations as they would be
31 affected primarily from operations-related actions of the conveyance features of the Alternatives.
32 DSM2 produced: (1) flow-fraction or “fingerprinting” output; and (2) EC and DOC concentrations for
33 specified Delta locations. Because the DSM2 model directly simulated EC and DOC concentrations
34 throughout the Delta, the estimated concentrations of these constituents were simply compared
35 among alternatives for impact assessment purposes. Additionally, because DSM2 accounts for
36 hydrodynamic conditions in the Delta, the effects of some of the habitat restoration actions (i.e., CM2
37 and CM4) on EC and DOC are evaluated quantitatively. Restoration actions that resulted in water
38 quality changes associated with altered hydrodynamics, which were captured in the DSM2
39 modeling, are discussed in constituent-specific impact assessment sections as operations-related
40 water quality changes. Restoration actions that could result in a potential increase in constituent
41 loading (e.g., increased nutrient, organic carbon, or suspended solids) to the Delta region were
42 assessed qualitatively.

1 For other constituents assessed quantitatively (See Appendix 8C, Table SA-11) for which
 2 concentrations were not directly estimated by DSM2, mean monthly flow-fraction output from
 3 DSM2 was used in mass-balance calculations (processed outside of DSM2) to estimate constituent
 4 concentrations. The flow-fraction output from DSM2 is the average percentage of water at each
 5 specified Delta location that was constituted by the five primary source waters (i.e., SAC, SJR,
 6 eastside tributaries [EST], BAY, and AGR). These flow-fractions were used together with source
 7 water constituent concentrations derived from historical data to estimate a given constituent
 8 concentration at assessment locations according to equation 1:

$$9 \quad f_{SAC,i}(C_{SAC}) + f_{SJR,i}(C_{SJR}) + f_{EST,i}(C_{EST}) + f_{BAY,i}(C_{BAY}) + f_{AGR,i}(C_{AGR}) = C_i \quad (1)$$

10 In the above equation, $f_{X,i}$ is the mean monthly flow fraction from source X at assessment location i,
 11 C_X is the constituent concentration from source X, and C_i is the constituent concentration at
 12 assessment location i. Contribution from the Yolo Bypass was added to contribution from the
 13 Sacramento River to constitute a single source, except in the case of selenium. Source water
 14 concentrations in the above equation are described for each of the constituents assessed via this
 15 method in Section 8.3.1.7, Constituent-Specific Considerations Used in the Assessment. Source water
 16 concentrations may vary seasonally, and this was examined. In some cases, source water
 17 concentrations were varied seasonally based on historical trends. It is recognized that C_{BAY} is
 18 dependent on flows in the Sacramento and San Joaquin Rivers as well as Delta exports (i.e., net Delta
 19 outflow), which may change due to climate change/sea level rise, and altered operations of the
 20 SWP/CVP system. It is also dependent on the tidal exchange volume, which may change as a result of
 21 restoration associated with CM4. However, beyond accounting for seasonal trends in the historical
 22 data, neither of these were taken into account in determining a value for C_{BAY} . Therefore, for cases in
 23 which net delta outflow increases or decreases relative to what has historically occurred, the value
 24 used for C_{BAY} may overestimate or underestimate the concentrations associated with San Francisco
 25 Bay water (as measured at Martinez). Additionally, if restoration component CM4 increases tidal
 26 exchange volume, the value used for C_{BAY} would underestimate concentrations associated with San
 27 Francisco Bay water (as measured at Martinez). For constituents associated with seawater intrusion
 28 that were not modeled directly in DSM2 (bromide, chloride), these considerations were addressed
 29 qualitatively. Additionally, due to the uncertainty inherent in using a constant historical monthly
 30 average concentration as the value of C_{BAY} , a second modeling approach was used for chloride and
 31 bromide for west Delta locations that were influenced by seawater intrusion. Results from this
 32 alternative modeling approach were used to supplement the results using the approach described
 33 above as a means of providing best available information related to chloride and bromide in the
 34 Delta.

35 For chloride, the alternative modeling approach applied relationships between EC and chloride
 36 developed based on historical water quality data to the DSM2 output for EC. This relationship was
 37 developed based on data at Mallard Island, Jersey Island, and Old River at Rock Slough (Contra Costa
 38 Water District 1997). The relationship was:

$$39 \quad Cl = \max \left(\begin{array}{l} 0.15 * EC - 12 \\ 0.285 * EC - 50 \end{array} \right) \quad (2)$$

40 In the equation above, Cl is the chloride concentration in mg/L, and EC is in $\mu\text{S}/\text{cm}$.

41 For bromide, the same EC to chloride relationship was used, followed by a relationship between
 42 chloride and bromide, to estimate bromide concentrations. The chloride to bromide relationship is
 43 approximately the same in multiple areas in the west delta, including Old River at Rock Slough

1 (Contra Costa Water District 1997), the intakes at Banks Pumping Plant (CALFED 2007a), and
 2 Mallard Island (Appendix 8E Figure 1). The relationship used was:

$$3 \quad Br = 0.0035 * Cl \quad (3)$$

4 In the equation above, Br is the bromide concentration in mg/L, and Cl is the chloride concentration
 5 in mg/L.

6 It should be noted that this alternative modeling approach is limited in the sense that the
 7 relationships described above are based on historical water quality data that is representative of
 8 historical Delta hydrodynamics. It is unknown whether these relationships will still apply in the
 9 future with sea-level rise, and particularly under an altered Delta hydrodynamic regime (as would
 10 be expected under the project alternatives). Because each of the two approaches have limitations
 11 and uncertainty, there is no way to determine which method results in more accurate estimates of
 12 chloride or bromide. Thus, where applicable (i.e., for west Delta locations), both methods were
 13 applied and the results of both approaches discussed. In general, when the methods displayed
 14 disagreement, impacts were assessed based on the more conservative of the two approaches.

15 A key assumption for the mass-balance calculation is that the constituent acts in a conservative
 16 manner throughout the system, as the various source waters mix and flow through the Delta,
 17 although most behave, to some degree, in a nonconservative manner. For constituents where this
 18 assumption does not hold because of decay, uptake, or other losses, this mass-balance approach
 19 would be expected to overestimate the actual concentrations at any given Delta location.

20 As described above, these approaches were used to calculate values/concentrations for water
 21 quality parameters on a daily or monthly average basis for the DSM2 period of record (1976–1991).
 22 Results were generally compiled and presented based on two averaging periods: all water years, and
 23 the drought period (water years 1987–1991). The drought period was chosen to represent water
 24 quality in “worst-case” conditions, as it includes several dry and critical years in sequence. This was
 25 done in lieu of calculating water quality effects on a water year type basis (using the Sacramento
 26 River Water Year Hydrologic Classification Index). The reasons for this included simplicity of
 27 presenting and discussing results, and also because the drought period represents truly worst-case
 28 conditions, whereas discussion of dry or critical year water types includes years that water supply
 29 and quality were not significantly affected because they were preceded by and succeeded by wet or
 30 above normal water years (e.g., 1981, 1985). However, when necessary, analysis of effects during
 31 certain water year types was conducted (for example, for chloride and EC, whose water quality
 32 standards depend on the water year type).

33 **Calculation of Use of Assimilative Capacity**

34 The concept of assimilative capacity was used as a measure of the extent of water quality
 35 degradation that could occur under the alternatives, relative to water quality conditions under the
 36 baselines. Water quality degradation was assessed in order to address the Federal and State
 37 Antidegradation Policies, which state that existing instream water uses and the level of water quality
 38 necessary to protect the existing uses shall be maintained and protected (see Section 8.2.1.3 for a
 39 full discussion). Assimilative capacity is the capacity of a water body to experience increased levels
 40 of a water quality constituent without exceeding the adopted water quality criterion/objective. In
 41 practical terms, when levels or concentrations of a water quality constituent are below water quality
 42 criteria/objectives, use of available assimilative capacity by an action is the relative amount of water
 43 quality degradation that the action causes (i.e., causing an existing constituent concentration to

1 increase such that its resulting concentration is now closer to, but still below the applicable
 2 criterion/objective). If the action causes sufficient degradation of water quality such that the
 3 resulting constituent level or concentration is now greater than the criterion/objective, then 100%
 4 of the available assimilative capacity would be “used” by the action, and thus no assimilative
 5 capacity would remain for that constituent.

6 In this assessment, assimilative capacity available under a baseline was calculated according to
 7 equation 2:

$$8 \quad A_{avail} = C_{WQO} - C_{base} \quad (2)$$

9 In the equation above, A_{avail} is the available assimilative capacity, C_{WQO} is the concentration of the
 10 water quality objective, and C_{base} is the concentration in the modeled baseline.

11 The amount of assimilative capacity used by an alternative was calculated according to equation 3:

$$12 \quad A_{used} = C_{ALT} - C_{base} \quad (3)$$

13 In the equation above, A_{used} is the assimilative capacity that was used under the alternative, relative
 14 to the baseline, and C_{ALT} is the concentration in the modeled alternative.

15 The determination of the percent use of available assimilative capacity under an alternative was
 16 dependent on the relative values of A_{used} and A_{avail} , and thus was calculated according to equation 4:

$$17 \quad - \frac{A_{used}}{A_{avail}} \times 100 \quad \text{for} \quad A_{used} \leq A_{avail} > 0$$

$$18 \quad \text{No Calculation} \quad \text{for} \quad A_{avail} \leq 0 \quad (4)$$

$$19 \quad - 100 \quad \text{for} \quad A_{used} \geq A_{avail}$$

20 In the above equation, the second case in which no calculation was performed occurs when there is
 21 no assimilative capacity under the baseline (i.e., concentrations are above water quality objectives),
 22 in which case the concept of assimilative capacity is not a useful tool for assessing water quality
 23 changes. In the third case, all of the available assimilative capacity is used by the alternative, but the
 24 percent use of assimilative capacity is limited to what was initially available (i.e., cannot have
 25 greater than 100% use of available assimilative capacity).

26 **Qualitative Assessments**

27 Some constituents were assessed strictly qualitatively (Appendix 8C, Table SA-11) because: (1)
 28 insufficient historical monitoring data were available to adequately characterize the concentrations
 29 of the five source waters to the Delta (i.e., to accurately define the distribution of concentrations
 30 observed in the SAC, SJR, BAY, eastside tributaries, AGR), which are necessary to implement the
 31 quantitative mass-balance assessment approach described above; (2) the locations for which the
 32 constituent was assessed (within the affected environment) was outside of any available modeling
 33 domain, or available modeling tools were not appropriate for predicting constituent concentrations
 34 based on the physical, chemical, and/or biological properties and environmental fate and transport
 35 of the constituent. Nevertheless, the same conceptual framework was used for qualitatively
 36 assessing constituents of concern. Best available information regarding concentrations/levels in the

1 Delta source waters was evaluated relative to how flow-fractions at various Delta locations would
 2 change under the Alternatives, as defined by DSM2 model flow-fraction output (Appendix 8D), to
 3 estimate the relative frequency and magnitude of change expected for a given constituent at a
 4 specified location.

5 Additionally, assessments of the effects of implementing CM2–CM22 were qualitative, at a
 6 programmatic level, for all constituents. Construction-related water quality changes also were
 7 assessed qualitatively. Potential water quality effects of these generally specific and/or
 8 geographically localized actions were assessed by evaluating the anticipated type, duration, and
 9 geographic extent of construction activities to take place, and location and type of water bodies
 10 potentially affected. The potential for soil, sediment, and contaminants to be discharged to water
 11 bodies was determined by identifying construction practices and equipment that could be used,
 12 common materials or contaminants that may be present or be used for construction or construction
 13 equipment, and pathways by which contaminants may enter receiving waters, and measures to
 14 minimize or eliminate adverse construction-related effects on water quality.

15 **8.4.1.4 SWP/CVP Export Service Areas**

16 Assessment of water quality changes in the SWP/CVP Export Service Areas, which begin at the
 17 export pumps (i.e., Banks and Jones pumping plants) and extend to facilities receiving exported
 18 Delta water, was conducted for construction-related, operations-related, and restoration-related
 19 (CM2–CM22) effects.

20 Water quality changes in the SWP/CVP Export Service Areas were assessed both quantitatively and
 21 qualitatively. Water quality changes at the export pumps (i.e., Banks and Jones pumping plants)
 22 were quantified using DSM2 for EC and DOC and from mass-balance calculations based on DSM2
 23 flow-fraction output data and Delta source water quality data. Because DSM2 does not account for
 24 water sourced from the new north Delta intakes (that are part of all Alternatives except Alternative
 25 9), modeled water quality at Banks and Jones pumping plants under the various alternatives was
 26 accounted for in post-processing the DSM2 data. For the Existing Conditions, No Action Alternative,
 27 and Alternative 9, no post-processing was necessary, since all of the exported water was from the
 28 existing south Delta intakes (i.e., “Through-Delta” conveyance). For all “Dual-Conveyance”
 29 alternatives (i.e., Alternatives 1–5, and 7–8), EC, DOC, and fingerprinting data at the export pumps
 30 were blended according to equation 5:

$$31 \quad \frac{Q_N C_N + Q_S C_S}{Q_N + Q_S} = C_{EXP} \quad (5)$$

32 In the equation above, Q_N is the flow diverted from the north Delta intakes to either Banks or Jones
 33 pumping plants, C_N is the value of the water quality parameter (EC, DOC, or fingerprinting for the 5
 34 source waters) in the Sacramento River at Green’s Landing (used as representative of intake water
 35 quality), Q_S is the flow exported from the south Delta in either Banks or Jones pumping plants, C_S
 36 is the value of the water quality parameter at the existing south Delta intakes for the pumping plants,
 37 and C_{EXP} is the value of the water quality parameter in the exported water. For the “Isolated-
 38 Conveyance” alternative, Alternative 6, all water quality parameters for the exports at both pumping
 39 plants were set equal to the values in the Sacramento River at Green’s Landing.

40 Water quality changes at the export pumps served as the basis for making determinations of water
 41 quality changes within the associated primary conveyance facilities, Delta Mendota Canal and

1 California Aqueduct, as well as the other locations within the service area outside of the Delta, such
 2 as San Luis Reservoir and reservoirs operated by southern California water purveyors. Water
 3 quality changes in the conveyance and terminus facilities were assessed qualitatively, with
 4 consideration of dilution, transformation, uptake, and loss to the extent such factors were applicable
 5 to the constituents evaluated.

6 **8.4.1.5 Mercury and Selenium Bioaccumulation Assessment**

7 Mercury and selenium are bioaccumulative constituents of concern in Delta waters. They also are
 8 listed as causes of impairment under the Clean Water Act Section 303(d), and a substantial amount
 9 is known about their fate and transport within the Delta or similar systems. Consequently, a specific
 10 analysis approach was developed for these two constituents.

11 Mercury and selenium concentrations in surface water were estimated at Delta assessment
 12 locations (Figure 8-51) as described previously (Section 8.3.1.3). Linkages between abiotic media
 13 (sediment and surface water, as applicable) and biological tissues (fish muscle, whole-body fish, and
 14 bird eggs) that provide an estimate of the potential bioaccumulation and impacts on ecological and
 15 human receptors were evaluated to determine the linkages with the greatest degree of confidence.
 16 Potential linkages explored included the following.

- 17 • **Literature-based regression models or bioaccumulation factors.** These resources provide a
 18 basis for estimating tissue concentrations for mercury and selenium from concentrations in
 19 surface water or sediment.
- 20 • **Site-specific linkages.** Methods were developed to describe existing relationships between
 21 waterborne concentrations of mercury and selenium at the nearest modeling nodes, existing
 22 sediment (for mercury), and fish tissue concentrations in an attempt to create predictive
 23 relationships for impact analysis and alternatives comparisons.
- 24 • **Delta methylmercury.** The TMDL translation equation for mercury (Central Valley Water
 25 Quality Board 2011b) was used to estimate fish tissue concentrations from waterborne
 26 concentrations. In addition, DSM2 water quality model predictions were investigated separately
 27 for their ability to predict measured fish tissue concentrations at discrete locations. The two
 28 translation models were compared for their predictive ability.
- 29 • **U.S. Geological Survey Bioaccumulation and Trophic Transfer Factors for selenium.** Values
 30 for uptake of selenium from water to the lowest trophic levels (e.g., algae) and transfer factors
 31 from invertebrates to fish and bird eggs developed by Presser and Luoma (2009, 2010) were
 32 used to estimate uptake from water to fish and to bird eggs. Initial modeling for fish was based
 33 on a model calibrated for largemouth bass as the representative species because of the available
 34 data for bass across the Delta (Appendix 8M). However, because there would be more
 35 bioaccumulation of selenium by species such as sturgeon that feed in part on clams that are
 36 known to bioaccumulate selenium readily in Suisun Bay, additional modeling was conducted for
 37 sturgeon in the western Delta (Addendum M.A for Appendix 8M).

38 Adverse effects on ecological and human receptors were quantified through comparisons of
 39 measured and modeled surface water, and tissue (fish [fillets for mercury; whole body and fillets for
 40 selenium] and bird eggs [selenium only]) data to established benchmarks, including the following.

- 41 • Water quality objectives, criteria, and drinking water standards for mercury, methylmercury,
 42 and selenium.

- 1 • Literature-derived effect levels for mercury, methylmercury, and selenium in fish fillets for
2 species most representative of the Delta.
- 3 • Literature-derived effect levels for selenium in whole-body fish for species most representative
4 of the Delta.
- 5 • Literature-derived effect levels for selenium in eggs of bird species most representative of the
6 Delta.
- 7 • State of California Office of Environmental Health Hazard Assessment’s fish contaminant goals
8 and advisory tissue levels for mercury, methylmercury, and selenium.

9 The alternatives were evaluated with regard to potential adverse impacts on ecological and human
10 receptors through a weight-of-evidence approach. The Existing Conditions and each alternative
11 were evaluated for their potential to cause exceedances of water quality or tissue benchmarks and
12 for qualitative differences in the spatial extent of those exceedances. Exceedances of tissue
13 benchmarks were determined by evaluating exceedance quotients, which are ratios of the modeled
14 fish or bird egg tissue concentrations divided by the tissue benchmark (e.g., Level of Concern,
15 Toxicity Level, or Advisory Tissue Level) in similar units. Values over 1.0 indicate modeled tissue
16 concentrations exceed the lowest threshold (e.g., Level of Concern for selenium in whole-body fish
17 or in bird eggs) or potentially toxic levels of bioaccumulation (if there is exceedance of the higher
18 Toxicity Level benchmark). The water and tissue concentrations associated with modeled
19 alternatives were compared to modeled Existing Conditions and the No Action Alternative. In
20 addition, spatial changes in the extent of marshlands associated with each alternative (i.e., CM4–
21 CM10) were evaluated qualitatively for their potential to enhance mercury or selenium
22 bioavailability and risk.

23 **8.4.1.6 Summary of Methods Used to Assess Water Quality Changes** 24 **Related to Construction Activities (CM1–CM22), Conveyance** 25 **Operations and Maintenance (CM1), and Habitat Restoration** 26 **and Other Stressor Related Conservation Measures (CM2–CM22)**

27 The construction-related water quality changes associated with all conservation measures (CM1–
28 CM22) were assessed qualitatively by evaluating the anticipated type, duration, and geographic
29 extent of construction activities to take place, and location and type of water bodies potentially
30 affected. The potential for soil, sediment, and contaminants to be discharged to water bodies was
31 determined by identifying best management/construction practices and equipment that could be
32 used, common materials or contaminants that may be present or be used for construction or
33 construction equipment, and pathways by which contaminants may enter receiving waters.

34 Actions associated with new conveyance facilities and operations criteria that resulted in water
35 quality changes associated with altered hydrodynamics, which were captured in the DSM2
36 modeling, were assessed quantitatively and discussed in Section 8.3.4.

37 Restoration actions that would result in water quality changes associated with altered
38 hydrodynamics, which were captured in the DSM2 modeling, are discussed in Section 8.3.4 as
39 operations-related water quality changes (CM1). Restoration actions that could result in a potential
40 increase in constituent loading (e.g., increased nutrient, organic carbon, or suspended solids) to the
41 Delta region were assessed qualitatively.

1 Several conservation measures (i.e., CM12–CM22) address other stressors that may affect water
 2 quality through reducing contaminants and reducing predators and other sources of direct mortality
 3 to listed species. Changes in water quality associated with conservation measures implemented to
 4 address other stressors were assessed qualitatively under a separate numbered impact for CM2–
 5 CM22.

6 Table 8-38 provides a summary of the methodologies used to assess water quality impacts that
 7 could result from implementing the alternatives.

8 **Table 8-38. Summary of Methodologies Used for Water Quality Impact Analyses**

Project/ Alternative Component	Available Models/ Techniques	Affected Environment		
		Upstream of the Delta	Plan Area	SWP/CVP Export Service Areas
Conveyance and Operations- related Effects on Water Quality (CM1)	CALSIM II	Hydrologic changes (e.g., seasonal changes in reservoir storage and river flows) used to evaluate dilution effects on constituent levels in reservoirs and rivers.	CALSIM II hydrologic output served as input to the DSM2 model.	Operations of San Luis Reservoir.
	DSM2	N/A	EC, DOC concentrations and flow fractions.	EC, DOC concentrations directly modeled at the south Delta export pumps
	Mass Balance Using Flow Fraction and Constituent Concentrations	N/A	Estimated concentrations of constituents addressed quantitatively, other than EC, and DOC, which are directly modeled by DSM2.	Estimated concentrations of constituents addressed quantitatively, other than EC, and DOC, at the south Delta export pumps.
	Qualitative Analysis	All parameters. Qualitative approach determined whether constituent concentrations were correlated to reservoir storage or river flow levels.	For all parameters not addressed quantitatively (see Appendix 8C, Table SA- 11). Qualitative approach varied based on constituent of concern and location, but attempted to estimate concentration changes attributable to the Alternatives.	For all parameters addressed. Qualitative approach varied based on constituent of concern, but attempted to estimate concentration changes attributable to the Alternatives.
Habitat Restoration- related Effects on Water Quality (CM2- 11)	DSM2	N/A	To degree possible, the DSM2 model simulated altered Delta hydrodynamics attributable to restoration tidal and riparian habitats (CM2- CM4).	N/A

Project/ Alternative Component	Available Models/ Techniques Qualitative Analysis	Affected Environment		
		Upstream of the Delta	Plan Area	SWP/CVP Export Service Areas
		N/A	Additional qualitative impact analysis of how restoration wetlands may affect specific constituent concentrations (e.g., DOC) in specific areas was provided.	Additional qualitative impact analysis of how restoration wetlands may affect specific constituent concentrations (e.g., DOC) at the south Delta pumps was provided.
	Qualitative Analysis	N/A	Qualitative analysis of how temporary conveyance construction activities would affect water quality (e.g., turbidity, sedimentation) was provided.	Qualitative impact analysis of how conveyance construction activities may affect specific constituent concentrations (e.g., turbidity, nutrients) at the south Delta pumps was provided.
Construction- related Effects on Water Quality	Qualitative Analysis	N/A	Qualitative analysis of how actions would affect water quality was provided.	Qualitative impact analysis of how the actions may affect specific constituent concentrations at specified locations was provided.
Other Stressor- related Effects on Water Quality (CM12- CM22)	Qualitative Analysis	N/A	Qualitative analysis of how actions would affect water quality was provided.	Qualitative impact analysis of how the actions may affect specific constituent concentrations at specified locations was provided.

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2 **8.4.1.7 Constituent-Specific Considerations Used in the Assessment**

3 Constituent-specific considerations that are common to the assessment of all project alternatives are
4 discussed below. Water quality constituents are also discussed in section 8.1. Data in section 8.1 is
5 meant to characterize general conditions in the affected environment, and water quality criteria and
6 objectives presented in section 8.1 are a comprehensive set of all applicable criteria and objectives.
7 In the sections below, the methodology for each constituent assessment is presented, and only
8 historical data and water quality criteria and objectives that are applicable to the assessment are
9 presented. A summary of methods used in the assessments, including the specific methodologies for
10 the quantitative assessments, is shown in Table 8-61.

11 **Construction-Related Water Quality Effects**

12 Water quality effects associated with construction activities for all conservation measures (CM1-
13 CM22) were assessed in a qualitative manner. The potential construction-related water quality
14 effects were assessed considering many aspects of the work involved and potential environmental
15 exposure to contaminants, including, but not limited to the following factors:

- 1 • Types of materials and contaminants that may be handled, stored, used, or produced at project
2 facilities during project construction, and which could be released to the environment, and the
3 related fate, transport, and harmful characteristics of the contaminants.
- 4 • Magnitude, timing, and duration of the potential contaminant discharges, and exposure
5 sensitivity of water bodies and beneficial uses that could be affected by the discharge.
- 6 • Routes of exposure for contaminants, sediment and other constituents from the construction
7 activity causing potential discharges to sensitive water bodies, including likelihood of seasonal
8 exposure to rainfall and runoff, proximity of inland work to drainage ways, occurrence of direct
9 instream discharges, and whether exposure would involve long-term effects of tidal flow in the
10 estuary.

11 The assessment of potential water quality effects considered all of the beneficial uses. However,
12 given the generally temporary and intermittent characteristics of construction and maintenance
13 discharges, a focus of the assessment is on effects to aquatic life as the likely most sensitive
14 beneficial uses in the receiving water (also refer to Chapter 11, *Fish and Aquatic Resources*, for
15 additional discussion of the effects of construction). In particular, large or sudden increases in
16 sediment, or contaminant concentrations in sediment from construction or operations/maintenance
17 activities are most likely to affect short-term, sensitive water quality characteristics such as acute
18 health responses of aquatic organisms and their habitats. Other beneficial uses, such as
19 municipal/industrial water supplies, recreational activities, or livestock/agricultural irrigation, are
20 generally anticipated to be less sensitive to short-term water quality disturbances.

21 **Ammonia**

22 For the purposes of this analysis, the U.S. EPA's 1999 National Recommended Water Quality Criteria
23 for ammonia and the 2009 draft criteria were used. U.S. EPA's 2009 draft recommended criteria are
24 more restrictive than its 1999 recommended criteria. Values derived for water at 25 °C and pH 8 are
25 shown in Table 8-39, and were used as the reasonable worst case (i.e., most sensitive) criteria in the
26 affected environment. The chronic criteria derived according to the 2009 draft documentation (0.26
27 mg/L-N) is also lower than the LOEL of 0.36 mg/L-N for chronic effects recently derived to *P. forbesi*,
28 a copepod within the affected environment (Teh et al. 2011:2).

29 A final relevant threshold includes a recommended goal for sensitive crops of 1.5 mg/L-N (Ayers
30 and Westcot 1994). It is assumed that ammonia is beneficial for crops at levels below this threshold,
31 and thus that any increases in ammonia-N concentrations that are below the 1.5 mg/L-N threshold
32 are generally not of concern for agriculture.

1 **Table 8-39. Applicable Federal Criteria, State Objectives, and Other Relevant Effects Thresholds for**
 2 **Ammonia (mg N/L)**

	Region 5 Basin Plan	Region 2 Basin Plan ^a	CTR	Drinking Water MCL	U.S. EPA Recommended Criteria	Other Relevant Thresholds
Ammonia-N	--	25	--	--	5.6/1.2 (1999) ^b 2.9/0.26 (2009) ^c	1.5 ^d , 0.36 ^e

Notes:

^a San Francisco Bay Regional Water Quality Control Board 2007. 25 mg/L 4-day average for ammonia-N.

^b First value represents acute, salmon present, second value represents chronic, fish early life stage s present, for water temperature 25 °C and pH 8.

^c First value represents acute, freshwater mussels present, second value represents chronic, freshwater mussels present, for water temperature 25 °C and pH 8.

^d Ayers and Westcot (1994). Recommended goals for sensitive crops

^e Lowest Observed Effect Level (LOEL) determined in Teh et al. 2011, for chronic effects on *P. forbesi*.

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 4 Figure 8-52 shows the seasonal levels of ammonia in the three major source waters to the Delta—
 5 the Sacramento River (SAC), the San Joaquin River (SJR), and San Francisco Bay (BAY). The data
 6 indicate that SJR and BAY concentrations are similar during all months of the year. SAC
 7 concentrations are greater than BAY or SJR virtually all of the time, being more similar in January
 8 through March and much greater during the rest of the year. The high concentrations of ammonia in
 9 SAC are a result of the SRWTP, which discharges into the Sacramento River at Freeport. Ammonia
 10 concentrations upstream of the SRWTP are similar to those in BAY and SJR (Central Valley Water
 11 Board 2010a, p.5). Thus, the primary way in which BDCP alternatives could affect ammonia
 12 concentrations is by altering flows in the Sacramento River at Freeport, which would alter available
 13 dilution for ammonia from the SRWTP. Consequently, the assessment of ammonia in the Plan Area
 14 focused on the changes in flows in the Sacramento River at Freeport and the subsequent effects on
 15 dilution and ammonia concentrations downstream.

16 The SRWTP NPDES permit was renewed by the Central Valley Water Board on December 20, 2010.
 17 The permit contains seasonal effluent limitations for ammonia-N of 1.5 mg/L on an average monthly
 18 basis and 2.0 mg/L on a maximum daily basis for the months April through October, and of 2.4 mg/L
 19 on an average monthly basis and 3.3 mg/L on a maximum daily basis for the months November
 20 through March (Central Valley Water Board 2010b:14), that must be achieved by May of 2021. In
 21 order to meet these limits, the SRWTP must be upgraded to include nitrification. For the purposes of
 22 this assessment, assumptions were made regarding the status of the upgrades under the various
 23 baselines, alternatives, and time-steps, and these are summarized in Table 8-40.

24 **Table 8-40. Assumptions on Status of Sacramento Regional Wastewater Treatment Plant**
 25 **Nitrification Upgrades Under Assessment Scenarios**

Scenario	Status of Upgrades	Average Monthly Effluent Limit for Ammonia, mg/L as N
Existing Conditions	No Upgrades	33
No Action Alternative (2060)	Upgrades Complete	1.5 (Apr-Oct) 2.4 (Nov-Mar)
Alternatives 1–9 (2060)	Upgrades Complete	1.5 (Apr-Oct)

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Boron

Applicable boron objectives for the affected environment utilized in this assessment are summarized in (Table 8-41).

Table 8-41. Applicable Federal Criteria, State Objectives, and other Relevant Effects Thresholds for Boron

	Region 5 Basin Plan ^a	Region 2 Basin Plan	USEPA Recommended Criteria
	800 / 2000 ^b	500 / 2,000 ^e	2,000 / 5,000 ^g
Boron	1,000 / 2,600 ^c	5,000 ^f	
(µg/L)	1,300 ^d		

Notes:

- ^a Basin Plan objectives apply to the lower San Joaquin River from the mouth of the Merced River to Vernalis (Central Valley Water Board 2009a).
- ^b Agricultural objective for March 15 through September 15 specified as (monthly average) / (maximum) concentration (except critical water years).
- ^c Agricultural objective for September 16 through March 14 specified as (monthly average) / (maximum) concentration (except critical water years).
- ^d Agricultural objective applicable year-round as a monthly average for critical water years.
- ^e Basin Plan agricultural objectives specified for irrigation as (threshold concentration) / (limit concentration) (San Francisco Bay Water Board 2007).
- ^f Basin Plan agricultural objective specified for stock watering (San Francisco Bay Water Board 2007).
- ^g Recommended human health advisory levels for long-term exposure through drinking water supplies specified in the form of (children)/(adults) (U.S. Environmental Protection Agency 2008b).

Sources of boron to Delta waters include the Sacramento River, the San Joaquin River, the Eastside tributaries, Delta agricultural return drains, and the San Francisco Bay. Among these sources, San Francisco Bay water contains the highest boron concentrations, followed by Delta agricultural returns, the San Joaquin River, the Sacramento River, and the Eastside tributaries (Table 8-42). Point source discharges containing boron contribute a small fraction of the boron burden to the lower San Joaquin River (Central Valley Water Board 2009a).

The lower San Joaquin River is listed on the State's CWA section 303(d) list of impaired water bodies for salt and boron (State Water Resources Control Board 2011). Boron is paired with salt in this listing due to its regular association with saline waters. The Central Valley Water Board has prepared a TMDL with implementation program where it is assumed that actions taken to control salts also will control for boron as well (Central Valley Water Board 2004).

1 **Table 8-42. Historical Boron Concentrations in the Five Delta Source Waters**

Data Parameters	Source Water				
	Sacramento River	San Joaquin River	San Francisco Bay ^a	East Side Tributaries	Delta Agriculture Return Waters ^b
Mean (µg/L)	100	349	880	68	492
Minimum (µg/L)	100	100	-	10	103
Maximum (µg/L)	200	1,100	-	250	1,192
75th Percentile (µg/L)	100	400	-	100	584
99th Percentile (µg/L)	100	918	-	244	1,159
Data source	DWR	DWR	Paulsen and List (1997) and DWR	USGS	DWR
Station(s)	Sacramento River at Greene's Landing, Sacramento River at Hood	San Joaquin River at Vernalis	Martinez and Sacramento River at Mallard Island	Cosumnes River	-- ^b
Date range	1986–2009	1986–2009	1986–2009	1953–1977	1987–2001
ND replaced with RL ^c	Yes	No	No	Yes	Yes
Data omitted	Two data points assumed to be in error (1,900 µg/L, 1,000 µg/L)	None	None	None	None
No. of Data Points	468	483	265	60	339

Notes:

^a No data available for boron at Martinez in any of the available data sets. Paulsen and List (1997) measured boron daily at Martinez from 4/13/96–8/29/96. Paulsen and List (1997) lists only the mean, minimum, and maximum concentrations found. However, extensive boron data was available for the Sacramento River at Mallard Island (i.e., DWR MWQI program data for 1986–2009) which indicated a strong seasonal concentration pattern in the western Delta. Consequently, to estimate the seasonal monthly average boron concentrations at Martinez, the monthly average mean values for Mallard Island were multiplied by the ratio of the average Martinez (Paulsen and List 1997) to long term average Mallard Island mean concentrations. Refer to Appendix 8F, Table Bo-1 for additional information and tabulation of the calculated monthly average boron concentrations for the Bay source water.

^b Agricultural return drains are distributed unevenly throughout the Delta. Water quality associated with these drains varies depending on the specific location of the drain within the Delta, and largely coincides with the water quality of the water that is withdrawn from the Delta for application onto agricultural lands. In order to characterize boron concentrations in agricultural drain water as a whole, the following process was followed:

All boron data from those agricultural drains from the DWR Water Data Library, which had historical boron data, were placed into a database.

The drains were assigned a region in the Delta according to their location (Central, North, East, South, and West)

Three drains from each region were chosen at random, and the data from each of these drains was downloaded.

The stations selected included: Ag Drain on Jersey Island, Ag Drain on King Island, PP. No. 1, Ag Drain on King Island, PP. No. 2, Ag Drain on Orwood Tract, Ag Drain on Palm Tract, Ag Drain on Pescadero Tr., PP. No. 3, Ag Drain on Pescadero Tract, PP. No. 4, Ag Drain on Rindge Tract, PP. No. 1, Ag Drain on Twitchell Isl., PP. No. 1, Ag Drain on Pescadero Tr., PP. No. 1

To derive an overall mean, minimum, maximum, 75th, and 95th percentile, the mean, minimum, maximum, 75th and 95th percentiles of the individual drain averages was calculated.

The process was an attempt to derive values that were representative of the Delta as a whole, regardless of how many drains in each region had data, and how many data points existed at each drain.

^c In some cases, data were reported as non-detects, and the entry contained an accompanying reporting limit. "Yes" indicates that at least one non-detect was replaced with the reporting limit in order to calculate summary statistics, while "No" indicates that this was not done, generally because no data were reported as non-detect.

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1 Because of boron's elemental nature, it is considered a conservative constituent, not subject to
2 degradation through volatilization, breakdown, or uptake as it moves through the system. Boron,
3 however, does adsorb to mineral soils and organic matter, which allows for its accumulation in soils
4 irrigated with water containing boron. Because of its ability to leach through soils, this partitioning
5 can be considered temporary; therefore, the assessment of potential impacts from boron assumes
6 that mass is generally conserved. Consequently, boron concentrations at any location in the Delta
7 primarily reflect the mass balance of the flow and concentrations of the major water sources.
8 Therefore, a quantitative mass-balance approach using the source water flow fractions from the
9 DSM2 model output and source water concentrations was used to estimate boron concentration
10 changes that would occur with the alternatives. The long-term average source water concentrations
11 were used for most locations in the mass-balance assessment; however, due to the presence of a
12 distinct seasonal pattern in the boron concentrations of the San Francisco Bay source water at the
13 interface with the Delta in relation to seasonal Delta outflow pattern, monthly average
14 concentrations were used for this location. Additionally, sample data for boron at the Martinez
15 location were limited to literature values for the annual average concentration, whereas substantial
16 monthly data were available for the Sacramento River at Mallard Island. Consequently, monthly
17 average Martinez concentrations were estimated by simple linear extrapolation of the monthly
18 average Mallard Island concentrations by the ratio of the annual average Mallard Island to Martinez
19 concentration.

20 The mass-balance modeling results were used to compare predicted changes in assessment
21 variables (e.g., exceedances of objectives/criteria, amount of water quality degradation relative to
22 boron, and contribution to 303(d) impairment effects). The assessment of effects relative to
23 applicable objectives/criteria for the protection of agricultural beneficial uses was based on changes
24 in monthly average concentrations modeled for all water year types for the 16-year (1976–1991)
25 hydrologic period of record and for the drought years only (i.e., 1987–1991), and the effects relative
26 to municipal and industrial water supply was based on changes in annual average concentrations for
27 the modeled 16-year and drought periods.

28 The implementation of CM4 would restore substantial areas of tidal habitat that is expected to
29 increase the magnitude of daily tidal water exchange at the restoration areas, and could alter other
30 hydrodynamic conditions in adjacent Delta channels. San Francisco Bay water is a substantial source
31 of boron, thus, the increased tidal exchange resulting from tidal habitat restoration may increase
32 boron concentrations in the portion of the Bay water that enters the western Delta. The DSM2
33 modeling included assumptions regarding possible locations of tidal habitat restoration areas, and
34 how restoration would affect Delta hydrodynamic conditions and source water flow fractions.
35 However, the magnitude of increased boron concentrations in Bay source water in the western Delta
36 as a result of increased tidal exchange is uncertain. Consequently, the potential effects of tidal
37 restoration on boron concentrations in the Bay source water was assessed qualitatively based on
38 predicted changes in the Bay source water fraction. The effects of other conservation measures (i.e.,
39 CM2, CM3, and CM5–CM22) which do not substantially affect flows or Delta hydrodynamic
40 conditions, also were assessed qualitatively.

41 **Bromide**

42 Bromide concentrations at a particular location and time in the Delta are determined primarily by
43 the sources of water to that location, at a given time. Hence, long-term average concentrations at a
44 particular Delta location are determined primarily by the long-term average sources of water to that
45 location, and the long-term average concentration of bromide in each of the major source waters to

1 the location. The major source waters to any given Delta location are: (1) Sacramento River, (2) San
2 Joaquin River, (3) Bay water, (4) eastside tributaries, and (5) agricultural return water.

3 Bromide is not routinely monitored in surface water samples collected north of the Delta, primarily
4 due to the low concentration of bromide in this region. Data available for the American River
5 suggests that bromide concentrations are <10 µg/L. Table 8-43 provides a summary of bromide
6 concentrations in the primary source waters of the Delta, as well as information on the source of the
7 data and summary statistics. Due to the quality and quantity of data available, as well as the
8 conservative nature of the constituent, a quantitative assessment utilizing a mass-balance approach
9 was employed in the assessment of alternatives. Additionally, results of a second modeling approach
10 utilizing EC to chloride and chloride to bromide relationships were used to supplement the results of
11 the mass-balance approach (see Section 8.3.1.3). Because bromide is a precursor to the formation of
12 DBPs which represent a long-term risk to human health, and because the existing source water
13 quality goal is based on a running annual average, the quantitative assessment focuses on the degree
14 to which an alternative may result in change in long-term average bromide concentrations at
15 various locations throughout the affected environment. For municipal intakes located in the Delta
16 interior, assessment locations at Contra Costa Pumping Plant No. 1 and Rock Slough are taken as
17 representative of Contra Costa's intakes at Rock Slough, Old River and Victoria Canal, and the
18 assessment location at Buckley Cove is taken as representative of the City of Stockton's intake on the
19 San Joaquin River. Municipal intakes at Mallard Slough, City of Antioch, and the North Bay Aqueduct
20 are represented by their respective assessment locations. For the purposes of this assessment,
21 bromide concentrations for water transported into the SWP/CVP Export Service Areas are assessed
22 based on concentrations at the primary SWP and CVP Delta export locations (i.e., Banks and Jones
23 pumping plants).

24 As demonstrated in Table 8-43, achieving the CALFED goal of 50 µg/L bromide at drinking water
25 intakes is severely challenged by the quality of at least three of the five primary source waters,
26 where long-term average concentrations exceed this goal many fold in the source waters
27 themselves. In establishing its source water goal for bromide, CALFED assumed more stringent DBP
28 criteria for treated drinking water than are currently in place. Source water with bromide between
29 100 µg/L and 300 µg/L is believed sufficient to meet currently established drinking water criteria
30 for DBPs, depending on the amount of *Giardia* inactivation required (California Urban Water
31 Agencies 1998, ES2). This assessment of alternatives evaluates how each alternative would affect
32 the frequency with which predicted future bromide concentrations would exceed 50 µg/L and 100
33 µg/L on a long-term average basis at the assessment locations. Because, in many cases, the existing
34 condition is one already exceeding 50 µg/L, the frequency with which bromide exceeds 100 µg/L
35 becomes a key focus of the assessment, as well as the change in long-term average bromide
36 concentration.

1 **Table 8-43. Source Water Concentrations for Dissolved Bromide ($\mu\text{g/L}$)**

Source Water	Sacramento River	San Joaquin River	San Francisco Bay ^a	Eastside Tributaries	Agriculture in the Delta
Mean ($\mu\text{g/L}$)	15	251	13,149–32,951	16	456
Minimum ($\mu\text{g/L}$)	1	20	28–17,465	14	20
Maximum ($\mu\text{g/L}$)	100	650	33,985–44,100	17	2,720
75th Percentile ($\mu\text{g/L}$)	20	345	22,313–38,500	N/A	580
99th Percentile ($\mu\text{g/L}$)	44	565	22,313–38,500	N/A	1,850
Data Source	DWR	DWR	BDAT	BDAT	DWR
Station(s)	Sac River at Greene's Landing, Sac River at Hood	SJR at Vernalis	^b	Mokelumne River at Sacto Road	^c
Date Range	1990–2009	1990–2009	1980–2007	1990–1990	1990–2001
ND Replaced with RL	Yes	No	No	No	No
Data Omitted	None	None	None	None	Yes ^d
No. of Data Points	560	547	26–27	2	991

Notes:

- ^a Values reported as range of monthly values (minimum monthly–maximum monthly). Trends in monthly average bromide at Martinez suggested a seasonality to concentration. Due to the appearance of seasonality in monthly average concentration at this location, average monthly concentration was used. Actual monthly values for the dataset are provided in Appendix 8E, Bromide Table 1.
- ^b Measured bromide data at Martinez was not available for this analysis. Bromide data at Martinez was estimated from the regressed relationship of bromide to chloride at Mallard Island (Appendix 8E, Bromide Figure 1). The empirical relationship of bromide to chloride obtained at Mallard Island was similar to that of ocean water (Morris and Riley 1966), or 0.0035 parts bromide to 1 part chloride. Bromide data at Martinez used in this analysis therefore represents measured Martinez chloride multiplied by a factor of 0.0035.
- ^c Values calculated from all agriculture drain data pooled together. All bromide data from agricultural drains contained in the DWR Water Data Library were placed into a single database. Due to the uneven distribution of agricultural drains in the Delta, geographical trends in agricultural drain water quality were evaluated by categorizing the data based on their associated location in the Delta. Categories included western, southern, northern, eastern, and central Delta, following the geographical delineations of the State Water Resources Control Board. With data pooled and categorized by region, average concentration by region were compared. Average bromide varied by less than a factor of 3, with highest concentration in the southern Delta and lowest in the central Delta. No bromide data was available for the northern Delta. Due to the apparent low regional variability, values were obtained by pooling all data together and obtaining summary statistics from this pooled database.
- ^d Data for the Byron Tract #2 and Byron Tract #3 agricultural drains were omitted from the database due to their reported values being substantially outside the distribution of all other values. These values were: 65,000 $\mu\text{g/L}$ and 46,800 $\mu\text{g/L}$. In total, 2 data points were omitted and 991 were retained.

2

3 **Chloride**

4 As an inorganic anion, chloride is generally conservative in the aquatic environment and its fate and
5 transport characteristics are similar to other salinity constituents. Consequently, chloride

1 concentrations at any location in the Delta primarily reflect the mass balance of the flow and
2 concentrations of the major water sources. Therefore, a quantitative mass-balance approach using
3 the source water flow fractions from the DSM2 model output and source water concentrations was
4 used to estimate chloride concentration changes that would occur as a result of implementation of
5 changed water conveyance features under CM1 for the alternatives.

6 In addition, the implementation CM4 would restore substantial areas of tidal habitat that would
7 increase the magnitude of daily tidal water exchange at the restoration areas, and could alter other
8 hydrodynamic conditions in adjacent Delta channels. San Francisco Bay water is a major source of
9 chloride, thus, the increased tidal exchange resulting from tidal habitat restoration may increase
10 chloride concentrations in the portion of the Bay water that enters the western Delta. The DSM2
11 modeling included assumptions regarding possible locations of tidal habitat restoration areas, and
12 how restoration would affect Delta hydrodynamic conditions and source water flow fractions.
13 However, the magnitude of increased chloride concentrations in Bay source water in the western
14 Delta as a result of increased tidal exchange is uncertain. Consequently, the potential effects of tidal
15 restoration on chloride concentrations in the Bay source water was assessed qualitatively based on
16 predicted changes in the Bay source water fraction. The effects of other conservation measures (i.e.,
17 CM2, CM3, and CM5–CM22) which do not substantially affect flows or Delta hydrodynamic
18 conditions also were assessed qualitatively.

19 Applicable chloride objectives for the affected environment utilized in this assessment are
20 summarized in (Table 8-44). The mass-balance modeling results were used to compare predicted
21 changes in assessment variables (e.g., exceedances of objectives/criteria, amount of water quality
22 degradation relative to chloride) based on averaging periods appropriate for each relevant
23 beneficial use. Results of a second modeling approach utilizing relationships between EC and
24 chloride were used to supplement those results (see Section 8.3.1.3). The assessment of effects
25 relative to designated beneficial uses and associated water quality objectives/criteria was based on
26 changes in long-term average concentrations modeled for all water year types for the 16-year
27 (1976–1991) hydrologic period of record and for the drought years only (i.e., 1987–1991).
28 Compliance for some applicable objectives/criteria are based on short-term averaging period
29 concentrations; e.g., daily data for Bay-Delta WQCP objectives for municipal and industrial water
30 supply for specific locations in the Delta (e.g., daily data) and the U.S. EPA aquatic life criteria (i.e., 4-
31 day chronic and 1-hour acute criteria). The available monitoring data for source water chloride
32 concentrations are not adequate to characterize daily variability, and the channel flows modeled in
33 CALSIM, which provides the hydrologic input to the DSM2 model, is on a monthly time-step.
34 Therefore, the mass-balance approach can only be used for monthly average assessment, and thus
35 for the chloride assessment cannot be used to evaluate exceedances of the 150 mg/L objective, and
36 can only evaluate exceedances of the 250 mg/L objective on a monthly average basis instead of a
37 daily average basis. Consequently, the assessment of potential effects of alternatives relative to the
38 150 mg/L objective was based only on daily chloride data obtained via the EC to chloride
39 relationships and DSM2 EC output (as described in Section 8.3.1.3). Relative to the 250 mg/L
40 objective, assessment was based on both monthly average concentrations from the mass-balance
41 approach and daily average concentrations from the EC to chloride relationship approach.

42

1 Table 8-44. Applicable Federal Criteria, State Objectives, and Other Relevant Effects Thresholds for Chloride (mg/L unless specified)

Location	Bay-Delta WQCP		Region 5 Basin Plan	Region 2 Basin Plan	Drinking Water MCL	U.S. EPA Recommended Criteria
<i>All Receiving Waters Other Than the Delta</i>	--		250 ^{a, b} 500 ^{a, c} 600 ^{a, d}	142/355 ^e 250 ^{a, b} 500 ^{a, c} 600 ^{a, d}	250 ^b 500 ^c 600 ^d	230/860 ^f
<i>Delta-Specific</i>						
Contra Costa Canal @ Pumping Plant No. 1 or San Joaquin River @ Antioch Water Works Intake	Year Type	Objective ^g	--	--	--	--
	W	<150-240 days/calendar year (66%)				
	AN	<150-190 days/calendar year (52%)				
	BN	<150-175 days/calendar year (48%)				
	D	<150-165 days/calendar year (45%)				
Contra Costa Canal @ Pumping Plant #1, West Canal @ Mouth of Clifton Court Forebay, Jones Pumping Plant, Barker Slough @ North Bay Aqueduct, and Cache Slough @ the City of Vallejo Intake	250 (Oct.-Sep.) ^h		--	--	--	--
Notes: A = Annual, etc.						
^a State secondary maximum contaminant level (MCL) incorporated by reference in the Basin Plan. No fixed consumer acceptance contaminant level has been established. Municipal water systems must monitor for compliance based on a running average of four quarterly values. The Region 5 Basin Plan incorporates the MCLs by reference, but do not specify an averaging period for assessment of compliance.						
^b Recommended Contaminant Level for the state secondary MCL. Constituent concentrations lower than the recommended contaminant level are desirable for a higher degree of consumer acceptance.						
^c Upper Contaminant Level for the state secondary MCL. Constituent concentrations ranging to the upper contaminant level are acceptable if it is neither reasonable nor feasible to provide more suitable waters.						
^d Short Term Contaminant Level for the state secondary MCL. Constituent concentrations ranging to the short term contaminant level are acceptable only for existing community water systems on a temporary basis pending construction of treatment facilities or development of acceptable new water sources.						
^e Objectives for agricultural water supply identified in Basin Plan as a "threshold value/limit value"; no averaging period is defined for assessment of compliance.						
^f U.S. EPA National Recommended Water Quality Criteria specified as Criterion Continuous Concentration (CCC)/Criteria Maximum Concentration (CMC).						
^g Municipal and industrial water supply beneficial use objective, specified as a maximum mean daily value for at least the number of days shown during the calendar year. Must be provided in intervals of not less than two weeks duration (percentage of calendar year shown in parentheses).						
^h Municipal and industrial water supply beneficial use objective, specified as a maximum mean daily value to be applied year-round for all water year types.						
Need to define Water Year Types						

1 The U.S. EPA has also published recommended national aquatic life criteria for chloride (Table 8-
 2 44). This recommended chloride criterion is not used in the assessment of Delta effects for several
 3 reasons. Firstly, the U.S. EPA recommended chloride criterion is only applicable to freshwater, and
 4 its appropriate application in a dynamic estuary such as the Delta is uncertain. Secondly, the
 5 national recommended criterion is currently being revised by U.S. EPA. New toxicity studies have
 6 resulted in a different understanding of species sensitivities in freshwater, and have revealed a
 7 hardness and sulfate dependence (i.e., similar to that of trace metals) that was not taken into
 8 consideration in the drafting of the most current criterion. Thirdly, with regard to aquatic life
 9 beneficial uses in the Delta, the State has taken the approach of regulating salinity through the
 10 establishment of EC objectives. Chloride is a major component of salinity, as measured by EC. Effects
 11 on compliance with EC-related aquatic life objectives is addressed for each project alternative
 12 relative to model predicted changes in Delta EC. In addition, salinity-based project alternative effects
 13 to covered and uncovered fish species, invasive benthic invertebrates, invasive aquatic vegetation,
 14 and blue-green algae are addressed in Chapter 11, *Fish and Aquatic Resources*.

15 Table 8-45 provides a summary of chloride concentrations in the primary source waters of the Delta
 16 used for the mass-balance approach, as well as information on the source of the data and summary
 17 statistics. The long-term average source water concentrations were used for most locations in the
 18 mass-balance assessment; however, due to the presence of a distinct seasonal pattern in the chloride
 19 concentrations of the San Francisco Bay source water at the interface with the Delta in relation to
 20 seasonal Delta outflow pattern, monthly average concentrations were used for this location.

21 **Table 8-45. Historical Chloride (Dissolved) Concentrations in the Five Delta Source Waters**

Source Water	Sacramento River	San Joaquin River	San Francisco Bay ^a	East Side Tributaries	Delta Agriculture Return Waters ^b
Mean (mg/L)	6.38	81.4	3,757–9,414	2.36	136
Minimum (mg/L)	1.00	1.00	8–4,990	0.30	3.0
Maximum (mg/L)	33.0	221	9,710–12,600	8.60	830
75th Percentile (mg/L)	8.00	111	6,375–11,000	3.05	175
99th Percentile (mg/L)	12.3	186	9,643–1,2574	5.79	636
Data Source	DWR, BDAT	DWR, BDAT	BDAT	USGS	DWR
Station(s)	Sac River at Greene's Landing, Sac River at Hood	SJR at Vernalis	Suisun Bay at Bulls Head near Martinez	Mokelumne River, Cosumnes River	^b
Date Range	1980–2009	1980–2009	1980–2007	1952–1994	1987–2001
ND Replaced with RL	No	No	No	No	No
Data Omitted	None	None	None	Single <0.1 value from each data set, 0 values from Cosumnes River	None
No. of Data Points	867	844	26–27	391	1,543

Notes:

^a Values reported as range of monthly values (minimum monthly–maximum monthly). Review of available sample data for the Martinez location suggests that there is a generally seasonal trend in monthly average chloride concentration.

Chloride concentrations used to represent San Francisco Bay water in the mass-balance assessment were determined on a monthly average basis. Refer to Appendix 8G, Table Cl-61 for additional information and tabulation of the calculated monthly average chloride concentrations for the Bay source water.

^b Values calculated from all agriculture drain data pooled together. All chloride data from agricultural drains contained in the DWR Water Data Library were placed into a single database.

1 Seasonal or long-term changes in chloride concentrations at western Delta locations would be
 2 associated with changes in the location of the tidal mixing zone and interface of the elevated Bay salt
 3 water and freshwater Delta outflow. Changes in the salt water/freshwater interface may result in
 4 shifts of the acceptability of a location between freshwater- and salinity-tolerant aquatic fish,
 5 aquatic vegetation, and other aquatic organisms. The significance of these potential effects relative
 6 to applicable freshwater and estuarine water quality objectives is not assessed in the chloride
 7 assessment. Rather, the reader is referred to Chapter 11, *Fish and Aquatic Resources*, for the detailed
 8 assessment of changes in the location of the tidal mixing zone (e.g., as measured by the location of
 9 X2) and for its impact(s) to aquatic life beneficial uses.

10 **Dissolved Oxygen**

11 DO levels in the reservoirs and rivers upstream of the Delta are primarily affected by water
 12 temperature, flow velocity, turbulence, amounts of oxygen demanding substances present (e.g.,
 13 ammonia, organics), and rates of photosynthesis (which is influenced by nutrient levels),
 14 respiration, and decomposition. Water temperature and salinity affect the maximum DO saturation
 15 level (i.e., the highest amount of oxygen the water can dissolve). Flow velocity affects the turbulence
 16 and re-aeration of the water (i.e., the rate at which oxygen from the atmosphere can be dissolved in
 17 water). High nutrient content can support aquatic plant and algae growth, which in turn generates
 18 oxygen through photosynthesis and consumes oxygen through respiration and decomposition.

19 Effects of the alternatives on temperature in the Delta relative to the No Action alternative were not
 20 considered in the DO assessment. This is because, as stated in the USFWS (2008b:194) OCAP BiOp:

21 The [state and federal] water projects have little if any ability to affect water temperatures in the
 22 Estuary (Kimmerer 2004). Estuarine and Delta water temperatures are driven by air temperature.
 23 Water temperatures at Freeport can be cooled up to about 3°C by high Sacramento River flows, but
 24 only by very high river flows that cannot be sustained by the projects. Note also that the cooling
 25 effect of the Sacramento River is not visible in data from the west Delta at Antioch (Kimmerer 2004)
 26 so the area of influence is limited.

27 Since Delta water temperatures are driven by air temperature, climate change (as included in the No
 28 Action Alternative and all action alternatives) that increases air temperatures relative to existing
 29 conditions would be expected to increase water temperatures in the Delta as well. Effects of climate
 30 change on air and Delta water temperatures are discussed in Appendix 29C. In general, waters of the
 31 Delta would be expected to warm less than 5 degrees F, which translates into a < 0.5 mg/L decrease
 32 in DO.

33 The dissolved oxygen assessments were conducted in a qualitative manner based on anticipated
 34 changes in these factors.

35 **Electrical Conductivity**

36 EC and TDS values tend to be highly correlated, because the majority of chemicals that contribute to
 37 TDS are charged particles that impart conductance of water. Because EC measurement is easily
 38 conducted with a portable meter, as compared to the requirement for physical sample collection and
 39 laboratory gravimetric analysis for TDS, the majority of water quality regulatory criteria/objectives
 40 are established for EC. Moreover, where regulatory objectives for TDS exist, they co-occur with the
 41 equivalent EC value (i.e., there are no independent TDS-only regulatory criteria/objectives or
 42 guidance values). EC also is the parameter modeled to represent salinity in DSM2. Therefore, this

1 impact assessment for “salinity” as indicated by EC and TDS is based on EC values only and TDS is
2 not addressed separately.

3 Applicable EC objectives for the affected environment utilized in this assessment are summarized in
4 Table 8-46.

5 The assessment of effects on EC in the reservoirs and rivers upstream of the Delta was qualitative,
6 and evaluates changes in EC based on anticipated changes in EC-contributing sources in the
7 watersheds under the various BDCP alternatives assessed.

8 The assessment of hydrodynamic effects of the BDCP alternatives' CM1, CM2, and CM4 on EC in the
9 Plan Area relied on DSM2 output. Because implementation CM4 would restore substantial areas of
10 tidal habitat that would increase the magnitude of daily tidal water exchange at the restoration
11 areas, and could alter other hydrodynamic conditions in adjacent Delta channels, the DSM2
12 modeling included assumptions regarding possible locations of tidal habitat restoration areas, and
13 how restoration would affect Delta hydrodynamic conditions and source water flow fractions. The
14 effects of other conservation measures (i.e., CM3 and CM5–CM22) which do not substantially affect
15 Delta hydrodynamic conditions were assessed qualitatively.

- 16 • DSM2 directly models Delta EC levels on a 15-minute interval. DSM2 output for EC was post-
17 processed to compare results to the Bay-Delta WQCP objectives at the following locations.
- 18 • Western Delta: Sacramento River at Emmaton and San Joaquin River at Jersey Point
- 19 • Interior Delta: South Fork Mokelumne River at Terminous, San Joaquin River at San Andreas
20 Landing, and San Joaquin River at Prisoners Point
- 21 • Southern Delta: San Joaquin River at Vernalis, San Joaquin River at Brandt Bridge, Old River near
22 Middle River, and Old River at Tracy Road Bridge

23 For the assessment of Alternatives 1–9, the Sacramento River at Emmaton compliance location is
24 relocated to Three Mile Slough near the Sacramento River. For comparing effects of the alternatives
25 on EC in this portion of the Delta, two comparisons were made:

- 26 • changes in EC in the Sacramento River at Emmaton under the alternatives are compared to EC at
27 Emmaton under Existing Conditions and the No Action Alternative, and
- 28 • changes in EC in Three Mile Slough under the alternatives are compared to EC at Emmaton
29 under Existing Conditions and the No Action Alternative.

30 The western and interior Delta EC objectives are expressed as a 14-day running average, and the
31 southern Delta EC objectives are expressed as a 30-day running average. Compliance with these EC
32 objectives was assessed by calculating 14-day and 30-day running averages of the 15-minute DSM2
33 EC results and tallying the number of days out of compliance with the applicable objective. The Bay-
34 Delta WQCP considers all days in an averaging period out of compliance, if the objective is exceeded
35 on the last day of the averaging period. Because this could overestimate the general change in EC at
36 compliance locations, the number of days the running average EC objective was exceeded was also
37 assessed to identify general trends in EC changes under the alternatives assessed.

1 **Table 8-46. Applicable State Objectives and Other Relevant Effects Thresholds for Electrical Conductivity ($\mu\text{mhos/cm}$ [at 25°C] unless specified)**

Location	Bay-Delta WQCP	Region 5 Basin Plan	Region 2 Basin Plan	Drinking Water MCL
<i>All Receiving Waters Other than the Delta</i>	--	900 ^{a, b}	200-3,000 ^e	900 ^{a, b}
		1,600 ^{a, c}	900 ^f	1,600 ^{a, c}
		2,200 ^{a, d}		2,200 ^{a, d}
<i>Delta-Specific</i>	<u>Year Type</u>	<u>Objective^g for Agricultural Beneficial Uses</u>		
Western Delta– Sacramento River @ Emmaton	W	450 (Apr. 1–Aug. 15)	--	--
	AN	450 (Apr. 1–Jun. 30); 630 (Jul. 1–Aug 15)		
	BN	450 (Apr. 1–Jun. 19); 1,140 (Jun. 20–Aug 15)		
	D	450 (Apr. 1–Jun. 14); 1,670 (Jun. 15–Aug 15)		
	C	2,780 (Apr. 1–Aug. 15)		
Western Delta– SJR @ Jersey Point	W	450 (Apr. 1–Aug. 15)	--	--
	AN	450 (Apr. 1–Aug. 15)		
	BN	450 (Apr. 1–Jun. 19); 740 (Jun. 20–Aug 15)		
	D	450 (Apr. 1–Jun. 14); 1,350 (Jun. 15–Aug 15)		
	C	2,200 (Apr. 1–Aug. 15)		
Interior Delta– S.F. Mokelumne @ Terminus	W	450 (Apr. 1–Aug. 15)	--	--
	AN	450 (Apr. 1–Aug. 15)		
	BN	450 (Apr. 1–Aug. 15)		
	D	450 (Apr. 1–Aug. 15)		
	C	540 (Apr. 1–Aug. 15)		
Interior Delta– SJR @ San Andreas Landing	W	450 (Apr. 1–Aug. 15)	--	--
	AN	450 (Apr. 1–Aug. 15)		
	BN	450 (Apr. 1–Aug. 15)		
	D	450 (Apr. 1–Jun. 24); 580 (Jun. 25–Aug 15)		
	C	870 (Apr. 1–Aug. 15)		

Location	Bay-Delta WQCP	Region 5 Basin Plan	Region 2 Basin Plan	Drinking Water MCL
Southern Delta	<u>Objective for Agricultural Beneficial Uses</u>	--	--	-
	700 (Apr. 1–Aug. 31)			
	1,000 (Sep. 1–Mar. 31) ^h			
Export Area	<u>Objective for Agricultural Beneficial Uses</u>	--	--	--
	1,000 (Oct. 1–Sep. 30) ⁱ			
SJR at and between Prisoners Point and Jersey Point	<u>Objective for Fish and Wildlife Beneficial Uses</u>	--	--	--
	440 (Apr. 1–May 31) ^j			
Eastern Suisun Marsh (Sacramento @ Collinsville; Montezuma Slough @ National Steel; Montezuma Slough near Beldon Landing)	<u>Month</u> <u>Objective ^k for Fish and Wildlife Beneficial Uses</u>	--	--	--
	Oct 19,000			
	Nov–Dec 15,500			
	Jan 12,500			
	Feb–Mar 8,000			
	Apr–May 11,000			
Western Suisun Marsh (Cadbourn Slough @ Sunrise Duck Club, Suisun Slough [300 ft south of Volanti Slough], Cordelia Slough at Ibis Club, Goodyear Slough at Morrow Is. Clubhouse, and water supply intakes for water fowl management areas on Van Sickle and Chipps Is.)	<u>Month</u> <u>Objective ^l</u> <u>Month</u> <u>Objective ^m for Fish and Wildlife Beneficial Uses</u>	--	--	--
	Oct 19,000 Oct 19,000			
	Nov 16,500 Nov 16,500			
	Dec 15,500 Dec–Mar 15,600			
	Jan 12,500 Apr 14,000			
	Feb–Mar 8,000 May 12,500			
	Apr–May 11,000			

1
2

1 Notes for Table 8-46

Notes:

- ^a State secondary maximum contaminant level (MCL). No fixed consumer acceptance contaminant level has been established. Municipal water systems must monitor for compliance based on a running average of four quarterly values. The Region 5 Basin Plan incorporates the MCLs by reference, but do not specify an averaging period for assessment of compliance.
 - ^b Recommended Contaminant Level. Constituent concentrations lower than the recommended contaminant level are desirable for a higher degree of consumer acceptance.
 - ^c Upper Contaminant Level. Constituent concentrations ranging to the upper contaminant level are acceptable if it is neither reasonable nor feasible to provide more suitable waters.
 - ^d Short Term Contaminant Level. Constituent concentrations ranging to the short term contaminant level are acceptable only for existing community water systems on a temporary basis pending construction of treatment facilities or development of acceptable new water sources.
 - ^e Objectives for agricultural water supply specified as a “limit” consisting of a range of concentrations and no averaging period is defined for assessment of compliance.
 - ^f Objective for municipal supply.
 - ^g Agricultural objective is a 14-day running average of mean daily EC.
 - ^h Agricultural objective is a maximum 30-day running average of mean daily EC. Objectives applicable to all southern Delta channels and specified compliance stations (i.e., San Joaquin River @ Airport Way Bridge-Vernalis, San Joaquin River @ Brandt Bridge, Old River near Middle River, and Old River @ Tracy Road Bridge).
 - ⁱ Agricultural objective is a maximum monthly average of mean daily EC. Compliance stations are West Canal @ Mouth of Clifton Court Forebay and Delta-Mendota Canal at Tracy Pumping Plant.
 - ^j Fish and wildlife objective is a maximum 14-day running average of mean daily EC.
 - ^k Fish and wildlife objectives for Sacramento @ Collinsville, Montezuma Slough @ National Steel, and Montezuma Slough near Beldon Landing. Compliance based on maximum monthly average of both daily high tide EC values, or demonstrate that equivalent of better protection will be provided at the location. Applies in all water year types except during deficiency period.
 - ^l Fish and wildlife objectives for Caddourne Slough @ Sunrise Duck Club, Suisun Slough (300 ft south of Volanti Slough), Cordelia Slough at Ibis Club, Goodyear Slough at Morrow Is. Clubhouse, and water supply intakes for water fowl management areas on Van Sickle and Chipps Is. Compliance based on maximum monthly average of both daily high tide EC values, or demonstrate that equivalent of better protection will be provided at the location. Applies in all water year types except during deficiency period.
 - ^m A deficiency period is: (1) the second consecutive dry water year following a critical year; (2) a dry water year following a year in which the Sacramento River Index (described in footnote e) was less than 11.35; or (3) a critical water year following a dry or critical water year. The determination of a deficiency period is made using the prior year’s final Water Year Type determination and a forecast of the current year’s Water Year Type; and remains in effect until a subsequent water year is other than a Dry or Critical water year as announced on May 31 by DWR and U.S. Bureau of Reclamation (Reclamation) as the final water year determination.
-

2

1 The effects on EC in SWP/CVP Export Service Areas also relied on DSM2 output. For assessment of
2 alternatives involving conveyance of north Delta water to the Banks and Jones pumping plants,
3 DSM2 results for the south Delta pumping plant locations were blended, or mass-balanced, with
4 modeled north Delta diversions to provide an estimate of the EC of the water conveyed by these
5 pumping plants to the SWP/CVP Export Service Areas south of the Delta. The resulting blended
6 monthly mean EC levels were compared to the Bay-Delta WQCP objectives for the export areas,
7 which are the objectives for protection of the agricultural beneficial uses in the south Delta
8 SWP/CVP Export Service Areas.

9 Assessment of Suisun Marsh EC was conducted qualitatively, utilizing average EC for the entire
10 period modeled (1976–1991) to determine the overall change and degree to which EC could be
11 affected by the alternatives. The Suisun Marsh locations utilized in the analysis correspond to the EC
12 compliance locations in the Bay-Delta WQCP: Sacramento River at Collinsville, Montezuma Slough at
13 National Steel, Montezuma Slough near Beldon Landing, Chadbourne Slough at Sunrise Duck Club,
14 and Suisun Slough 300 feet south of Volanti Slough. These locations represent a geographic range
15 from which to assess changes.

16 Understanding some basic input assumptions for DSM2 is important for interpreting the results and
17 effects analysis, including assessment of compliance with water quality objectives. While DSM2
18 simulates EC on a 15-minute time-step, the Delta inflow and agricultural return flow inputs, and
19 Delta operations (e.g., Delta Cross Channel gate operations) inputs to DSM2 are on a monthly time-
20 step. Because the DSM2 inputs are on a monthly time-step, the assessment of compliance with sub-
21 monthly objectives (e.g., 14-day running averages) is conducted in terms of assessing the overall
22 direction and degree to which Delta EC would be affected relative to a baseline, and discussion of
23 compliance does not imply that the alternative would literally cause Delta EC to be out of
24 compliance a certain period of time. In other words, the model results are used in a comparative
25 mode, not a predictive mode.

26 **Mercury and Methylmercury**

27 Mercury is an element of concern for the Delta, its tributaries, Suisun Marsh, and San Francisco Bay
28 because of contamination from historical upstream sources originating from mercury mines in the
29 Coast Ranges (via Putah and Cache creeks to the Yolo Bypass) and gold extraction processes in the
30 Sierra Nevada (via Sacramento, San Joaquin, Cosumnes, and Mokelumne river sources) (Alpers et al.
31 2008; Wiener et al. 2003). Examples of primary mercury sources include mercury ore tailings (e.g.,
32 Cache Creek) or elemental mercury from gold field use (e.g., Eastside tributaries). The mercury
33 supplied from historical gold mining processes appears to be the most bioavailable of the two
34 primary sources (Central Valley Water Board 2008a). Although atmospheric deposition is a source
35 of mercury, none of the proposed actions affect that source and in the case of the California Central
36 Valley, mining sources completely dominate loading (Central Valley Water Board 2011b).

37 The bioavailability and toxicity of mercury (from whatever primary source) is greatly enhanced
38 through the natural, bacterial conversion of mercury to methylmercury in marshlands or wetlands.
39 These stagnant locations with reduced oxygen concentrations promote chemical reduction
40 processes that make methylation possible.

41 Areas of enhanced bioavailability and toxicity of mercury (created through the mercury methylation
42 process) exist in the Delta, and elevated mercury concentrations in fish tissue produce subsequent
43 exposure and risk to humans and wildlife. Consequently, the beneficial uses most directly affected

1 by mercury include shellfish harvesting and commercial and sport fishing activities that pose a
 2 human health concern, and wildlife habitat and Rare, Threatened, and Endangered species resources
 3 that can be exposed to bioaccumulation of mercury (Table 8-1). Because of these concerns, mercury
 4 was the first TMDL approved for San Francisco Bay in 2007 (San Francisco Bay Water Board 2006),
 5 and a methylmercury TMDL was promulgated for the Delta (Central Valley Water Board 2011b). The
 6 Delta, many direct tributaries to the Delta (i.e., Sacramento River, San Joaquin River, Mokelumne
 7 River, Putah Creek, and Calaveras River), and downstream areas (e.g., Suisun Bay and Suisun Marsh)
 8 are listed as impaired water bodies on the Clean Water Act Section 303(d) lists for mercury in fish
 9 tissue (State Water Resources Control Board 2011).

10 This section summarizes the potential impacts from project-related changes to concentrations of
 11 mercury and methylmercury in water and estimated changes to fish tissue concentrations of
 12 mercury. A model was developed linking methylmercury concentrations in water to concentrations
 13 in Largemouth Bass muscle tissue. Bass tissue mercury concentrations were estimated for each
 14 location and time step based on the co-located waterborne methylmercury concentration estimates
 15 from DSM2. Details are provided in Appendix 8I. Refer also to Chapter 25 (Public Health) for
 16 discussion of the effects of mercury to human health.

17 Applicable mercury objectives for the affected environment for waterborne concentrations are
 18 summarized in Table 8-47. In evaluating the potential effects of waterborne mercury as measured
 19 by percentage change in assimilative capacity, only total mercury concentrations are judged against
 20 the lowest mercury objective of 25 ng/L; all estimates of methylmercury concentrations in water
 21 already exceed recommended objectives of 0.06 ng/L and, therefore, no assimilative capacity exists
 22 for that compound and no comparable percentage changes in assimilative capacity were used in the
 23 evaluation of differences among alternatives.

24 **Table 8-47. Applicable Federal Criteria, State Objectives, and Other Relevant Effects Thresholds for**
 25 **Mercury and Methylmercury in Water**

Analyte	CTR ^a	USEPA Recommended Criteria ^b	Delta Methylmercury TMDL ^c	San Francisco Bay Mercury TMDL ^d
Mercury (ng/L)	50	770	—	25
Methylmercury (ng/L)	—	—	0.06	—

Notes:

- a Criterion for the protection of human health from total recoverable mercury in freshwater (U.S. Environmental Protection Agency 2012b).
 b Criterion for the protection of chronic exposure from total mercury to freshwater aquatic life (U.S. Environmental Protection Agency 2012b).
 c The recommended water column TMDL concentration of methylmercury for the protection of fish bioaccumulation (Central Valley Water Board 2008a).
 d The recommended water column 4-day average TMDL concentration for total mercury (U.S. Environmental Protection Agency 2012b).

26
 27 Fish tissue concentrations were evaluated in relation to the Delta methylmercury TMDL tissue
 28 targets of 0.24 mg mercury/kg wet-weight of Largemouth Bass filets (muscle tissue) for fish
 29 normalized to a standard 350 mm total length (Central Valley Water Board 2011b). The
 30 normalization is necessary because of the strong dependence of tissue mercury concentrations on
 31 fish size and age; all fish tissue mercury results presented in this document are length-normalized. It
 32 is assumed that impact evaluations relative to this established locally derived toxicity limit will

1 provide an appropriate surrogate for effects of bioaccumulated mercury exposure to humans and
 2 wildlife from fish consumption and relative impacts on the fish. Most measured and modeled
 3 (current and future) fish tissue concentrations of mercury exceed the TMDL tissue target levels.
 4 Formulation of the fish tissue mercury model and comparisons between measured and modeled fish
 5 tissue results are provided in Appendix 8I. The Central Valley Water Board TMDL water/tissue
 6 translation model as well as a model specifically developed using DSM2 water outputs to predict fish
 7 tissue concentrations are compared in Appendix 8I.

8 Water quality data from the Delta and Suisun Marsh include records of mercury and methylmercury
 9 waterborne concentrations as total or filtered water fractions. Water quality summary information
 10 since 1999 is shown in Table 8-48 and Table 8-49. The general pattern of mercury waterborne
 11 loading to the Delta shows the dominance of mercury mining sources via Cache Creek and Yolo
 12 Bypass (Central Valley Water Board 2011c); however, the waterborne average concentrations do
 13 not reflect the same pattern as loads (Table 8-48). Instead, the Eastside tributary streams and San
 14 Joaquin River show higher mercury and methylmercury concentrations than the Sacramento River
 15 inputs.

16 **Table 8-48. Historical Mercury Concentrations in the Five Delta Source Waters for the Period 1999–**
 17 **2008**

Data Parameters	Source Water									
	Sacramento River ^a		San Joaquin River ^a		San Francisco Bay ^a		East Side Tributaries ^a		Agriculture within the Delta ^b	
Mean (ng/L)	4.1	—	7.6	0.8	7.8	—	8.6	1.4	6.5	—
Minimum (ng/L)	1.2	—	3.1	0.3	—	—	0.3	1.4	—	—
Maximum (ng/L)	30.6	—	21.7	3.0	—	—	26.2	1.4	—	—
75th Percentile (ng/L)	5.5	—	8.6	1.2	—	—	7.5	1.4	—	—
99th Percentile (ng/L)	24.2	—	17.4	2.8	—	—	25.2	1.4	—	—
Data Source	CVRWQCB 2008 ^a	—	BDAT 2010; CVRWQCB 2008 ^a	BDAT 2010; USGS 2010	SFEI 2010	—	CVRWQCB 2008 ^a	USGS 2010	CVRWQCB 2008 ^a	—
Station(s)	Sacramento River at Freeport	—	San Joaquin River at Vernalis	—	Martinez	—	Mokelumne and Calaveras Rivers ^{b,c}	Cosumnes River ^d	Mid-Delta locations, median	—
Date Range	1999–2002	—	2000–2004	2000–2002	2007	—	2000–2001; 2003–2004	2002	2008	—
ND Replaced with RL	Not Applicable	—	Not Applicable	—	—	—	Not Applicable	—	Not Applicable	—
Data Omitted	None	—	None	—	—	—	None	—	None	—
No. of Data Points	45	—	49	19	—	—	25	1	—	—

Notes: Means are geometric means. ng/L: nanograms per liter.

^a The total recoverable concentration of the analyte is presented in first cell and the dissolved concentration of the analyte is presented in the second cell.

^b Mokelumne River at I-5.

^c Calaveras River at rail road upstream of West Lane.

^d Cosumnes River at Michigan Bar.

Sources: Bay Delta and Tributaries Project 2010; Central Valley Water Board (CVRWQCB) 2008a; San Francisco Estuary Institute 2010; U.S. Geological Survey 2010

1 **Table 8-49. Historical Methylmercury Concentrations in the Five Delta Source Waters for the Period**
 2 **2000–2008**

Source Water	Sacramento River ^a		San Joaquin River ^a		San Francisco Bay ^a		East Side Tributaries ^a		Agriculture within the Delta ^a	
Mean (ng/L)	0.10	0.03	0.15	0.03	0.032	—	0.22	0.08	0.25	
Minimum (ng/L)	0.05	0.03	0.09	0.01	—	—	0.02	0.02	—	—
Maximum (ng/L)	0.24	0.03	0.26	0.08	—	—	0.32	0.41	—	—
75th Percentile (ng/L)	0.12	0.03	0.18	0.06	—	—	0.20	0.15	—	—
99th Percentile (ng/L)	0.23	0.03	0.26	0.08	—	—	0.31	0.39	—	—
Data Source	CVRWQCB 2008a		BDAT 2010; CVRWQC B 2008a	BDAT 2010; CVRWQCB 2008a; USGS 2010	SFEI 2010	—	CVRWQCB 2008a	CVRWQCB 2008a; USGS 2010	CVRWQCB 2008a	—
Station(s)	Sacramento River at Freeport		San Joaquin River at Vernalis		Martinez	—	Mokelumne and Calaveras Rivers	Mokelumne and Cosumnes Rivers	Mid-Delta locations, median	
Date Range	2000–2003	2000	2000–2001; 2003–2004	2000–2002	2007	—	2000–2001; 2003–2004	2000; 2002	2008	—
ND Replaced with RL	Not Applicable	Not Applicable	Not Applicable	Yes	—	—	Yes	Yes	Not Applicable	
Data Omitted	None		None		—	—	None	—	None	
No. of Data Points	36	1	49	25	—	—	27	9	—	—

^a The total recoverable concentration of the analyte is presented in first cell and the dissolved concentration of the analyte is presented in the second column.

Notes: Means are geometric means. ng/L: nanograms per liter.

Sources: Bay Delta and Tributaries Project (BDAT) 2010; Central Valley Water Board (CVRWQCB) 2008a; San Francisco Estuary Institute (SFEI) 2010; U.S. Geological Survey 2010

3

4 Nitrate

5 Applicable nitrate objectives for the affected environment utilized in this assessment are
 6 summarized in Table 8-50. The 5 mg/L-N threshold is for irrigation water as recommended by
 7 Ayers and Westcot (1994), who recommend a value of 5 mg/L nitrate-N for sensitive crops (e.g.,
 8 sugar beets, grapes, apricot, citrus, avocado, grains). The concern for these crops is that too much
 9 nitrate may cause greater growth than desired, diluting sugars and flavors and thus lowering the
 10 value of the crop. However, at levels below 5 mg/L-N, it is assumed that nitrate is beneficial for these
 11 crops, and thus increases below the 5 mg/L-N threshold are generally not of concern for agriculture.
 12 This 5 mg/L-N Ayers and Westcot (1994) threshold has not been identified as a recommended
 13 criterion by U.S. EPA, nor has it been adopted by the state as a water quality objective.

Table 8-50. Applicable Federal Criteria, State Objectives, and other Relevant Effects Thresholds for nitrate (mg N/L)

	Region 5 Basin Plan	Region 2 Basin Plan ^a	CTR	Drinking Water MCL	USEPA Recommended Criteria	Other Relevant Thresholds ^b
Nitrate-N	--	30 100	--	10	10 ^c	5

^a San Francisco Bay Water Board (2007). 30 mg/L nitrate-N criterion for irrigation water; 100 mg/L nitrate-N criterion for livestock watering.

^b Ayers and Westcot (1994). Recommended goals for sensitive crops.

^c For the consumption of water and organisms.

Table 8-51 characterizes nitrate concentrations in source waters to the Delta. Data indicate that the San Joaquin River and agriculture within the Delta contain the highest nitrate concentrations, while concentrations in the Sacramento River, San Francisco Bay, and East Side Tributaries are considerably lower. Both the Sacramento and San Joaquin Rivers exhibit seasonal patterns in nitrate concentration.

Table 8-51. Nitrate Concentrations in the Source Waters to the Delta

Source Water	Sacramento River ^a	San Joaquin River ^a	San Francisco Bay	East Side Tributaries	Agriculture within the Delta ^{a, b}
Mean (mg/L as N)	0.068–0.209	0.791–1.839	0.07	0.17	0.059–3.833
Minimum (mg/L as N)	0.023–0.113	0.068–1.175	0.026	0.010	0.002–0.339
Maximum (mg/L as N)	0.136–0.553	2.123–3.614	0.12	1.70	0.135–54.644
75th Percentile (mg/L as N)	0.09–0.248	1.017–2.169	0.09	0.16	0.068–4.516
99th Percentile (mg/L as N)	0.122–0.545	1.992–3.479	0.12	0.99	0.133–34.182
Data Source	DWR	DWR	SFEI	USGS	DWR
Station(s)	Sac River at Greene's Landing, Sac River at Hood	SJR at Vernalis	BD40 (Just W. of Carquinez Straight)	Mokelumne River, Cosumnes River	See footnote ^b
Date Range	1997–2008	1990–2009	1993–2001	1961–1993	1990–2001
ND Replaced with RL	No	No	No	No	Yes
Data Omitted	Data prior to 1992 (EPA Method 353.2; poor detection limit)	Two values > 9 mg/L as N	None	Values reported as "0"	None
No. of Data Points	25–33	29–35	25	45	5–81

^a Values reported as range of monthly values (minimum monthly–maximum monthly). Trends in monthly average nitrate at these locations suggested a seasonality to concentration. Due to the appearance of seasonality in monthly average concentration at these locations, average monthly concentration was used. Tables of these parameters by month are show in the Nitrate Appendix, Appendix 8J.

^b Values calculated from all agriculture drain data pooled together. All nitrate data from agricultural drains contained in the DWR Water Data Library were placed into a single database. Due to the uneven distribution of agricultural drains in the Delta, geographical trends in agricultural drain water quality were evaluated by categorizing the data based on their associated location in the Delta. Categories included western, southern, northern, eastern, and central Delta, following the geographical delineations of the State Water Resources Control Board. With data pooled and categorized by region, average concentration by region were compared. Average nitrate did not vary greatly between regions. Due to the apparent low regional variability, values were obtained by pooling all data together and obtaining summary statistics from this pooled database.

1 Nitrate does not behave conservatively in the environment. It can be created via conversion from
2 ammonia to nitrate and can be taken up and metabolized by organisms and sediments. However,
3 because nitrate concentrations vary considerably between the source waters to the Delta,
4 conservative modeling via DSM2 and the mass-balance approach described in section 8.3.1.3 was
5 employed to provide a characterization of changes in nitrate concentration anticipated as a result of
6 changes in source water fractions throughout the Delta alone (using mean concentrations from
7 Table 8-51, above). Addition and loss mechanisms are considered qualitatively in the context of the
8 quantitative mixing results to characterize changes in nitrate concentrations under the alternatives
9 assessed.

10 While temperature can affect the rates of creation and loss of nitrate in the affected environment, as
11 discussed above for DO, temperature is not expected to change substantially under the project
12 alternatives, relative to the No Action Alternative. Temperature increases due to climate change,
13 relative to Existing Conditions, are expected to be < 5°F, which is not considered a great enough
14 change to substantially affect nitrate levels.

15 **Organic Carbon**

16 While existing goals and action threshold for organic carbon as a DBP precursor are expressed as
17 TOC, it is the dissolved fraction, expressed as DOC, which is the focus of the organic carbon
18 assessment. As previously stated, 85–90% of Delta TOC is in the DOC or “dissolved” form. Further,
19 while the relative potency of organic carbon as a DBP precursor can vary considerably across
20 samples (CALFED Bay-Delta Program 2008a:5), in the Delta it is generally believed that the
21 dissolved fraction (i.e., DOC) most frequently influences DBP formation potential (CALFED Bay-Delta
22 Program 2007b:5–22). Even within the DOC fraction, DBP formation can vary considerably,
23 indicating that the nature of the organic matter that comprises DOC in a sample is important.
24 Nevertheless, DOC is considered a more accurate surrogate for DBP formation relative to TOC or
25 POC.

26 Given the strong link between THM and HAA formation potential and organic carbon, THM and HAA
27 formation potential will not be assessed separately, but rather the assessment of organic carbon
28 addresses concerns regarding THM and HAA formation potential.

29 Table 8-52 provides a summary of DOC concentrations for the Sacramento and San Joaquin Rivers as
30 utilized for DSM2 boundary conditions. As discussed in the Methods For Analysis section (Section
31 8.3.1 above), DSM2 was utilized directly to model and predict DOC at 11 locations across the Delta,
32 and the degree DOC changed under the various project alternatives. Because DOC is a precursor to
33 the formation of DBPs which represent a long-term risk to human health, and because the existing
34 source water quality goal is based on a running annual average, the quantitative assessment focuses
35 on the degree to which an alternative may result in change in long-term average DOC concentrations
36 at select locations upstream of the Delta, within the Delta, and in the SWP/CVP Export Service Areas.
37 For municipal intakes located in the Delta interior, assessment locations at Contra Costa Pumping
38 Plant No. 1 and Rock Slough are taken as representative of Contra Costa’s intakes at Rock Slough,
39 Old River and Victoria Canal, and the assessment location at Buckley Cove is taken as representative
40 of the City of Stockton’s intake on the San Joaquin River. Municipal intakes at Mallard Slough, City of
41 Antioch, and the North Bay Aqueduct are represented by their respective assessment locations. For
42 the purposes of this assessment, effects within the SWP/CVP Export Service Areas are assessed
43 based on DOC concentrations at the primary SWP and CVP Delta export locations (i.e., Banks and
44 Jones pumping plants). DOC in the Delta is generally considered to act conservatively; thus, the

1 mass-balance modeling approach employed. Moreover, the POC fraction would be largely removed
 2 through conventional drinking water treatment (State Water Project Contractors Authority 2007:3-
 3 19).

4 **Table 8-52. Monthly Average Dissolved Organic Carbon Utilized in DSM2 Modeling for Sacramento**
 5 **and San Joaquin River Source Waters (mg/L)**

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Sacramento at Hood	1.8	2.3	2.9	3.0	2.9	2.7	2.4	2.0	1.8	1.8	1.8	1.8
San Joaquin at Vernalis	3.4	3.5	3.6	4.7	4.8	4.7	3.9	3.4	3.4	3.4	3.4	3.4

6
 7 In establishing its source water goal for organic carbon, CALFED assumed more stringent DBP
 8 criteria for treated drinking water than are currently in place. Source water with TOC between 4 and
 9 7 mg/L is believed sufficient to meet currently established drinking water criteria for DPBs,
 10 depending on the amount of *Giardia* inactivation required (California Urban Water Agencies 1998,
 11 ES2). In light of these source water goals and EPA's TOC removal action thresholds, the assessment
 12 of alternatives evaluates how each alternative would affect the frequency with which predicted
 13 future DOC concentrations would exceed 2, 3, and 4 mg/L on a long-term average basis at the
 14 assessment locations. Because, in many cases, the existing condition is one already exceeding 2 and
 15 3 mg/L, the frequency with which DOC exceeds 4 mg/L becomes a key focus of the assessment, as
 16 well as the change in long-term average DOC concentration.

17 An important Delta assessment location is DWR's North Bay Aqueduct intake at Barker Slough.
 18 While source-water fingerprinting identifies the Sacramento River as comprising the majority of
 19 flow at the Barker Slough location, the quality of water is substantially influenced by local sources in
 20 the Barker Slough catchment. These local sources contribute a significant organic carbon load to the
 21 Barker Slough location, where average TOC between 2001 and 2005 was 5.8 mg/L and as high as 20
 22 mg/L in winter months (State Water Project Contractors Authority 2007: 3-19, 3-26). The DSM2
 23 model does not account for these local sources and, therefore, concentrations presented in this
 24 assessment generally underestimate baseline DOC conditions. Nevertheless, operations and
 25 maintenance activities will not substantially affect these local sources to Barker Slough and thus
 26 their contribution to annual average DOC would continue to occur regardless of project alternative
 27 implementation. The modeling presented in this assessment for the Barker Slough location accounts
 28 for expected changes in DOC relative to changes in Delta hydrodynamics, excluding local watershed
 29 sources to Barker Slough.

30 Pathogens

31 The assessments of pathogens were conducted in a qualitative manner with consideration to
 32 sources of pathogens and factors that contribute to elevated levels in surface waters, including flow
 33 rate and distance from pathogen sources.

34 Pesticides

35 Assessing pesticide-related effects is substantially challenged by: 1) limited available monitoring
 36 data in the Delta and other water bodies of the affected environment, and 2) a continually changing
 37 pesticide use market. Due to a number of factors, including historic pesticide use patterns and

1 analytical capabilities, there is more data available for certain classes of pesticides, such as OP
2 insecticides, than that for other classes of pesticides, including herbicides, fungicides, and
3 insecticides such as pyrethroids and carbamates.

4 Likely the single most recent and comprehensive compilation of pesticide data for the Delta and
5 upstream water bodies (within 30 miles of the Delta) was compiled by Johnson et al. (2010). The
6 result of this compilation and review was the conclusion that there were few chemicals for which
7 data were of sufficient number and quality to allow a definitive conclusion regarding contaminants
8 and toxicological issues in the Delta such as the POD. The stated exception was that of the OP
9 insecticides chlorpyrifos and diazinon, where frequent toxicity to bioassay indicator organisms has
10 been associated with measurable concentrations of chlorpyrifos and diazinon (Kuivila and Foe
11 1995; Werner et al. 2000). In fact, in the comprehensive review of Johnson et al. (2010), only the
12 analysis of diazinon, chlorpyrifos, several pyrethroid insecticides and the herbicide diuron were
13 carried forward, primarily due to data quantity and quality limitation. In this compilation,
14 cumulative frequency distributions were prepared, suggesting that less than 10% of all samples for
15 chlorpyrifos, diazinon, and diuron would be expected to exceed benchmark toxicity thresholds. Data
16 for the pyrethroid insecticides were too limited, primarily due to data quality issues (i.e.,
17 insufficiently low detection limits). However, pyrethroid-related research and regulatory interest
18 has intensified with the fairly recent observation of substantial pyrethroid-associated toxicity in
19 sediments and the water column of numerous urban streams, agricultural drainage canals, and
20 municipal wastewater effluent (Weston and Lydy 2010). These pyrethroid observations are largely
21 believed to be related to their recent increased use as a suitable substitute for diazinon and
22 chlorpyrifos.

23 Perhaps more challenging than a limited monitoring effort is the dynamic state of the pesticide
24 market. Regulatory and pest resistance pressures have left the pesticide market, namely the
25 insecticide market, in a state of flux. Pesticide use varies from year to year depending on numerous
26 external factors such as climate and associated pest outbreaks, cropping patterns, and economic
27 trends in housing construction and urban development. Layered upon this year-to-year variation is
28 an overall trend of decreased OP insecticides use and increased pyrethroid use, primarily due to the
29 early regulatory phase-out of many OP insecticide uses initiated in early 2000. The market has yet to
30 balance and reach equilibrium, and what limited and relatively short-term monitoring data that is
31 available ultimately only represents a snapshot of a trend in the gradual replacement of many OP
32 uses with that of pyrethroids. Until markets stabilize, trends will inevitably continue to develop.

33 For rivers, a number of factors are necessary for pesticide-related impacts on beneficial uses to be a
34 possibility. Although a number of relevant beneficial uses exist, for the majority of pesticides aquatic
35 life beneficial uses are the greatest concern. For concentrations of pesticides in surface water to
36 reach thresholds of aquatic life concern, a number of controlling factors are typically at play. First
37 and foremost, pesticides must be used, and used in a location with hydrologic connectivity to surface
38 water, and used in amounts that are not easily diluted in the environment. Secondly, the pesticide
39 must be transportable. The ultimate transportability of a pesticide is largely determined by its
40 individual chemistry, where its chemistry determines important properties such as water solubility,
41 vaporization, and soil sorption. Factors unrelated to the pesticide are also important, such as
42 substrate erosivity, precipitation or irrigation amounts, and time elapsed from application to runoff.
43 Thirdly, the pesticide must be stable in the environment, such that residues of the applied pesticide
44 are present during runoff events. And finally, if transported to surface waters, sufficient amounts of
45 pesticide must be present that once diluted by surface water flows, the resulting concentration is of
46 a magnitude capable of eliciting a measurable effect in aquatic life. All of these factors contribute in

1 the end to the potential for adverse beneficial use effects, but of the many factors involved,
2 CVP/SWP operations only affect river flows and, thus available dilution. In an estuary environment,
3 where substantial dilution capacity typically occurs, duration of aquatic life exposure in addition to
4 pesticide concentration is important. While the capacity of the Delta to dilute pesticide inputs is
5 largely unaffected by CVP/SWP operations, the duration of exposure, or residence time, can be
6 affected by operations. Therefore, in the Delta, changes in source water fractions represent long-
7 term changes in exposure potential.

8 Similar to the assessment of Johnson et al. (2010), there is insufficient data to perform an
9 assessment of BDCP alternatives' effects on all pesticides. Within available data, however, there is
10 sufficient evidence that the OP insecticides diazinon and chlorpyrifos, and the herbicide diuron may
11 be found in the affected environment at concentrations frequently toxic to aquatic life, and to such a
12 degree that changes in CVP/SWP operations could possibly have an effect. Furthermore, although
13 pyrethroid insecticides have not been demonstrated to have the same magnitude of concern
14 throughout the affected environment, trends in OP replacement, increased pyrethroid use, and
15 increased pyrethroid incidence in urban streams and agricultural drains suggest that pyrethroids
16 may become a broader concern in the future. Therefore, the pesticide assessment focuses on
17 potential effects of CVP/SWP operations into the future, under the various considered alternatives,
18 on diazinon, chlorpyrifos, pyrethroids, and diuron, and the possibility that the frequency or
19 magnitude of existing pesticide-related risk to beneficial uses might change.

20 The pesticide assessment utilizes recent research and monitoring related to OP, diuron and
21 pyrethroid incidence in ambient waters to qualitatively assess the effects of the alternatives on
22 those pesticides and their possible related aquatic harm. Effects of alternatives on pesticides are
23 primarily incidental and indirect, as existing and future sources of pesticide loading are largely
24 unrelated. Further, effects on pesticides would be related to the change in river flow rates and Delta
25 source water volumes. Because these changes would not directly affect pesticide source loading, but
26 could affect in-stream pesticide concentrations through dilution as well as in-water pesticide
27 dispersion and geographic distribution, changes in CVP/SWP operations could alter the long-term
28 risk of pesticide-related effects on aquatic life beneficial uses. This change in risk can be qualitatively
29 assessed through change in river flows and associated dilution, as well as change in source water
30 fraction and associated opportunity for exposure. Pesticide effect assessments based on dilution
31 flows and source water fraction is heavily burdened by assumptions regarding pesticide use into the
32 future. As well, pesticide effects assessments based on changes in potential risk are heavily
33 burdened by presumptions of real hazard relative to actual in-stream concentrations and actual
34 effect thresholds which cannot be determined. It is assumed that sources of pesticides to water
35 bodies would be similar for all alternatives.

36 In addition to the present-use pesticides described above, "legacy" pesticides, which have been
37 banned for decades and include numerous organochlorine insecticides including DDT, can still be
38 found in terrestrial soils and riverine sediments throughout the Central Valley. These were assessed
39 based on the understanding that residues of these pesticides enter rivers primarily through surface
40 runoff and erosion of terrestrial soils during storm events, and through resuspension of riverine
41 bottom sediments, the combination of which to this day may contribute to excursions above water
42 quality objectives (Central Valley Water Board 2010c). These low level sources are widespread and
43 dispersed throughout the Central Valley.

1 Phosphorus

2 An analysis of nutrient loads to the Delta found that phosphorus concentrations showed little inter-
 3 seasonal variability between the Sacramento and San Joaquin Rivers (Tetra Tech 2006a). Data
 4 gathered for this assessment confirm this finding, and also show that little variability exists between
 5 these two rivers and between San Francisco Bay water at Martinez. Current estimates for in-Delta
 6 contribution of nutrients from agriculture on the Delta islands are small compared to tributary
 7 sources (Tetra Tech 2006a). Table 8-53 summarizes dissolved ortho-phosphate data for source
 8 waters to the Delta, and Figure 8-56 shows the seasonal variation in dissolved ortho-phosphate
 9 concentrations among the three major source waters. During April through December, ortho-
 10 phosphate concentrations from the three major source waters are very similar. During January
 11 through March, concentrations in the San Joaquin River at Vernalis are noticeably greater than from
 12 the Sacramento River at Hood/Greene's Landing or San Francisco Bay at Martinez.

13 **Table 8-53. Summary of Dissolved Ortho-Phosphate Concentrations (mg/L-P) in Delta Source**
 14 **Waters**

Source Water	Sacramento River	San Joaquin River	San Francisco Bay	East Side Tributaries
Mean (mg/L as P)	0.068	0.106	0.092	0.018
Minimum (mg/L as P)	0.010	0.010	0.030	0.010
Maximum (mg/L as P)	0.24	0.45	0.18	0.090
75th Percentile (mg/L as P)	0.090	0.130	0.11	0.020
99th Percentile (mg/L as P)	0.18	0.28	0.17	0.06
Data Source	DWR, BDAT	DWR, BDAT	BDAT	USGS
Station(s)	Sac River at Greene's Landing (BDAT only), Sac River at Hood	SJR at Vernalis	Suisun Bay at Bulls Head near Martinez	Mokelumne River
Date Range	1975–2009	1975–2009	1975–2006	1977–1994
ND Replaced with RL	No	No	No	Yes
Data Omitted	None	None	None	Single value reported as "0"
No. of Data Points	523	502	203	100

15 Phosphorus does not behave conservatively in the environment. It can be taken up and metabolized
 16 by organisms or lost to or supplied by sediment. Because phosphorus concentrations do not vary
 17 considerably between the major source waters (as discussed above), phosphorus was assessed
 18 qualitatively. The primary way in which the BDCP alternatives could affect phosphorus levels is by
 19 increasing the fraction of San Joaquin River water at point in the Plan Area during January through
 20 March. Thus, source water fractions for the San Joaquin River were analyzed for that period to
 21 determine if the changes would be expected to substantially affect phosphorus concentrations.
 22

23 Selenium

24 Potential impacts may occur from project-related changes to concentrations of selenium in water as
 25 well as changes to concentrations in fish tissues (whole-body and fillets) and bird eggs.
 26 Bioaccumulation models were developed linking selenium concentrations in water to

1 concentrations in fish tissue and bird eggs, which were estimated for each assessment location and
 2 alternative based on the modeled selenium concentration estimates for water from DSM2 (as
 3 described in Appendix 8M), and from water to whole-body sturgeon in the western Delta (as
 4 described in Addendum M.A to Appendix 8M). Because of differences in bioaccumulation among
 5 water-year types, one model was used for all water years and a modified model was developed for
 6 drought years (when bioaccumulation was higher for fish). Detailed results are presented in
 7 Appendix 8M and Addendum M.A to Appendix 8M.

8 Applicable selenium objectives for water in the affected environment are summarized in Table 8-54,
 9 and selected benchmarks for assessment of selenium in whole-body fish, bird eggs, and fish fillets
 10 are presented in Table 8-55.

11 **Table 8-54. Applicable Federal Criteria, State Standards/Objectives, and Other Relevant Effects**
 12 **Thresholds for Selenium**

	Region 5 Basin Plan ^a	Region 2 Basin Plan ^b	CTR ^c	Drinking Water MCL ^d	USEPA Recommended Criteria ^e	Other Relevant Thresholds ^f
Selenium (µg/L)	5/12	5/20	5/20	50	5/variable	2

^a Objectives apply to the lower San Joaquin River from the mouth of the Merced River to Vernalis as 5 µg/L (4-day average) and 12 µg/L (maximum concentration) total selenium concentration (Central Valley Water Board 2009a).

^b Selenium criteria were promulgated as total recoverable concentrations for all San Francisco Bay/Delta waters in the National Toxics Rule (NTR) (U.S. Environmental Protection Agency 1992; San Francisco Bay Water Board 2007).

^c Standard is Criterion Continuous Concentration as 5 µg/L total recoverable selenium; California Toxics Rule (CTR) deferred to the NTR for San Francisco Bay/Delta waters and San Joaquin River (U.S. Environmental Protection Agency 2000).

^d Maximum Contaminant Level. In addition, the California Office of Environmental Health Hazard Assessment (OEHHA 2010) has recommended a Public Health Goal of 30 µg/L.

^e Criteria for protection of freshwater aquatic life are 5 µg/L (continuous concentration, 4-day average) total recoverable selenium and they vary for the Criterion Maximum Concentration (CMC; 24-hour average) (U.S. Environmental Protection Agency 2012b). The CMC = $1/[(f1/CMC1) + (f2/CMC2)]$ where f1 and f2 are the fractions of total selenium that are treated as selenite and selenate, respectively.

^f Concentration as total recoverable selenium identified as a Level of Concern for the Grassland Bypass Project (Beckon et al. 2008).

13
 14 **Table 8-55. Selected Benchmarks for Assessment of Selenium in Whole-body Fish, Bird Eggs, and Fish**
 15 **Fillets**

	Whole-Body Fish ^a		Bird Eggs ^a		Fish Fillets ^b
	Low ^c	High ^d	Low ^e	High ^f	
Selenium	4	9	6	10	2.5

^a mg/kg, dry-weight basis.

^b mg/kg, wet-weight basis; Advisory Tissue Level (OEHHA 2008).

^c Level of Concern for whole-body fish (lower end of range) (Beckon et al. 2008). For sturgeon the low benchmark was 5 mg/kg, dry weight (Presser and Luoma 2013).

^d Toxicity Level for whole-body fish (Beckon et al. 2008). For sturgeon the high benchmark was 8 mg/kg, dry weight (Presser and Luoma 2013).

^e Level of Concern for bird eggs (lower end of range) (Beckon et al. 2008).

^f Toxicity Level for bird eggs (Beckon et al. 2008).

1 The State Water Board lists the western Delta as having impaired water quality for selenium and
 2 several other constituents under Clean Water Act Section 303(d) (State Water Resources Control
 3 Board 2011). The Central Valley Water Board completed a TMDL for selenium in the lower San
 4 Joaquin River (downstream of the Merced River) in 2001, and USEPA approved this in 2002 (Central
 5 Valley Water Board 2001, 2009d). Historical selenium concentrations in source waters to the Delta
 6 are shown in Table 8-56. DSM2 modeling for other constituents considered five sources of water to
 7 the Delta, as described in Section 8.3.1.3. However, for selenium, the Sacramento River mean
 8 concentration upstream of the American River (as measured at Knights Landing, upstream of the
 9 Yolo Bypass) was somewhat higher than that at Freeport (representing the main flow of the river to
 10 the Delta). Consequently, the value for Knights Landing was used as the input through the Yolo
 11 Bypass and the value for Freeport was used to represent the main flow of the Sacramento River to
 12 the Delta.

13 **Table 8-56. Historical Selenium Concentrations in the Six Delta Source Waters for the Period 1996–**
 14 **2010**

Source Water	Sacramento River ^a	San Joaquin River ^b	San Francisco Bay ^a	East Side Tributaries ^c	Agriculture within the Delta ^a	Yolo Bypass ^d
Mean (µg/L) ^e	0.32	0.84	0.09	0.1	0.11	0.45
Minimum (µg/L)	0.04	0.40	0.03	0.1	0.11	0.19
Maximum (µg/L)	1.00	2.80	0.45	0.1	0.11	1.05
75th percentile (µg/L)	1.00	1.20	0.11	0.1	0.11	0.65
99th percentile (µg/L)	1.00	2.60	0.41	0.1	0.11	1.04
Data Source	USGS 2010	SWAMP 2009	SFEI 2010	None	Lucas and Stewart 2007	DWR 2009b
Station(s)	Sacramento River at Freeport	San Joaquin River at Vernalis (Airport Way)	Central-West; San Joaquin River near Mallard Is. (BG30)	None	Mildred Island, Center	Sacramento River at Knights Landing
Date Range	1996–2001, 2007–2010	1999–2007	2000–2008	None	2000	2003, 2004, 2007, 2008
ND Replaced with RL	Yes	Yes	Yes	Not applicable	No	Yes
Data Omitted	None	Pending Data	None	Not applicable	None	None
No. of Data Points	62	452	11	None	1	13

^a Dissolved selenium concentration.

^b Not specified whether total or dissolved selenium.

^c Dissolved selenium concentration in Mokelumne, Calaveras, and Cosumnes rivers are assumed to be 0.1 µg/L due to lack of available data and lack of sources that would be expected to result in concentrations greater than 0.1 µg/L.

^d Total selenium concentration.

^e Means are geometric means.

SFEI = San Francisco Estuary Institute

SWAMP = Surface Water Ambient Monitoring Program

1 Largemouth bass collected from sites near the source locations in 2000, 2005, and 2007 were
 2 analyzed for selenium (Foe 2010). Measured selenium concentrations in those fish and modeled
 3 selenium concentrations in whole-body fish at three source water locations are presented in Table
 4 8-57. Selenium concentrations in fish fillets, whole-body fish, and bird eggs at assessment locations
 5 in the Delta were estimated using models described in Appendix 8M. Additional modeling for
 6 selenium bioaccumulation in whole-body sturgeon was conducted for the two western-most
 7 locations in the Delta as described in Addendum M.A to Appendix 8M.

8 **Table 8-57. Measured and Modeled Selenium Concentrations (mg/kg, dry-weight basis) in Whole-**
 9 **body Fish at or Near Source Water Locations to the Delta**

Year	Sacramento River ^a		San Joaquin River ^b		Suisun Bay ^c	
	Measured	Modeled	Measured	Modeled	Measured	Modeled
2000	2.6	1.4 ^d	1.7	1.8 ^e	No Data	0.9 ^d
2005	1.5	1.4 ^d	1.9	1.8 ^e	No Data	1.0 ^d
2007 ^g	1.8	2.3 ^f	2.4	2.4 ^g	No Data	1.2 ^f

^a Sacramento River Mile (RM) 44.

^b Vernalis.

^c Montezuma Slough near Grizzly Bay; bass not sampled near here.

^d Concentration of selenium estimated from Model 8: Trophic level 4 (TL-4) fish eating TL-3 fish, using $K_d = 1760$, $TTF_{invertebrate} = 2.1$, and $TTF_{fish} = 1.1$.

^e Concentration of selenium estimated from Model 8a: Trophic level 4 (TL-4) fish eating TL-3 fish, using $K_d = 850$, $TTF_{invertebrate} = 2.1$, and $TTF_{fish} = 1.1$.

^f Concentration of selenium estimated from Model 9: Trophic level 4 (TL-4) fish eating TL-3 fish, using $K_d = 2840$, $TTF_{invertebrate} = 2.1$, and $TTF_{fish} = 1.1$.

^g Concentration of selenium estimated from Model 9a: Trophic level 4 (TL-4) fish eating TL-3 fish, using $K_d = 1130$, $TTF_{invertebrate} = 2.1$, and $TTF_{fish} = 1.1$.

K_d = particulate/water ratio.

TTF_{fish} = trophic transfer factor from diet to fish.

$TTF_{invertebrate}$ = trophic transfer factor from particulate to invertebrate.

10

11 Trace Metals

12 Water quality criteria used in the assessment of trace metals are presented in Table 8-51. The CTR
 13 criteria for cadmium, chromium (III), copper, lead, nickel, silver, and zinc are promulgated as
 14 equations that contain three adjustments: 1) the water-effect ratio (WER), 2) the conversion factor
 15 (CF) from total to dissolved fraction, and 3) hardness (freshwater criteria only), which are used to
 16 adjust the criteria based on site-specific water quality conditions in order to provide the level of
 17 protection intended by U.S. EPA. Table 8-52 presents hardness adjusted CTR criteria for the primary
 18 Delta source waters, including the Sacramento and San Joaquin Rivers. Criteria were calculated
 19 based on each source waters average and 5th percentile hardness (See Appendix 8N for hardness
 20 data). Due to lower average and 5th percentile hardness on the Sacramento River, calculated
 21 hardness-based metals aquatic life criteria are lowest on the Sacramento River.

22 The quality of water representative of the Bay source water fraction is highly seasonal, with
 23 conditions ranging between freshwater and saltwater conditions. In such a case, CTR metals criteria
 24 guidance states that the more stringent of the freshwater or saltwater criteria is to be used.
 25 Comparing saltwater criteria listed in Table 8-58 to freshwater criteria in Table 8-59, saltwater

1 criteria for copper and nickel are more stringent than the corresponding hardness-based freshwater
2 criteria.

3 **Table 8-58. Water Quality Criteria and Objectives for Trace Metals ($\mu\text{g/L}$)**

Metal	Freshwater		Saltwater		Human Health		Region 5 Basin Plan	California Drinking Water MCLs ^e
	Acute ^a	Chronic ^a	Acute ^a	Chronic ^a	Water & Organisms	Organisms Only		
Arsenic	340	150	69	36	n/a	n/a	10 ^b	10
Cadmium	4.3/3.9 ^c	2.2/1.1 ^c	42	9.3	n/a	n/a	0.22 ^d	5
Chromium (III)	550	180	n/a	n/a	n/a	n/a	n/a	50
Copper	13	9	4.8	3.1	1,300	n/a	5.6 ^d /10 ^b	1,000
Iron	n/a	1,000 ^f	n/a	n/a	n/a	n/a	300 ^b	300
Lead	65	2.5	210	8.1	n/a	n/a	n/a	15
Manganese	n/a	n/a	n/a	n/a	n/a	n/a	50 ^b	50
Nickel	470	52	74	8.2	610	4,600	n/a	100
Silver	3.4	n/a	1.9	n/a	n/a	n/a	10 ^b	100
Zinc	120	120	90	81	n/a	n/a	100 ^b /16 ^d	5,000

All values in micrograms per liter ($\mu\text{g/L}$) and expressed as dissolved metal, unless otherwise noted.

n/a = non-applicable.

^a Values represent both CTR/NTR criteria and criteria contained within the Region 2 Basin Plan. Acute values are applicable to short periods of time, generally defined as 1-hour average concentrations. Chronic values are defined as 4-day average concentrations. For metals whose CTR criteria allow for adjustments based on WER, CF, and hardness, values in the table assume a default WER of 1.0, default CFs contained within the CTR, and a default hardness of 100 mg/L (as CaCO_3).

^b Applies at the following locations: Sacramento River from Keswick Dam to the I Street Bridge at City of Sacramento; American River from Folsom Dam to the Sacramento River; Folsom Lake; and the Sacramento-San Joaquin Delta.

^c First value is the CTR cadmium criterion, second value is Region 2 Basin Plan criterion.

^d Applies to the Sacramento River and its tributaries above State Hwy 32 bridge at Hamilton City.

^e Expressed as total recoverable metal.

^f EPA 304(a) national recommended criteria.

4

5 Metals differ in their physical and chemical parameters and thus in their fate, transport, and
6 bioavailability in the aquatic environments. Throughout the trace metals assessment dissolved
7 metals concentrations are utilized, because the dissolved fraction better approximates the
8 bioavailable fraction to aquatic organisms. Furthermore, drinking water treatment plants readily
9 remove particulate and suspended matter from raw water. While maximum contaminant levels for
10 treated drinking water are measured on a total recoverable basis, the dissolved fraction of these
11 metals is taken as the more accurate predictor of metals concentration post-treatment. This is
12 particularly the case with iron and manganese which are both naturally abundant in soil. Total
13 recoverable iron and manganese concentrations can be very high in water carrying a substantial
14 load of suspended matter (i.e., TSS). Therefore, assessment of aquatic life and drinking water effects
15 utilizes the dissolved fraction of trace metals in the environment.

1 **Table 8-59. Hardness-based dissolved freshwater aquatic life criteria by primary source water ($\mu\text{g/L}$)**

Metal	Criteria for Sacramento Source Water Based on 5 th Percentile Hardness		Criteria for Sacramento Source Water Based on Average Hardness	
	Acute	Chronic	Acute	Chronic
Cadmium	0.81	0.128	1.19	0.168
Copper	5.53	4.006	8.04	5.623
Chromium (III)	263.50	34.276	364.71	47.441
Lead	22.86	0.891	35.52	1.384
Nickel	211.11	23.448	295.34	32.803
Silver	0.64	--	1.26	--
Zinc	52.77	53.199	73.86	74.464
Metal	Criteria for San Joaquin Source Water Based on 5 th Percentile Hardness		Criteria for San Joaquin Source Water Based on Average Hardness	
	Acute	Chronic	Acute	Chronic
Cadmium	1.13	0.162	2.93	0.321
Copper	7.65	5.373	19.32	12.447
Chromium (III)	349.18	45.421	781.14	101.610
Lead	33.49	1.305	97.98	3.818
Nickel	282.37	31.362	648.66	72.046
Silver	1.15	-	6.24	--
Zinc	70.61	71.187	162.41	163.742
Metal	Criteria for Bay Source Water Based on 5 th Percentile Hardness		Criteria for Bay Source Water Based on Average Hardness	
	Acute	Chronic	Acute	Chronic
Cadmium	1.11	0.160	13.98	0.981
Copper	7.52	5.290	88.25	49.357
Chromium (III)	343.97	44.744	2925.17	380.504
Lead	32.82	1.279	518.97	20.224
Nickel	278.02	30.879	2537.13	281.796
Silver	1.11	--	99.88	--
Zinc	69.52	70.089	636.59	641.798

Criteria calculated based on each source waters average and 5th percentile hardness.

2

3 Research has shown that elevated copper levels in water bodies are of concern for disruption of
4 olfactory cues in salmonids when migrating to their natal streams to spawn, which can lead to
5 increased straying. However, the U.S. EPA-developed biotic ligand model (BLM)-based copper
6 criteria have been shown to always be protective of these concerns (Meyer and Adams 2010: 2096).
7 Because of this, BLM-based copper criteria were derived for the Sacramento and San Joaquin Rivers,
8 as shown in Table 8-60. The BLM criteria account for the aggregate effect of several different water
9 quality parameters on copper toxicity in addition to hardness (e.g., dissolved organic carbon, pH,
10 and various salt concentrations), with the protective criterion being sensitive to DOC concentrations
11 in water. When calculated based on the average of all necessary parameters and the 5th percentile
12 DOC, copper BLM-based criteria were higher (i.e., less sensitive) than the corresponding non WER-
13 adjusted copper criteria presented in Table 8-59. Therefore, the calculated hardness-based CTR
14 copper criteria are found to be adequately protective of fish olfaction.

1 **Table 8-60. BLM-based criteria for dissolved copper ($\mu\text{g/L}$)**

Sacramento	CMC	CCC
Average of all BLM parameters	10.9299	6.7888
5th Percentile DOC; Average of remaining parameter	6.9774	4.3338
San Joaquin	CMC	CCC
Average of all BLM parameters	15.9659	9.9167
5th Percentile DOC; Average of remaining parameter	10.0879	6.2658

2

3 There is currently no single program or effort for the coordinated and comprehensive measurement
4 of trace metals in the Delta and its primary source waters. Moreover, analytical techniques for trace
5 metals measurement have improved considerably over time, often resulting in substantially lower
6 detection limits and at time showing earlier techniques to be prone to analytical error. Nevertheless,
7 local monitoring efforts such as the San Francisco Bay Regional Monitoring Program (RMP) and the
8 Sacramento Coordinated Regional Monitoring Program have collected trace metals on the
9 Sacramento River and the San Francisco Bay for more than a decade, resulting in an adequate long-
10 term characterization of these waters. Unfortunately, there has been no equivalent effort on the San
11 Joaquin River, east-side tributaries, or within the Delta itself. This imbalance in available data limits
12 the effects assessment approach. Effects are qualitatively assessed.

13 Summaries of trace metals data compiled for this qualitative assessment are provided in Appendix
14 8N. Data of sufficient quality were available for the Bay, Sacramento River and San Joaquin River
15 source waters, although data for the San Joaquin are very few. These data used to inform the
16 qualitative assessment on trace metal effects upstream of the Delta, within the Delta, and the SWP
17 and CVP service areas. Due to the relatively short exposure durations related to aquatic life acute
18 and chronic effects, long-term trace metals effects are evaluated on a 95th percentile concentration
19 basis. Due to the relatively long exposure durations related to drinking water effects, long-term
20 trace metals effects are evaluated on an average concentration basis.

21 **Total Suspended Solids and Turbidity**

22 TSS concentrations and turbidity levels in rivers upstream of the Delta are affected primarily by: 1)
23 TSS concentrations and turbidity levels of the water released from the upstream reservoirs, 2)
24 erosion occurring within the river channel beds, which is affected by river flow velocity and bank
25 protection, 3) TSS concentrations and turbidity levels of tributary inflows, point-source inputs, and
26 nonpoint runoff as influenced by surrounding land uses; and 4) phytoplankton, zooplankton and
27 other biological material in the water.

28 TSS and turbidity in Delta waters is affected by TSS concentrations and turbidity levels of the Delta
29 inflows (and associated sediment load). TSS and turbidity within Delta waters also is affected by
30 fluctuation in flows within the channels due to the tides, with sediments depositing as flow
31 velocities and turbulence are low at periods of slack tide, and sediments becoming suspended when
32 flow velocities and turbulence increase when tides are the near the maximum. TSS and turbidity
33 variations can also be attributed to phytoplankton, zooplankton and other biological material in the
34 water.

35 The TSS and turbidity assessments were conducted in a qualitative manner based on anticipated
36 changes in these factors.

1 **8.4.2 Determination of Effects**

2 The water quality effects of the action alternatives and the No Project Alternative, relative to
3 Existing Conditions for CEQA, and of the action alternatives relative to the No Action Alternative for
4 NEPA were determined consistent with the Methods for Analysis presented in the previous section,
5 and are presented below. Additional discussion beyond that presented herein pertaining to the
6 potential for water quality-related effects on fish and aquatic resources, human health, and
7 agriculture are addressed in Chapter 11, *Fish and Aquatic Resources*; Chapter 25, *Public Health*; and
8 Chapter 14, *Agricultural Resources*, respectively.

9 As discussed in greater detail in Chapter 5, *Water Supply*, Section 5.3.2, the NEPA No Action
10 Alternative, which reflects an anticipated future condition in 2060, includes both sea level rise and
11 climate change (changed precipitation patterns), and also assumes, among many other programs,
12 projects, and policies, implementation of most of the required actions under both the December
13 2008 USFWS BiOp and the June 2009 NMFS BiOp. The NEPA effects analyses in this chapter reflect
14 these No Action assumptions.

15 **8.4.2.1 Screening Analysis and Results**

16 This water quality analysis assessed the potential effects of implementing the various alternatives
17 on 182 constituents (or classes of constituents). The initial analysis of water quality effects, referred
18 to as the “screening analysis” in the Methods of Analysis section (above) resulted in the following
19 findings. Of the 182 constituents, 110 were determined to have no potential to be adversely affected
20 by the alternatives to an extent to which adverse environmental effects would be expected.
21 Historical data for these constituents showed no exceedances of water quality objectives/criteria in
22 the major Delta source waters, were not on the State’s 303(d) list in the affected environment, were
23 not of concern based on professional judgment or scoping comments, and had no potential for
24 substantial long-term water quality degradation. Consequently, no further analyses were performed
25 for these 110 constituents. Conversely, further analysis was determined to be necessary for 72
26 constituents. Of these, 15 are addressed further in the Screening Analysis itself in Appendix 8C
27 because they did not warrant alternative-specific analyses, and 1—temperature—is addressed in
28 Chapter 11, *Fish and Aquatic Resources*. The remaining 56 constituents are addressed in the
29 Environmental Consequences section, and are contained in the sections noted in Table 8-61.

30 As discussed in the Methods for Analysis section, constituents that require analysis beyond that of
31 the initial screening analysis, and that do not behave conservatively (e.g., degrade or are consumed
32 in biochemical processes) within the system were further assessed qualitatively. Conversely,
33 constituents that are primarily conserved (i.e., do not change) as they move through the system (e.g.,
34 dissolved salts) were candidates for further quantitative assessments, via comparisons of modeled
35 scenarios that depict the Existing Conditions, No Action Alternative, and the action alternatives
36 (Table 8-61).

1 **Table 8-61. Water Quality Constituents for which Detailed Assessments are Performed**

Constituents Carried Forward for Further Analysis	Quantitative ^a	Qualitative	Section of Environmental Consequences
Ammonia		X	Ammonia
Boron	DSM2+MB		Boron
Bromide	DSM2+MB/ EC Ratios		Bromide
Chloride	DSM2+MB/ EC Ratios		Chloride
Oxygen		X	Dissolved Oxygen
Conductance (EC)	DSM2-QUAL		Electrical Conductivity (EC)/TDS
Total Dissolved Solids		X	Electrical Conductivity (EC)/TDS
Mercury	DSM2+MB		Mercury
Nitrate	DSM2+MB	X	Nitrate
Nitrite		X	Nitrate
Nitrite + Nitrate		X	Nitrate
Organic Carbon	DSM2-QUAL		Organic Carbon (DOC/TOC)
Haloacetic acids ^b		X	Organic Carbon (DOC/TOC)
Trihalomethanes ^c		X	Organic Carbon (DOC/TOC)
Cryptosporidium		X	Pathogens
Escherichia™coli		X	Pathogens
Organochlorine, Organophosphate, and Pyrethroid Pesticides ^d		X	Pesticides and Herbicides
Phosphorus		X	Phosphorus
Selenium	DSM2+MB		Selenium
Other Trace Metals ^e		X	Trace Metals
Total Suspended Solids		X	Turbidity and TSS
Volatile Suspended Solids		X	Turbidity and TSS
Turbidity		X	Turbidity and TSS

^a DSM2+MB = Constituent was modeled via mass balance approach described in section 8.3.1.3 (i.e., DSM2 fingerprinting results coupled with historical source water quality data); EC Ratios = Constituent was modeled via EC to chloride and/or chloride to bromide ratios described in section 8.3.1.3; DSM2-QUAL = Constituent was modeled directly using DSM2-QUAL.

^b Dibromoacetic Acid (DBAA), dichloroacetic Acid (DCAA), trichloroacetic Acid (TCAA), total haloacetic acids

^c Bromodichloromethane, bromoform, dibromochloromethane, total THMs

^d Aldrin, BHC, BHC-alpha, BHC-beta, BHC-delta, BHC-gamma (lindane), chlordane, chlorpyrifos, diazinon, dieldrin, endosulfan (mixed isomers), endosulfan-I, endosulfan-II, endrin, heptachlor, p,p'-DDD, p,p'-DDE, p,p'-DDT, toxaphene, pyrethroids

^e Arsenic, cadmium, copper, lead, manganese, nickel, zinc, aluminum, silver

2

3 **8.4.2.2 Comparisons**

4 For hydrologic (i.e., CALSIM) modeling purposes, which depicts CVP and SWP system-wide
5 operations and thus how water would be routed through the Delta, Existing Conditions, the No
6 Action Alternative and the action alternatives were partly defined according to the key inputs shown
7 in Table 8-62. For the quantitative and qualitative assessments performed, comparisons of the
8 assessment scenarios were made consistent with Table 8-63 and are presented in the Effects and
9 Mitigation Approaches section, below. The CEQA baseline, "Existing Conditions", is defined in
10 Appendix 3D, and for the purposes of the quantitative water quality assessments, is represented by

1 Existing Conditions modeling runs, not historical water quality monitoring data as presented in
 2 Section 8.1.3. The No Action Alternative is defined by the future surface water demands at the 2025
 3 level of development, specific future planned and approved facilities and operations described in
 4 Appendix 3D, and projected climate change and sea level rise estimated to occur by 2060. The longer
 5 planning horizon assumed for climate change compared to system water supply and demands is
 6 included to be commensurate with the 50-year implementation timeframe for BDCP actions.

7 **Table 8-62. Water Quality Assessment Scenarios**

Input Parameters	Existing Conditions	No Action Alternative	Project Alternatives
Surface Water Demands ^a	2005 / Recent Historical	2025 / Full Water Rights	2025 / Full Water Rights
Conveyance	Through Delta	Through Delta	Various
CVP/SWP Operational Criteria	Per USFWS and NMFS BiOps RPAs ^b	Per USFWS and NMFS BiOps RPAs ^b	Various
Fall X2	No	Yes	Some Yes, Some No
Climate Change / Sea Level Rise	None	Year 2060	Year 2060

Notes:

^a This is a simplified characterization of the water demands to illustrate the differences between the scenarios. Water demands for some purveyors under the No Action and action alternatives are the same as those under Existing Conditions, while others are increased to a full contract amount or 2030 level. See CALSIM II modeling assumptions for specific differences (Appendix 5A, *BDCP EIR/EIS Modeling Technical Appendix*).

^b USFWS/NMFS Biological Opinions (BiOps) RPAs are described in Appendix 3D, *Defining Existing Conditions, No Action Alternative, No Project Alternative, and Cumulative Impact Conditions*, and Appendix 5A, *BDCP EIR/EIS Modeling Technical Appendix*.

8

9 **Table 8-63. Scenario Comparisons Performed for Impact Assessment Purposes**

Comparison	Purpose of Comparison
1 Existing Conditions versus Alternatives (including No Action Alternative)	A required comparison to current conditions for CEQA purposes. Shows effects due not only to changes in conveyance and operational criteria defined by the alternative (CM1), including meeting fall X2, but also the effects of future surface water demands and climate change/sea level rise. ^a
2 No Action Alternative versus Project Alternatives	Identifies potential alternative-specific effects caused by changes in conveyance and operating criteria (CM1).

Notes:

^a The CEQA baseline, "Existing Conditions", is defined in Appendix 3D, and for the purposes of quantitative water quality assessments, is represented by Existing Conditions modeling runs, not historical water quality monitoring data as presented in Section 8.1.3.

10

11 **8.4.2.3 Effects Determinations**

12 Both qualitative and quantitative water quality assessments have been conducted to determine the
 13 anticipated changes in water quality that may occur throughout the affected environment from
 14 implementing an each alternative, relative to the water quality conditions that would occur under
 15 the Existing Conditions or the No Action Alternative. The water quality effects of the action or
 16 alternative would be adverse (under NEPA) and significant (under CEQA) if implementation of an
 17 alternative would result in one of the numbered conditions below. As defined and used for

1 assessment purposes, these conditions serve as both effects criteria under NEPA and thresholds of
 2 significance under CEQA. As is explained in more detail below, the thresholds build on, and add
 3 detail to, general questions posed in the sample Initial Study checklist found in Appendix G to the
 4 CEQA Guidelines. The refinements to the language set forth in that document reflects the application
 5 of professional judgment and experience to the more general language found in the original.

- 6 1. Cause exceedance of applicable state or federal numeric or narrative water quality
 7 objectives/criteria, or other relevant water quality effects thresholds identified for this
 8 assessment (applicable objectives/criteria are identified in Appendix 8A and the constituent-
 9 specific assessments in Section 8.3.1.7), by frequency, magnitude, and geographic extent that
 10 would result in adverse effects to one or more beneficial uses within affected water bodies.
- 11 2. Increase levels of a bioaccumulative pollutant by frequency, magnitude, and geographic extent
 12 such that the affected water body (or portion of a water body) would be expected to have
 13 measurably higher body burdens of the bioaccumulative pollutant in aquatic organisms,
 14 thereby substantially increasing the health risks to wildlife (including fish) or humans
 15 consuming those organisms.
- 16 3. Cause long-term degradation of water quality in one or more water body of the affected
 17 environment, resulting in sufficient use of available assimilative capacity such that occasionally
 18 exceeding water quality objectives/criteria would be likely and would result in substantially
 19 increased risk for adverse effects to one or more beneficial uses.
- 20 4. Further degrade water quality by measurable levels, on a long-term basis, for one or more
 21 parameters that are already impaired and, thus, included on the State's Clean Water Act
 22 Section 303(d) list for the water body, such that beneficial use impairment would be made
 23 discernibly worse.
- 24 5. Substantially alter the existing drainage pattern of the site or area, including through the
 25 alteration of the course of a stream or river, in a manner which would result in substantial
 26 erosion or siltation on- or off-site.

27 The third effect assessment criterion/threshold listed above is triggered not by increased
 28 exceedances of water quality standards or adverse impacts on beneficial uses, but rather by the
 29 more sensitive threshold of demonstrated water quality degradation, on a long-term basis, that
 30 eliminates a substantial amount of the receiving water body's available assimilative capacity,
 31 thereby resulting in water quality conditions that substantially increase the likelihood of water
 32 quality objectives/criteria exceedances and adverse effects to beneficial uses. This effects
 33 assessment criterion/threshold would not be met if a substantial amount of available assimilative
 34 capacity is used under the alternative assessed, yet substantial assimilative capacity remains such
 35 that exceeding water quality objectives/criteria would be rare, if it were to occur at all and,
 36 therefore, resulting water quality poses negligible risk for adverse effects to beneficial uses.

37 Similarly, the fourth effect assessment criterion/threshold above is met not by demonstrated or
 38 potential adverse effects to beneficial uses, but rather the more sensitive criteria/threshold of
 39 "measurable degradation," on a long-term basis, under already impaired conditions. This effect
 40 assessment criterion/threshold is included in recognition that an adverse effects determination
 41 should be more sensitive when water quality conditions are already impaired in a water body and,
 42 therefore, any measurable worsening, on a long-term basis, may be considered substantial and
 43 adverse. This fourth effects assessment criterion/threshold provides meaningful sensitivity for
 44 already impaired conditions by requiring measurable changes, on a long-term basis, rather than

1 “any” change at any time (i.e., a change that could be calculated, but may not be measureable in the
 2 actual environment, or may not occur frequently enough to measurably alter water quality on a
 3 long-term basis).

4 The fifth effect assessment criterion/threshold listed above applies to alteration of drainage
 5 patterns, which occurs through construction of various components of the project. Consequently,
 6 effects of the project were assessed relative to this criterion/threshold fully in the sections relating
 7 to effects of construction only.

8 As indicated above, these thresholds/criteria set forth above were derived from questions relating
 9 to hydrology and water quality in Appendix G (Section IX) of the CEQA Guidelines. Without
 10 refinements, thresholds derived literally from that source would read as follows:

- 11 ● Violate any water quality standards (criterion 1);
- 12 ● Substantially alter the existing drainage pattern of the site or area, including through the
 13 alteration of the course of a stream or river, in a manner which would result in substantial
 14 erosion or siltation on- or off-site (criterion 5);
- 15 ● Otherwise substantially degrade water quality (criteria 3 and 4).

16 Appendix G thresholds of significance relating specifically to hydrology and flooding, and whether
 17 the project would substantially increase the rate or amount of surface runoff in a manner which
 18 would result in flooding on- or off-site, are addressed in Chapter 6, *Surface Water*. The above-listed
 19 Appendix G thresholds have been integrated into the five numbered effects criteria/thresholds
 20 listed above and the applicable water quality objectives/criteria are identified in Appendix 8A and in
 21 Section 8.3.1.7.

22 The first bulleted Appendix G threshold, “violate any water quality standard,” was refined for
 23 application in effects criterion/threshold #1. This is because a “water quality standard” contains
 24 three components: 1) the beneficial uses of the water body to be protected, 2) the criteria/objectives
 25 that, when met, result in water quality protective of the designated beneficial uses, and 3) an
 26 antidegradation policy. Therefore, effects criterion/threshold #1 started with the basic concept
 27 behind this first Appendix G threshold, and was further refined to account for the frequency,
 28 magnitude, and geographic extent with which a water quality criterion or objective could be
 29 exceeded, thereby giving the assessor the ability to relate such exceedances to adverse effects on
 30 beneficial uses (i.e., actual adverse environmental effects). As such, effects criterion/threshold #1
 31 will identify significant impacts under CEQA when water quality under an alternative is anticipated
 32 to change substantially, thereby causing adverse effects to beneficial uses, and will avoid making
 33 such determinations when the violation of a water quality standard is too infrequent, low in
 34 magnitude, and/or isolated geographically to actually cause any adverse effects on beneficial uses of
 35 the water body or water body segment.

36 Similarly, the third bulleted Appendix G threshold of “... substantially degrade water quality,” is
 37 vague as written and thus not sufficiently specific to allow meaningful or precise application as a
 38 threshold of significance. Therefore, it too has been refined and expanded into effects
 39 criteria/thresholds #3 and #4 enumerated above.

40 Finally, the second bulleted CEQA Appendix G threshold has been included directly as effects
 41 criterion/threshold #5. Consequently, the applicable water quality thresholds of significance
 42 identified in Section IX of Appendix G of the CEQA Guidelines have been fully incorporated into the

1 five numbered effects criteria/thresholds used to assess the identified water quality changes under
 2 the alternatives for the purposes of making impact determinations for CEQA purposes.

3 **8.4.3 Effects and Mitigation Approaches**

4 **8.4.3.1 No Action Alternative**

5 Per the description of comparisons made in this chapter which are discussed in section 8.3.2.2, this
 6 section contains the comparison of the No Action Alternative vs. Existing Conditions for CEQA
 7 purposes.

8 Under the No Action Alternative, the facilities and operations of the SWP and CVP would continue to
 9 be similar to Existing Conditions with the following changes.

- 10 • Effects of sea level rise and climate change on system operations.
- 11 • An increase in demands and the buildout of facilities associated with water rights and CVP and
 12 SWP contracts of about 443 TAF per year, north of Delta at the future level of development. This
 13 is an increase in CVP M&I service contracts (253 TAF per year) and water rights (184 TAF per
 14 year) related primarily to urban M&I use, especially in the communities in El Dorado, Placer, and
 15 Sacramento Counties.
- 16 • An increase in demands associated with SWP contracts, up to full contract amounts, south of
 17 Delta at the future level of development. SWP M&I demands, which under the existing level of
 18 development vary on hydrologic conditions between 3.0 and 4.1 MAF per year, under the future
 19 condition are at maximum contract amounts in all hydrologic conditions. This represents a
 20 potential 25% increase on average in south of Delta demands under SWP M&I contracts
 21 between existing and future levels of development due to assumed additional development and
 22 demographics.
- 23 • New urban intake/Delta export facilities:
 - 24 ○ Freeport Regional Water Project (see Appendix 5A, *BDCP EIR/S Modeling* for information on
 25 additional EBMUD demand of about 26 TAF/YR on the average with increased demand in
 26 dry years)
 - 27 ○ 30 million-gallon-per-day City of Stockton Delta Water Supply Project
 - 28 ○ Delta-Mendota Canal–California Aqueduct Intertie
 - 29 ○ Contra Costa Water District Alternative Intake and 55 TAF/YR increased demand
 - 30 ○ South Bay Aqueduct rehabilitation, to 430 cfs capacity, from the junction with California
 31 Aqueduct to Alameda County Flood Control and Water Conservation District Zone 7.
- 32 • An increase in supplies for wildlife refuges including Firm Level 2 supplies of about 8 TAF per
 33 year at the future level of development. In addition, there is a shift in refuge demands from
 34 south to north (24 TAF per year reduction in south of Delta and 32 TAF per year increase in
 35 north of Delta).
- 36 • Implementation of the Fall X2 RPA action (see Appendix 5A, *BDCP EIR/S Modeling*), which
 37 requires maintenance of X2 at specific locations in wet and above normal years in September
 38 and October, plus releases in November to augment Delta outflow dependent on hydrology.

1 A detailed description of the modeling assumptions associated with the No Action Alternative is
2 included in Appendix 5A, *BDCP EIR/S Modeling*.

3 **Impact WQ-1: Effects on Ammonia Concentrations Resulting from Facilities Operations and** 4 **Maintenance**

5 ***Upstream of the Delta***

6 Substantial point sources of ammonia-N do not exist upstream of the SRWTP in the Sacramento
7 River watershed, in the watersheds of the eastern tributaries (Cosumnes, Mokelumne, and Calaveras
8 Rivers), or upstream of the Delta in the San Joaquin River watershed. Nonpoint sources of ammonia-
9 N within the watersheds are also relatively low, thus resulting in generally low ammonia-N
10 concentrations in the reservoirs and rivers of the watersheds. Consequently, any modified reservoir
11 operations and subsequent changes in river flows under the No Action Alternative, relative to
12 Existing Conditions, are expected to have negligible, if any, effects on reservoir and river ammonia-N
13 concentrations upstream of Freeport in the Sacramento River watershed and upstream of the Delta
14 in the San Joaquin River watershed. Any negligible changes in ammonia-N concentrations that may
15 occur in the water bodies of the affected environment located upstream of the Delta would not be of
16 frequency, magnitude and geographic extent that would adversely affect any beneficial uses or
17 substantially degrade the quality of these water bodies, with regards to ammonia.

18 ***Delta***

19 As summarized in Table 8-40, under the No Action Alternative, it is assumed that SRWTP upgrades
20 would be in place, and thus that the average monthly effluent ammonia concentration would not
21 exceed 1.5 mg/L-N in April through October and 2.4 mg/L-N in November through March. In
22 comparison, the permitted average monthly effluent ammonia concentration under the Existing
23 Conditions is 33 mg/L-N, with actual monthly average ammonia concentration in the effluent being
24 approximately 24 mg/L-N (Central Valley Water Board 2010e). Because of this, ammonia
25 concentrations in the Sacramento River downstream of the SRWTP would be substantially lower
26 under the No Action Alternative, relative to Existing Conditions. As shown in Figure 8-52,
27 Sacramento River ammonia concentrations currently are of the same magnitude as San Joaquin
28 River and San Francisco Bay concentrations of ammonia during the January through March period of
29 the year, and much greater than these two sources for the remainder of the year. Consequently, a
30 substantial decrease in Sacramento River ammonia concentrations is expected to decrease ammonia
31 concentrations for all areas of the Delta that are influenced by Sacramento River water. Additionally,
32 San Joaquin River and San Francisco Bay concentrations are similar to each other throughout the
33 year (Figure 8-52), indicating that any change in source water fraction from BAY to SJR or from SJR
34 to BAY at locations in the Delta would not substantially alter concentrations at these locations.
35 Therefore, at locations which are not influenced notably by Sacramento River water, concentrations
36 are expected to remain relatively unchanged. Any negligible increases in ammonia-N concentrations
37 that may occur at certain locations in the Delta would not be of frequency, magnitude and
38 geographic extent that would adversely affect any beneficial uses or substantially degrade the water
39 quality at these locations, with regards to ammonia.

40 ***SWP/CVP Export Service Areas***

41 The assessment of effects on ammonia in the SWP/CVP Export Service Areas is based on assessment
42 of ammonia-N concentrations at Banks and Jones pumping plants. The dominant source waters
43 influencing the Banks and Jones pumping plants are the Sacramento and San Joaquin Rivers (see

1 Appendix 8D). As discussed above for the Plan Area, for areas of the Delta that are influenced by
2 Sacramento River water, including Banks and Jones pumping plants, ammonia concentrations are
3 expected to decrease under the No Action Alternative, relative to Existing Conditions. This decrease
4 in ammonia-N concentrations for water exported via the south Delta pumps is not expected to result
5 in adverse effects on beneficial uses or substantially degrade water quality of exported water, with
6 regards to ammonia.

7 In summary, based on the discussion above, effects on ammonia of facilities operations and
8 maintenance are considered to be not adverse.

9 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
10 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
11 purpose of making the CEQA impact determination for this constituent. For additional details on the
12 effects assessment findings that support this CEQA impact determination, see the effects assessment
13 discussion that immediately precedes this conclusion.

14 Ammonia-N concentrations are generally low in the reservoirs and rivers of the watersheds, owing
15 to the lack of substantial point and nonpoint sources of ammonia-N upstream of the SRWTP in the
16 Sacramento River watershed, in the watersheds of the eastern tributaries (Cosumnes, Mokelumne,
17 and Calaveras Rivers), or upstream of the Delta in the San Joaquin River watershed. Consequently,
18 any modified reservoir operations and subsequent changes in river flows under the No Action
19 Alternative, relative to Existing Conditions, are expected to have negligible, if any, effects on
20 reservoir and river ammonia-N concentrations upstream of Freeport in the Sacramento River
21 watershed and upstream of the Delta in the San Joaquin River watershed.

22 Ammonia-N concentrations in the Sacramento River downstream of the SRWTP would be
23 substantially lower under the No Action Alternative, relative to Existing Conditions, due to upgrades
24 to the SRWTP that are assumed to be in place, and thus, ammonia concentrations for all areas of the
25 Delta that are influenced by Sacramento River water are expected to decrease. At locations which
26 are not influenced notably by Sacramento River water, concentrations are expected to remain
27 relatively unchanged, due to the similarity in SJR and BAY concentrations and the lack of expected
28 changes in either of these concentrations.

29 The assessment of effects on ammonia in the SWP/CVP Export Service Areas is based on assessment
30 of ammonia-N concentrations at Banks and Jones pumping plants. As discussed above for the Plan
31 Area, for areas of the Delta that are influenced by Sacramento River water, including Banks and
32 Jones pumping plants, ammonia-N concentrations are expected to decrease under the No Action
33 Alternative, relative to Existing Conditions.

34 Based on the above, there would be no substantial, long-term increase in ammonia-N concentrations
35 in the rivers and reservoirs upstream of the Delta, in the Plan Area, or the waters exported to the
36 SWP/CVP Export Service Areas under the No Action Alternative relative to Existing Conditions. As
37 such, this alternative is not expected to cause additional exceedance of applicable water quality
38 objectives/criteria by frequency, magnitude, and geographic extent from ammonia that would cause
39 adverse effects on any beneficial uses of waters in the affected environment. Because ammonia
40 concentrations would not be expected to increase substantially, no long-term water quality
41 degradation is expected to occur and, thus, no adverse effects on beneficial uses would occur.
42 Ammonia is not 303(d) listed within the affected environment and thus any minor increases that
43 may occur in some areas would not make any existing ammonia-related impairment measurably
44 worse because no such impairments currently exist. Because ammonia-N is not bioaccumulative,

1 minor increases that may occur in some areas would not bioaccumulate to greater levels in aquatic
 2 organisms that would, in turn, pose substantial health risks to fish, wildlife, or humans. This impact
 3 is considered to be less than significant.

4 **Impact WQ-3: Effects on Boron Concentrations Resulting from Existing Facilities Operations** 5 **and Maintenance**

6 *Upstream of the Delta*

7 Under the No Action Alternative, greater water demands (see Table 8-55) and climate change would
 8 alter the magnitude and timing of reservoir releases and river flows upstream of the Delta in the
 9 Sacramento River watershed and east-side tributaries, relative to Existing Conditions. Because
 10 substantial sources of boron do not exist upstream of the Delta in the watersheds of the Sacramento
 11 River and eastside tributaries, concentrations of boron in surface water are low and often below
 12 detection limits (see “Affected Environment-Environmental Setting” section). Consequently, changes
 13 in the magnitude and timing of reservoir releases and river flows upstream of the Delta would have
 14 negligible, if any, effect on boron sources, and ultimately the concentration of boron in the
 15 Sacramento River, the east-side tributaries, and the various reservoirs of the related watersheds.
 16 Consequently, the No Action Alternative would not be expected to cause exceedance of boron
 17 objectives or substantially degrade water quality with respect to boron and thus, would not
 18 adversely affect any beneficial uses of the Sacramento River, the east-side tributaries, or their
 19 associated reservoirs upstream of the Delta.

20 South of the Delta, the San Joaquin River is a substantial source of boron. While tributaries and
 21 associated reservoirs of the lower San Joaquin are likely negligible sources of boron, loading in the
 22 lower San Joaquin watershed contributes to relatively high concentrations which can be sourced to
 23 agricultural irrigation of soils containing boron and use of water imported from the south Delta.
 24 Average boron concentrations in the lower San Joaquin River at Vernalis are inversely correlated to
 25 net river flow and the dilution provided by this flow. Under the No Action Alternative, long-term
 26 average flows at Vernalis would decrease 6% relative to Existing Conditions (as a result of climate
 27 change and increased water demands) (Appendix 5A). Based on best-fit regressions of annual
 28 average San Joaquin River flow and boron, these decreases in flow would correspond to a potential
 29 increase in long-term average boron of about 2% relative to Existing Conditions (Appendix 8F, Table
 30 24). The relatively small increase would not cause boron concentrations to exceed applicable
 31 objectives relative to Existing Conditions and would not cause substantial long-term water quality
 32 degradation with regards to boron. Accordingly, with respect to the 303(d) listing of the lower San
 33 Joaquin River impairment for boron would not be made discernibly worse. The No Action
 34 Alternative also would not be expected to adversely affect necessary TMDL actions implemented to
 35 reduce boron loading in the lower San Joaquin River because the modeled increases are associated
 36 with less dilution of the existing load and boron loading would not be anticipated to change
 37 measurably. Consequently, the small increases in lower San Joaquin River boron levels that may
 38 occur under the No Action Alternative, relative to Existing Conditions, would not be expected to
 39 adversely affect any beneficial uses of the lower San Joaquin River.

40 *Delta*

41 Relative to Existing Conditions, the No Action Alternative would result in generally similar long-term
 42 annual average boron concentrations, or decreased average concentrations, at ten of the eleven
 43 Delta assessment locations for the 16-year period modeled (i.e., 1976–1991), and would increase

1 only at the Jones Pumping Plant location by about 3% (Appendix 8F, Table Bo-2). Increased monthly
2 average concentrations would occur under the No Action Alternative at nine of the assessment
3 locations during the months of December through June, with decreased or similar concentrations
4 occurring only at two interior Delta locations (i.e., SF Mokelumne River at Staten Island and San
5 Joaquin River at Buckley Cove). For the drought year period modeled (i.e., 1987–1991), the No
6 Action Alternative would result in increased annual average concentrations at six locations (up to a
7 maximum 4% increase at the Jones Pumping Plant) relative to Existing Conditions.

8 With respect to the 2,000 µg/L EPA drinking water human health advisory objective (i.e., for
9 children), the long-term annual average and monthly average boron concentrations, for either the
10 16-year period or drought period modeled, are low and would never exceed this objective at any of
11 the eleven Delta assessment locations under the No Action Alternative (i.e., maximum long-term
12 average concentration of about 417 µg/L at the Sacramento River at Mallard Island), which
13 represents a slight decrease from the Existing Conditions (Appendix 8F, Table Bo-3A). Long-term
14 average boron concentrations would be similar or slightly lower at most Delta assessment locations,
15 and no changes would result in measureable long-term use of assimilative capacity (i.e., less than
16 3% reduction) or further degradation of water quality conditions with respect to the 2,000 µg/L
17 objective (Appendix 8F, Table Bo-4). Consequently, boron levels that may occur under the No Action
18 Alternative, relative to Existing Conditions, would not be expected to adversely affect municipal
19 water supply beneficial uses of the Delta.

20 Similarly, under the No Action Alternative, the long-term annual average and monthly average
21 boron concentrations for either the 16-year period or drought period modeled would never exceed
22 the lowest agricultural objective of 500 µg/L contained in the San Francisco Bay RWQCB (Region 2)
23 Basin Plan at any Delta assessment location except at the Sacramento River at Mallard Island and
24 San Joaquin River at Antioch locations (Appendix 8F, Table Bo-3A). However, the agricultural
25 beneficial use is not an existing designated use at Mallard Island within the Region 2 Basin Plan, and
26 the Antioch location is in the far western Delta and not a location of agricultural diversions
27 (California Department of Water Resources 1993). Small reductions in the modeled long-term
28 average assimilative capacity would occur only at the Jones and Banks pumping plants, Old River at
29 Rock Slough, and Sacramento River at Emmaton locations (e.g., maximum reduction of 3% at Jones
30 Pumping Plant for both the 16-year and 4% for the modeled drought period) (Appendix 8F, Table
31 Bo-5). Moreover, the reduced assimilative capacity would not lead to an increased frequency of
32 exceedances of objectives because the absolute concentrations would be well below the lowest 500
33 µg/L objective for the protection of agricultural beneficial uses, as indicated in plots of monthly
34 average boron concentrations for representative interior and south Delta locations (i.e., Franks
35 Tract, Old River at Rock Slough, Jones Pumping Plant, and Old River at Tracy Road) (Appendix 8F,
36 Figure Bo-2). Consequently, the small increases in average boron concentrations that may occur
37 under the No Action Alternative, relative to Existing Conditions, would not be expected to adversely
38 affect municipal or agricultural water supply beneficial uses of the Delta, or substantially degrade
39 water quality with respect to boron.

40 ***SWP/CVP Export Service Areas***

41 Under the No Action Alternative, relatively small increases would occur in long-term average boron
42 concentrations at the Jones and Banks pumping plants relative to the Existing Conditions (i.e., up to
43 4% at Jones pumping plant for both the 16-year and drought period modeled) (Appendix 8F, Table
44 Bo-2). With respect to the 303(d) listing of the lower San Joaquin River impairment for boron,
45 increased boron concentrations in exported water to the San Joaquin River basin could lead to

1 increased loading in the lower San Joaquin River since boron is principally related to irrigation
2 water deliveries. However, the absolute average boron concentrations at Jones Pumping Plant
3 would be low relative to applicable objectives (Appendix 8F, Figure Bo-2), and the reduction in
4 assimilative capacity would be minor (i.e., 4% reduction for the drought period modeled) compared
5 to the Existing Conditions (Appendix 8F, Table Bo-5). Thus, the long-term increased boron
6 concentrations would not be expected to cause further measurable degradation in the lower San
7 Joaquin River that would make the existing impairment discernibly worse or adversely affect
8 necessary TMDL actions implemented to reduce boron loading. Consequently, the small increases in
9 average boron concentrations that may occur under the No Action Alternative, relative to Existing
10 Conditions, would not be expected to adversely affect municipal or agricultural water supply
11 beneficial uses in the SWP and CVP service area, or substantially degrade water quality with respect
12 to boron.

13 In summary, the effects of additional future climate change/sea level rise under the No Action
14 Alternative conditions would result in relatively small increases in long-term average boron
15 concentrations in the lower San Joaquin River and several Delta locations. However, the predicted
16 changes would not be expected to cause exceedances of applicable objectives or further measurable
17 water quality degradation, and thus would not constitute an adverse effect on water quality.

18 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
19 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
20 purpose of making the CEQA impact determination for this constituent. For additional details on the
21 effects assessment findings that support this CEQA impact determination, see the effects assessment
22 discussion that immediately precedes this conclusion.

23 Boron is not a constituent of concern in the Sacramento River watershed upstream of the Delta, thus
24 river flow rate and reservoir storage reductions that would occur under the No Action Alternative,
25 relative to Existing Conditions, would not be expected to result in a substantial adverse change in
26 boron levels. Additionally, relative to Existing Conditions, the No Action Alternative would not result
27 in reductions in river flow rates (i.e., less dilution) or increased boron loading such that there would
28 be any substantial increase in boron concentrations upstream of the Delta in the San Joaquin River
29 watershed.

30 It is expected there would be no substantial change in Delta boron levels (i.e., <4% increase at any
31 assessment location) in response to a shift in the Delta source water percentages under this
32 alternative or substantial degradation of these water bodies. With respect to the 303(d) listing of
33 boron in the lower San Joaquin River for the agricultural water supply beneficial use, the potential
34 small increase in long-term average boron concentration associated with reduced flows and
35 exported water at the Jones Pumping Plant would not be expected to cause substantial additional
36 boron loading, or further degradation at measurable levels in the lower San Joaquin River, and thus
37 would not cause the existing impairment to be discernibly worse.

38 Boron is not a bioaccumulative constituent, thus any increased concentrations under the No Action
39 Alternative would not result in adverse boron bioaccumulation effects to aquatic life or humans.
40 Relative to Existing Conditions, the No Action Alternative would not result in substantially increased
41 boron concentrations such that frequency of exceedances of municipal and agricultural water supply
42 objectives would increase. The levels of boron degradation that may occur under the No Action
43 Alternative would not be of sufficient magnitude to cause substantially increased risk of exceeding
44 objectives or adverse effects to municipal or agricultural beneficial uses, or any other beneficial

1 uses, within the affected environment. Based on these findings, this impact is determined to be less
2 than significant.

3 **Impact WQ-5: Effects on Bromide Concentrations Resulting from Facilities Operations and** 4 **Maintenance**

5 ***Upstream of the Delta***

6 Under the No Action Alternative, greater water demands (see Table 8-55) will alter the magnitude
7 and timing of reservoir releases upstream of the Delta, relative to Existing Conditions. As shown in
8 Table 8-43, the Sacramento River watershed and eastside tributaries are negligible sources of
9 bromide to the Delta. While greater water demands under the No Action Alternative would alter the
10 magnitude and timing of reservoir releases north and east of the Delta, these activities would have
11 negligible, if any, effect on the sources, and ultimately the concentration of bromide in the
12 Sacramento River, the eastside tributaries, and the various reservoirs of the related watersheds.
13 Consequently, the No Action Alternative would not be expected to adversely affect the MUN
14 beneficial use, or any other beneficial uses, of the Sacramento River, the eastside tributaries, or their
15 associated reservoirs upstream of the Delta.

16 South of the Delta, the San Joaquin River is a substantial source of bromide. While tributaries and
17 associated reservoirs of the lower San Joaquin are likely negligible sources of bromide, bromide on
18 the lower San Joaquin is relatively high and can be sourced to agriculture irrigation water imported
19 from the southern Delta. Agricultural irrigation drainage is the primary source of bromide on the
20 lower San Joaquin River, where concentrations at Vernalis are inversely correlated to net river flow
21 and the dilution provided by this flow. Under the No Action Alternative, long-term average flows at
22 Vernalis would decrease 6% relative to Existing Conditions (Appendix 5A). Based on best-fit
23 regressions of annual average San Joaquin River flow and bromide, these decreases in flow would
24 correspond to a possible increase in long-term average bromide of about 3% relative to Existing
25 Conditions (Appendix 8E, *Bromide*, Table 22). The relatively small magnitude of this increase is
26 considered to be less than substantial. Moreover, there are no existing municipal intakes on the
27 lower San Joaquin River. Consequently, the small increases in lower San Joaquin River bromide
28 levels that may occur under the No Action Alternative, relative to Existing Conditions, would not be
29 expected to adversely affect the MUN beneficial use, or any other beneficial uses, of the lower San
30 Joaquin River.

31 ***Delta***

32 Relative to Existing Conditions, the No Action Alternative would result in small decreases in long-
33 term average bromide concentrations at all modeled Delta assessment locations with the exception
34 being the Sacramento River at Emmaton for the drought period (Appendix 8E, *Bromide* Table 2).
35 Long-term average concentrations of seawater-derived constituents decrease under the No Action
36 Alternative relative to Existing Conditions because the No Action Alternative includes Fall X2
37 operations, while Existing Conditions does not (Appendix 3D, 5A). Therefore, even though sea level
38 rise is included in the No Action Alternative, and not in Existing Conditions, the effect of Fall X2 on
39 bromide is generally greater than sea level rise. For the modeled drought period, long-term bromide
40 concentrations at Emmaton are predicted to increase by about 8%.

41 The modeled frequency with which bromide concentration exceeds 50 and 100 µg/L would change
42 only slightly at all 11 assessment locations, with some Delta assessment locations experiencing
43 improved water quality relative to bromide (Appendix 8E, *Bromide*, Table 2). However, small

1 increases in modeled concentration threshold exceedances would occur at some Delta interior and
2 western Delta assessment locations. In the Delta interior at Rock Slough and Franks Tract, the
3 frequency of exceeding 100 µg/L would increase by a maximum of about 3 percentage points (4
4 percentage points for modeled drought period). Larger increases would occur in the western Delta,
5 however, where the frequency of exceeding 100 µg/L would increase by as much as 7 percentage
6 points at Emmaton (2 percentage points for modeled drought period). The greater frequencies of
7 exceedance can be sourced primarily to the assumptions of sea level rise in the late long-term. While
8 the greater influence of sea water would result in slightly more frequent bromide conditions
9 exceeding 50 and 100 µg/L in these select interior and western Delta locations, the resulting
10 conditions would not be expected to adversely affect MUN beneficial uses, or any other beneficial
11 use, particularly when considering the relatively small change in long-term annual average
12 concentration.

13 The seasonal intakes at Mallard Slough and City of Antioch are infrequently used due to water
14 quality constraints related to sea water intrusion. On a long-term average basis, bromide at these
15 locations is in excess of 3,000 µg/L, but during seasonal periods of high Delta outflow can be <300
16 µg/L. Given these seasonal constraints on use, mass balance modeling predicts that use of these
17 intakes would most frequently occur during the months of February, March, and April of wet and
18 above normal water year types when water quality suitable for diversion would be most typically
19 available. Focusing on this period of most likely seasonal use (February–April of wet and above
20 normal water years), under the No Action Alternative average bromide concentrations would
21 increase about 5% at the City of Antioch intake and would decrease about 4% at the Mallard Slough
22 intake relative to Existing Conditions (Appendix 8E, *Bromide*, Table 23). Such a relatively small
23 predicted increase in bromide concentrations at the City of Antioch intake would not be expected to
24 adversely affect MUN beneficial uses, or any other beneficial use, while decreases at Mallard Slough
25 would be considered beneficial.

26 The discussion above is based on results of the mass-balance modeling approach. Results of the
27 modeling approach which used relationships between EC and chloride and between chloride and
28 bromide (see Section 8.3.1.3) were consistent with the discussion above, and assessment of bromide
29 using these data results in the same conclusions as are presented above for the mass-balance
30 approach (see Appendix 8E, *Bromide*, Tables 3 and 24).

31 ***SWP/CVP Export Service Areas***

32 Under the No Action Alternative, long-term average bromide concentrations at the Banks and Jones
33 pumping plants would decrease by as much as 13% relative to Existing Conditions (Appendix 8E,
34 *Bromide* Table 2). As explained above for the Delta, long-term average concentrations of seawater-
35 derived constituents decrease under the No Action Alternative relative to Existing Conditions
36 because the No Action Alternative includes Fall X2, while Existing Conditions does not (Appendix
37 3D, 5A). Therefore, even though sea level rise is included in the No Action Alternative, and not in
38 Existing Conditions, the effect of Fall X2 on bromide is generally greater than sea level rise. The
39 frequency with which bromide would exceed bromide concentration thresholds at the Banks and
40 Jones pumping plants, relative to Existing Conditions, would remain unchanged or would improve
41 slightly, including years of drought (Appendix 8E, *Bromide*, Table 2). Consequently water exported
42 into the SWP/CVP Export Service Areas through these south Delta pumps would be of similar or
43 slightly better quality with regards to bromide under the No Action Alternative, relative to Existing
44 Conditions.

1 The discussion above is based on results of the mass-balance modeling approach. Results of the
2 modeling approach which used relationships between EC and chloride and between chloride and
3 bromide (see Section 8.3.1.3) were consistent with the discussion above, and assessment of bromide
4 using these data results in the same conclusions as are presented above for the mass-balance
5 approach (see Appendix 8E, *Bromide*, Table 3).

6 Maintenance of SWP and CVP facilities under the No Action Alternative would not be expected to
7 create new sources of bromide or contribute towards a substantial change in existing sources of
8 bromide in the affected environment. Maintenance activities would not be expected to cause any
9 substantial change in bromide such that MUN beneficial uses, or any other beneficial use, would be
10 adversely affected anywhere in the affected environment.

11 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
12 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
13 purpose of making the CEQA impact determination for this constituent. For additional details on the
14 effects assessment findings that support this CEQA impact determination, see the effects assessment
15 discussion that immediately precedes this conclusion.

16 While greater water demands under the No Action Alternative would alter the magnitude and
17 timing of reservoir releases north and east of the Delta, these activities would have negligible, if any,
18 effect on the sources of bromide, and ultimately the concentration of bromide in the Sacramento
19 River, the eastside tributaries, and the various reservoirs of the related watersheds. However, south
20 of the Delta, the San Joaquin River is a substantial source of bromide, primarily due to the use of
21 irrigation water imported from the southern Delta. Concentrations of bromide at Vernalis are
22 inversely correlated to net river flow. Under the No Action Alternative, long-term average flows at
23 Vernalis would decrease only slightly, resulting in less than substantial predicted increases in long-
24 term average bromide of about 3% relative to Existing Conditions.

25 Relative to Existing Conditions, the No Action Alternative would result in small decreases in long-
26 term average bromide concentrations at all modeled Delta assessment locations with the exception
27 being the Sacramento River at Emmaton for the drought period. For the modeled drought period,
28 long-term bromide concentrations at Emmaton are predicted to increase by about 8%. Small
29 increases in modeled concentration threshold exceedances would occur at some Delta interior and
30 western Delta assessment locations, including Rock Slough, Franks Tract, and Emmaton, but the
31 resulting conditions would not be expected to adversely affect MUN beneficial uses, or any other
32 beneficial use. Moreover, the small (i.e., $\leq 5\%$) predicted increase in long-term average bromide
33 concentrations at the City of Antioch intake would not be expected to adversely affect MUN
34 beneficial uses while decreases at Mallard Slough would be considered beneficial.

35 The assessment of effects on bromide in the SWP/CVP Export Service Areas is based on assessment
36 of changes in bromide concentrations at Banks and Jones pumping plants. Long-term average
37 bromide concentrations at the Banks and Jones pumping plants are predicted to decrease by as
38 much as 13% relative to Existing Conditions while exceedance of bromide concentration thresholds
39 at the Banks and Jones pumping plants, would remain largely unchanged.

40 Based on the above, the No Action Alternative would not cause exceedance of applicable state or
41 federal numeric or narrative water quality objectives/criteria because none exist for bromide. The
42 No Action Alternative would not result in any substantial change in long-term average bromide
43 concentration or exceed 50 and 100 $\mu\text{g/L}$ assessment threshold concentrations by frequency,
44 magnitude, and geographic extent that would result in adverse effects on any beneficial uses within

1 affected water bodies. Bromide is not a bioaccumulative constituent and thus concentrations under
2 this alternative would not result in bromide bioaccumulating in aquatic organisms. Increases in
3 exceedances of the 100 µg/L assessment threshold concentration would be 7 percentage points or
4 less at all locations assessed, which is considered to be less-than substantial long-term degradation
5 of water quality. The levels of bromide degradation that may occur under the No Action Alternative
6 would not be of sufficient magnitude to cause substantially increased risk for adverse effects on any
7 beneficial uses of water bodies within the affected environment. Bromide is not 303(d) listed and
8 thus the minor increases in long-term average bromide concentrations would not affect an existing
9 beneficial use impairment because no such use impairment currently exists for bromide. Based on
10 these findings, this impact is less than significant.

11 **Impact WQ-7: Effects on Chloride Concentrations Resulting from Facilities Operations and** 12 **Maintenance**

13 *Upstream of the Delta*

14 Under the No Action Alternative, greater water demands (see Table 8-55) and climate change would
15 alter the magnitude and timing of reservoir releases and river flows upstream of the Delta in the
16 Sacramento River watershed and eastside tributaries, relative to Existing Conditions. Because
17 substantial sources of chloride do not exist upstream of the Delta, concentrations of chloride in
18 surface water are low and often below detection limits (see “Affected Environment-Environmental
19 Setting” section). Consequently, changes in the magnitude and timing of reservoir releases and river
20 flows upstream of the Delta would have negligible, if any, effect on chloride sources, and ultimately
21 the concentration of chloride in the Sacramento River, the eastside tributaries, and the various
22 reservoirs of the related watersheds. Consequently, the No Action Alternative would not be expected
23 to cause exceedance of chloride objectives/criteria or substantially degrade water quality with
24 respect to chloride and thus would not adversely affect any beneficial uses of the Sacramento River,
25 the eastside tributaries, or their associated reservoirs upstream of the Delta.

26 South of the Delta, the San Joaquin River has generally elevated chloride concentrations compared
27 to the Sacramento River and east side tributaries; however, average monthly and maximum
28 concentrations are below the applicable drinking water MCL of 250 mg/L and the EPA chronic
29 aquatic life criterion of 230 mg/L (Table Cl-2). The chloride in the lower San Joaquin River can be
30 sourced to accumulation of salts in agricultural drainage from irrigation water imported from the
31 southern Delta. Chloride concentrations at Vernalis are inversely correlated to net river flow and the
32 dilution provided by the flow. Under the No Action Alternative, long-term average flows at Vernalis
33 would decrease by an estimated 6% relative to Existing Conditions (as a result of climate change and
34 increased water demands) (Appendix 5A, CALSIM Flow Data for Vernalis). Based on best-fit
35 regressions of annual average San Joaquin River flow and chloride, these decreases in flow would
36 correspond to a potential increase in long-term average chloride concentrations of about 2%
37 relative to Existing Conditions (Appendix 8G, Table Cl-62). The relatively small increase would not
38 cause chloride concentrations to exceed applicable objectives relative to existing concentrations and
39 would not cause substantial long-term water quality degradation with regards to chloride.
40 Moreover, there are no existing municipal supply intakes on the lower San Joaquin River.
41 Consequently, the small increases in lower San Joaquin River chloride levels that may occur under
42 the No Action Alternative, relative to Existing Conditions, would not be expected to adversely affect
43 any beneficial uses of the lower San Joaquin River.

1 **Delta**

2 Relative to Existing Conditions, modeling predicts that the No Action Alternative would result
 3 primarily in small decreases in long-term average chloride concentrations for the 16-year period
 4 modeled (i.e., 1976–1991) at all Delta assessment locations (Appendix 8G, Table Cl-1 and Table Cl-
 5 2). Long-term average concentrations of seawater-derived constituents decrease under the No
 6 Action Alternative relative to Existing Conditions because the No Action Alternative includes Fall X2,
 7 while Existing Conditions does not (Appendix 3D, 5A). Therefore, even though sea level rise is
 8 included in the No Action Alternative, and not in Existing Conditions, the effect of Fall X2 on chloride
 9 is generally greater than sea level rise. In the months of February through June, monthly average
 10 chloride concentrations would increase at all of the assessment locations except two interior Delta
 11 locations (i.e., SF Mokelumne River at Staten Island and San Joaquin River at Buckley Cove). For the
 12 other months of the year (i.e., July through January), the changes in chloride concentrations would
 13 be variable with increases and decreases occurring at all eleven assessment locations. The
 14 Sacramento River at Emmaton location in the western Delta would exhibit the largest seasonal
 15 increases compared to Existing Conditions, ranging from 11% to 48% during the months of
 16 December through June. For the drought year period modeled (i.e., 1987–1991), the annual average
 17 chloride concentration would remain unchanged or decrease at ten of the assessment locations, but
 18 increase by about 12% compared to Existing Conditions at the Sacramento River at Emmaton
 19 location (Appendix 8G, Table Cl-1 and Table Cl-2). The comparison to Existing Conditions reflects
 20 changes in chloride due to both increased demands and changed hydrology and Delta hydrodynamic
 21 conditions associated with climate change and sea level rise. The following outlines the modeled
 22 chloride changes relative to the applicable objectives and effects on beneficial uses in Delta waters.

23 *Municipal and Industrial Beneficial Uses—Relative to Existing Conditions*

24 Estimates of chloride concentrations generated using EC-chloride relationships and DSM2 EC output
 25 (see Section 8.3.1.3) were used to evaluate the 150 mg/L Bay-Delta WQCP objective for municipal
 26 and industrial beneficial uses on a basis of the percent of years the chloride objective is exceeded for
 27 the modeled 16-year period. The objective is exceeded if chloride concentrations exceed 150 mg/L
 28 for a specified number of days in a given water year at both the Antioch and Contra Costa Pumping
 29 Plant #1 locations. For No Action Alternative, the modeled frequency of objective exceedance would
 30 remain unchanged relative to Existing Conditions. The modeled frequency of exceedance is
 31 predicted to be 6% under Existing Conditions and 6% under the No Action Alternative (Appendix
 32 8G, Table Cl-64). Similarly, estimates of chloride concentrations generated using EC-chloride
 33 relationships and DSM2 EC output (see Section 8.3.1.3) were also used to evaluate the 250 mg/L
 34 Bay-Delta WQCP objective for chloride at Contra Costa Pumping Plant #1 where daily average
 35 objectives apply. The basis for the evaluation was the predicted number of days the objective was
 36 exceeded for the modeled 16-year period. For the No Action Alternative, the modeled frequency of
 37 objective exceedance would decrease slightly, from 6% of modeled days under Existing Conditions,
 38 to 4% of modeled days under the No Action Alternative (Appendix 8G, Table Cl-63).

39 Given the limitations inherent to estimating future chloride concentrations (see Section 8.3.1.3),
 40 estimation of chloride concentrations through both a mass balance approach and an EC-chloride
 41 relationship approach was used to evaluate the 250 mg/L Bay-Delta WQCP objectives in terms of
 42 both frequency of exceedance and use of assimilative capacity. When utilizing the mass balance
 43 approach, modeled monthly average chloride concentrations at the Barker Slough at North Bay
 44 Aqueduct for the 16-year period would not exceed the objective, which represents no change from
 45 the Existing Conditions (Appendix 8G, Table Cl-3). The modeled frequency of exceedances at the

1 Banks pumping plant would decrease slightly from 4% under Existing Conditions to 2%. At the
2 Contra Costa Canal at Pumping Plant #1, the modeled frequency of exceedances of this objective
3 would decrease about 10% from 24% to 14%. Chloride concentrations in the western Delta can
4 exceed the applicable 250 mg/L objective frequently in the low-flow fall and early winter months
5 under Existing Conditions. Consequently, water is diverted from the San Joaquin River at Antioch
6 and Mallard Slough municipal intakes only when salinity conditions are acceptable. The frequency of
7 exceedances of the objective at the San Joaquin at Antioch location for the 16-year period modeled
8 would increase from 66% under Existing Conditions to 73% for a net increase of about 7% and
9 would increase 1% (i.e., from 85% under Existing Conditions to 86%) at the Sacramento River at
10 Mallard Island location. Moreover, the increased chloride concentrations would occur during the
11 months of January through June, thus reducing water quality during the period of seasonal
12 municipal diversions (Appendix 8G, Figure Cl-1). The available assimilative capacity would decrease
13 substantially at the Antioch location in the months of March and April (i.e., maximum reduction of
14 39% for the 16-year period modeled and 97% for the drought period only) when chloride
15 concentrations would be near, or exceed, the objectives, thus increasing the risk of exceeding
16 objectives (Appendix 8G, Table Cl-5).

17 In comparison, when utilizing the chloride-EC relationship to model monthly average chloride
18 concentrations for the 16-year period, trends in frequency of exceedance and use of assimilative
19 capacity are similar to that discussed when utilizing the mass balance modeling approach (Appendix
20 8G, Table Cl-4). Based on the additional predicted seasonal and annual exceedances of one or both
21 Bay Delta WQCP objectives for chloride, and the associated long-term water quality degradation and
22 use of assimilative capacity, the potential exists for adverse effects on the municipal and industrial
23 beneficial uses in the western Delta, particularly at the Antioch location, through reduced
24 opportunity for diversion of water with acceptable chloride levels.

25 *303(d) Listed Water Bodies—Relative to Existing Conditions*

26 Tom Paine Slough in the southern Delta is on the 303(d) list for chloride with respect to the
27 secondary MCL of 250 mg/L. The plot of monthly average chloride concentrations at the Old River at
28 Tracy Bridge for the 16-year period modeled, which represents the nearest DSM2-modeled location
29 to Tom Paine in the south Delta, would be well below the MCL and generally would be similar, or
30 reduced slightly, compared to Existing Conditions (Appendix 8G, Figure Cl-2).

31 Suisun Marsh is on the 303(d) list for chloride in association with the Bay-Delta WQCP objectives for
32 maximum allowable salinity during the months of October through May, which establish
33 appropriate seasonal salinity conditions for fish and wildlife beneficial uses. The Sacramento River
34 at Mallard Island, Sacramento River at Collinsville, and Montezuma Slough at Beldon's Landing
35 within the marsh, are DSM2-modeled locations representative of source water quality conditions for
36 the marsh that is supported by inflowing flood tide waters from the west, and ebb tide flows of
37 Sacramento River water into Montezuma Slough through the Suisun Marsh Salinity Control Gates
38 located near the Collinsville location. Long-term average chloride concentrations at the Sacramento
39 River at the Mallard Island location for the 16-year period modeled would decrease slightly by 140
40 mg/L (-5%) compared to Existing Conditions (Appendix 8G, Table Cl-1). The plots of monthly
41 average chloride concentrations for the Sacramento River at Collinsville (Appendix 8G, Figure Cl-3)
42 and Montezuma Slough at Beldon's Landing (Appendix 8G, Figure Cl-4) for the 16-year period
43 modeled indicate that, compared to Existing Conditions, chloride concentrations would be similar or
44 lower during the months of October through May. Consequently, chloride concentrations at Tom

1 Paine Slough and Suisun Marsh would not be further degraded on a long-term basis or adversely
2 affect necessary actions to reduce chloride loading for any TMDLs developed.

3 **SWP/CVP Export Service Areas**

4 Under the No Action Alternative, long-term average chloride concentrations at the Banks and Jones
5 pumping plants would decrease by as much as 12% relative to Existing Conditions for the 16-year
6 period modeled (Appendix 8G, *Chloride*, Table Cl-1). The modeled frequency of exceedances of
7 applicable water quality objectives/criteria would decrease at the Banks and Jones pumping plants,
8 relative to Existing Conditions for both the 16-year period modeled and the drought period
9 (Appendix 8G, *Chloride*, Table Cl-3). As explained above for the Delta, long-term average
10 concentrations of seawater-derived constituents decrease under the No Action Alternative relative
11 to Existing Conditions because the No Action Alternative includes Fall X2, while Existing Conditions
12 does not (Appendix 3D, 5A). Therefore, even though sea level rise is included in the No Action
13 Alternative, and not in Existing Conditions, the effect of Fall X2 on chloride is generally greater than
14 sea level rise. Consequently, water exported into the SWP and CVP service area would generally be
15 of similar or slightly better quality with regards to chloride under the No Action Alternative relative
16 to Existing Conditions.

17 Results of the modeling approach which used relationships between EC and chloride (see Section
18 8.3.1.3) were consistent with the discussion above, and assessment of chloride using these data
19 results in the same conclusions as are presented above for the mass-balance approach (Appendix
20 8G, Table Cl-2 and Table Cl-4).

21 Maintenance of SWP and CVP facilities under the No Action Alternative would not be expected to
22 create new sources of chloride or contribute towards a substantial change in existing sources of
23 chloride in the affected environment. Maintenance activities would not be expected to cause any
24 substantial change in chloride such that any beneficial uses would be adversely affected anywhere in
25 the affected environment.

26 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
27 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
28 purpose of making the CEQA impact determination for this constituent. For additional details on the
29 effects assessment findings that support this CEQA impact determination, see the effects assessment
30 discussion that immediately precedes this conclusion.

31 Chloride is not a constituent of concern in the Sacramento River watershed upstream of the Delta,
32 thus river flow rate and reservoir storage reductions that would occur under the No Action
33 Alternative, relative to Existing Conditions, would not be expected to result in a substantial adverse
34 change in chloride levels. Additionally, relative to Existing Conditions, the No Action Alternative
35 would not result in reductions in river flow rates (i.e., less dilution) or increased chloride loading
36 such that there would be any substantial increase in chloride concentrations upstream of the Delta
37 in the San Joaquin River watershed.

38 It is expected there would be substantial changes in Delta chloride levels in response to a shift in the
39 Delta source water percentages under this alternative or substantial degradation of these water
40 bodies. Relative to Existing Conditions, the No Action Alternative would result in substantially
41 increased chloride concentrations such that frequency of exceedances of the 250 mg/L Bay-Delta
42 WQCP objective would increase at the San Joaquin River at Antioch (by 7%) and at Mallard Slough
43 (by 1%), and long-term degradation may occur, that may result in adverse effects on the municipal

1 and industrial water supply beneficial use. With respect to the 303(d) listings, the small increases in
 2 average chloride concentrations would not cause further degradation on a long-term basis that
 3 would adversely affect necessary actions to reduce chloride loading for any TMDLs developed for
 4 Tom Paine Slough and Suisun Marsh wetlands.

5 Chloride concentrations would be reduced in water exported from the Delta to the CVP/SWP Export
 6 Service Areas, thus reflecting a potential improvement to chloride loading in the lower San Joaquin
 7 River.

8 Chloride is not a bioaccumulative constituent, thus any increased concentrations under the No
 9 Action Alternative would not result in adverse chloride bioaccumulation effects to aquatic life or
 10 humans. However, based on these findings, this impact is determined to be significant due to
 11 increased chloride concentrations and objective exceedances, and additional long-term degradation,
 12 in the western Delta and associated effects on the municipal and industrial water supply beneficial
 13 uses.

14 **Impact WQ-9: Effects on Dissolved Oxygen Resulting from Facilities Operations and** 15 **Maintenance**

16 ***Upstream of the Delta***

17 DO levels in the reservoirs and rivers are primarily affected by water temperature, flow velocity,
 18 turbulence, amounts of oxygen demanding substances present (e.g., ammonia, organics), and rates
 19 of photosynthesis (which is influenced by nutrient levels), respiration, and decomposition. Water
 20 temperature and salinity affect the maximum DO saturation level (i.e., the highest amount of oxygen
 21 the water can dissolve). Flow velocity affects the turbulence and re-aeration of the water (i.e., the
 22 rate at which oxygen from the atmosphere can be dissolved in water). High nutrient content can
 23 support aquatic plant and algae growth, which in turn generates oxygen through photosynthesis and
 24 consumes oxygen through respiration and decomposition.

25 The No Action Alternative would alter the magnitude and timing of water releases from reservoirs
 26 upstream of the Delta relative to Existing Conditions, altering downstream river flows. There would
 27 be some increases and decreases in the mean monthly river flows, depending on month and year.
 28 Mean monthly flows would remain within the range historically seen under Existing Conditions.
 29 Moreover, these are large, turbulent rivers with velocities typically in the range of 0.5 fps to 2.0 fps
 30 or higher. Consequently, flow changes that would occur under the No Action Alternative would not
 31 be expected to have substantial effects on river DO levels; likely, the changes would be
 32 immeasurable. This is because sufficient turbulence and interaction of river water with the
 33 atmosphere would continue to occur under this alternative to maintain water saturation levels (due
 34 to these factors) at levels similar to that of Existing Conditions.

35 The changes in the magnitude and timing of water releases from reservoirs upstream of the Delta,
 36 relative to Existing Conditions, could affect downstream river temperatures, depending on month
 37 and year. Water temperature affects the maximum DO saturation level; as temperature increases,
 38 the DO saturation level decreases. When holding constant for barometric pressure (e.g., 760 mm
 39 mercury), the DO saturation level ranges from 7.5 mg/L at 30°C (86°F) to 11 mg/L at 10°C (50°F)
 40 (Tchobanoglous and Schroeder 1987:735). As described in the affected environment section, DO in
 41 the Sacramento River at Keswick, Feather River at Oroville, and lower American River ranged from
 42 7.3 to 15.6 mg/L, 7.4 to 12.5 mg/L, and 6.5 to 13.0 mg/L, respectively. Thus, these rivers are well
 43 oxygenated and experience periods of supersaturation (i.e., when DO level exceeds the saturation

1 concentration). Because these are large, turbulent rivers, any reduced DO saturation level that
2 would be caused by an increase in temperature under the No Action Alternative would not be
3 expected to cause DO levels to be outside of the range seen historically. This is because sufficient
4 turbulence and interaction of river water with the atmosphere would continue to occur under this
5 alternative to maintain saturation levels.

6 Amounts of oxygen demanding substances present (e.g., ammonia, organics) in the reservoirs and
7 rivers upstream of the Delta, rates of photosynthesis (which is influenced by nutrient
8 levels/loading), and respiration and decomposition of aquatic life is not expected to change
9 sufficiently under the No Action Alternative to substantially alter DO levels relative to Existing
10 Conditions. Any minor reductions in DO levels that may occur under this alternative would not be
11 expected to be of sufficient frequency, magnitude and geographic extent to adversely affect
12 beneficial uses, or substantially degrade the quality of these water bodies, with regard to DO.

13 An effect on salinity (expressed as EC) would not be expected in the rivers and reservoirs upstream
14 of the Delta. Thus, these parameters would not be expected to measurably change DO levels under
15 the No Action Alternative, relative to Existing Conditions.

16 **Delta**

17 Similar to the reservoirs and rivers upstream of the Delta, DO levels in the Delta are primarily
18 affected by water temperature, salinity, Delta channel flow velocities, nutrients (i.e., phosphorus and
19 nitrogen) and aquatic organisms (i.e., photosynthesis, respiration, and decomposition). Sediment
20 oxygen demand of organic material deposited in the low velocity channels also affects Plan Area DO
21 levels.

22 Under the No Action Alternative, minor DO level changes could occur due to nutrient loading to the
23 Delta relative to Existing Conditions (see WQ-1, WQ-15, WQ-23). The state has begun to aggressively
24 regulate point-source discharge effects on Delta nutrients, and is expected to further regulate
25 nutrients upstream of and in the Delta in the future. Although population increased in the affected
26 environment between 1983 and 2001, average monthly DO levels during this period of record show
27 no trend in decline in the presence of presumed increases in anthropogenic sources of nutrients (see
28 Table 4.4-15 in the ES/AE section). Based on these considerations, excessive nutrients that would
29 cause low DO levels would not be expected to occur under the No Action Alternative.

30 Various areas of the Delta could experience salinity increases due to change in quantity of Delta
31 inflows (see WQ-11). For a 5 ppt salinity increase at 68° Fahrenheit, the saturation level of oxygen
32 dissolved in the water is reduced by only about 0.25 mg/L. Thus, increased salinity under the No
33 Action Alternative would generally have relatively minor effects on Delta DO levels where salinity is
34 increased on the order of 5 ppt or less.

35 The relative degree of tidal exchange of flows and turbulence, which contributes to exposure of
36 Delta waters to the atmosphere for reaeration, would not be expected to substantially change
37 relative to Existing Conditions, such that these factors would reduce Delta DO levels below
38 objectives or levels that protect beneficial uses.

39 As discussed in the section on DO in section 8.3.1.7 Effects of climate change on air and Delta water
40 temperatures are discussed in Appendix 29C. In general, waters of the Delta would be expected to
41 warm less than 5 degrees F under the No Action Alternative, relative to Existing Conditions, due to
42 climate change, which translates into a < 0.5 mg/L decrease in DO saturation. Thus, increased

1 temperature under the No Action Alternative would generally have relatively minor effects on Delta
2 DO levels.

3 Some waterways in the eastern, southern, and western Delta are listed on the state's Clean Water
4 Act section 303(d) list as impaired due to low oxygen levels. ATMDL for the Deep Water Ship
5 channel in the eastern Delta has been approved and identifies the factors contributing to low DO in
6 the Deep Water Ship Channel as oxygen demanding substances from upstream sources, Deep Water
7 Ship Channel geometry, and reduced flow through the Deep Water Ship Channel (Central Valley
8 Water Board 2005:28). The TMDL takes a phased approach to allow more time to gather additional
9 informational on source and linkages to the DO impairment, while at the same time moving forward
10 on making improvements to DO conditions. One component of the TMDL implementation activities
11 is an aeration device demonstration project. It is expected that under the No Action Alternative that
12 DO levels in the Deep Water Ship Channel would remain similar to those under Existing Conditions
13 or improve as the TMDL-required studies are completed and actions are implemented to improve
14 DO levels. DO levels in other Clean Water Act section 303(d)-listed waterways would not be
15 expected to change relative to Existing Conditions, as the circulation of flows, tidal flow exchange,
16 and re-aeration would continue to occur similar to Existing Conditions.

17 ***SWP/CVP Export Service Areas***

18 The primary factor that would affect DO in the conveyance channels and ultimately the receiving
19 reservoirs in the SWP/CVP Export Service Areas would be changes in the levels of nutrients and
20 oxygen-demanding substances and DO levels in the exported water. For reasons provided above, the
21 Delta waters exported to the SWP/CVP Export Service Areas would not be expected to be
22 substantially lower in DO compared to Existing Conditions. Exported water could potentially be
23 warmer and have higher salinity relative to Existing Conditions. Nevertheless, because the
24 biochemical oxygen demand of the exported water would not be expected to substantially differ
25 from that under Existing Conditions (due to ever increasing water quality regulations), canal
26 turbulence and exposure of the water to the atmosphere and the algal communities that exist within
27 the canals would establish an equilibrium for DO levels within the canals. The same would occur in
28 downstream reservoirs. Consequently, substantial adverse effects on DO levels in the SWP/CVP
29 Export Service Areas would not be expected to occur under the No Action Alternative relative to
30 Existing Conditions.

31 The effects on dissolved oxygen from implementing the No Action Alternative is determined to not
32 be adverse.

33 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
34 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
35 purpose of making the CEQA impact determination for this constituent. For additional details on the
36 effects assessment findings that support this CEQA impact determination, see the effects assessment
37 discussion that immediately precedes this conclusion.

38 River flow rate and reservoir storage reductions that would occur under the No Action Alternative,
39 relative to Existing Conditions, would not be expected to result in a substantial adverse change in DO
40 levels in the reservoirs and rivers upstream of the Delta, given that mean monthly flows would
41 remain within the ranges historically seen under Existing Conditions and the affected river are large
42 and turbulent. Any reduced DO saturation level that may be caused by increased water temperature
43 would not be expected to cause DO levels to be outside of the range seen historically. Finally,

1 amounts of oxygen demanding substances and salinity would not be expected to change sufficiently
2 to affect DO levels.

3 It is expected there would be no substantial change in Delta DO levels in response to a shift in the
4 Delta source water percentages under this alternative or substantial degradation of these water
5 bodies, with regard to DO. DO levels would be affected by nutrient loading, which the state has
6 begun to aggressively regulate the discharges of, and this loading would not be expected to lower DO
7 levels relative to Existing Conditions based on historical DO levels. Further, the anticipated changes
8 in salinity would have relatively minor effects on DO levels, and tidal exchange, which contribute to
9 the reaeration of Delta waters would not be expected to change substantially.

10 There is not expected to be substantial, if even measurable, changes in DO levels in the SWP/CVP
11 Export Service Areas waters under the No Action Alternative, relative to Existing Conditions,
12 because the biochemical oxygen demand of the exported water would not be expected to
13 substantially differ from that under Existing Conditions (due to ever increasing water quality
14 regulations), canal turbulence and exposure of the water to the atmosphere and the algal
15 communities that exist within the canals would establish an equilibrium for DO levels within the
16 canals. The same would occur in downstream reservoirs.

17 There would be no substantial, and likely no measurable, long-term change in DO levels Upstream of
18 the Delta, in the Plan Area, or the SWP/CVP Export Service Areas under the No Action Alternative
19 relative to Existing Conditions. As such, this alternative is not expected to cause additional
20 exceedance of applicable water quality objectives by frequency, magnitude, and geographic extent
21 that would adversely affect beneficial uses. Because no substantial changes in DO levels are
22 expected, long-term water quality degradation would not be expected, and, thus, beneficial uses
23 would not be expected to be adversely affected. Various Delta waterways are Clean Water Act
24 section 303(d)-listed for low DO, but because no substantial decreases in DO levels are expected,
25 greater degradation and impairment of these areas is not expected to occur. This impact is
26 considered to be less than significant.

27 **Impact WQ-11: Effects on Electrical Conductivity Concentrations Resulting from Facilities** 28 **Operations and Maintenance**

29 ***Upstream of the Delta***

30 The No Action Alternative would alter the magnitude and timing of water releases from reservoirs
31 upstream of the Delta relative to Existing Conditions, altering downstream river flows relative to
32 Existing Conditions. With respect to EC, an increase or decrease in river flow alone is not of concern.
33 Measureable changes in the quality of the watershed runoff and reservoir inflows would not be
34 expected to occur in the future; therefore, the EC levels in these reservoirs would not be expected to
35 change relative to Existing Conditions. There could be increased discharges of EC-elevating
36 parameters in the future in water bodies upstream of the Delta as a result of urban growth and
37 increased runoff and wastewater discharges. The state has begun to aggressively regulate point-
38 source discharge effects on Delta salinity-elevating parameters, capping dischargers at existing
39 levels, and is expected to further regulate EC and related parameters upstream of and within the
40 Delta in the future as salt management plans are developed. Based on these considerations, EC levels
41 (highs, lows, typical conditions) in the Sacramento River and its tributaries, the eastside tributaries,
42 or their associated reservoirs upstream of the Delta would not be expected to be outside the ranges
43 occurring under Existing Conditions.

1 The effects on lower San Joaquin River EC would be somewhat different. Elevated EC in the San
 2 Joaquin River can be sourced to agricultural use of irrigation water imported from the southern
 3 Delta and applied on soils high in salts. This accumulation of salts is a primary contributor of
 4 elevated EC on the lower San Joaquin River. Tributary flows generally provide dilution of the high
 5 EC agricultural drainage waters. Under the No Action Alternative, long-term average flows at
 6 Vernalis would decrease 6% (as a result of climate change and increased water demands) relative to
 7 Existing Conditions (Appendix 5A). These decreases in flow, alone, would correspond to a possible
 8 increase in long-term average EC levels relative to Existing Conditions. The level of EC increase
 9 cannot be readily quantified but, based on estimated increase in bromide and chloride
 10 concentrations, to which EC is correlated, would be relatively small and on the order of about 3%.
 11 However, with the implementation of the adopted TMDL for the San Joaquin River at Vernalis and
 12 the ongoing development of the TMDL for the San Joaquin River upstream of Vernalis and its
 13 implementation, it is expected that EC levels would be improved under the No Action Alternative
 14 relative to Existing Conditions. Based on these considerations, substantial changes in EC levels in the
 15 San Joaquin River relative to Existing Conditions would not be expected of sufficient magnitude and
 16 geographic extent that would result in adverse effects on any beneficial uses, or substantially
 17 degrade the quality of these water bodies, with regard to EC.

18 **Delta**

19 Relative to Existing Conditions, the No Action Alternative would result in a fewer number of days
 20 when Bay-Delta WQCP compliance locations in the western, interior, and southern Delta would
 21 exceed EC objectives or be out of compliance with the EC objectives, with the exception of the
 22 Sacramento River at Emmaton (Appendix 8H, Table EC-1). Long-term average levels of seawater-
 23 derived constituents decrease under the No Action Alternative relative to Existing Conditions
 24 because the No Action Alternative includes Fall X2, while Existing Conditions does not (Appendix
 25 3D, 5A). Therefore, even though sea level rise is included in the No Action Alternative, and not in
 26 Existing Conditions, the effect of Fall X2 is generally greater than sea level rise. For electrical
 27 conductivity, the Sacramento River at Emmaton is an exception, where sea level rise and increased
 28 water demands (see Table 8-62) combine to cause increases in electrical conductivity. The percent
 29 of days the Emmaton EC objective would be exceeded for the entire period modeled (1976–1991)
 30 would increase from 6% under Existing Conditions to 12% under the No Action Alternative. Further,
 31 the percent of days out of compliance with the EC objective would increase from 11% under Existing
 32 Conditions to 22% under the No Action Alternative. Average EC levels at the western, interior, and
 33 southern Delta compliance locations, other than the Sacramento River at Emmaton, would decrease
 34 from 1–14% for the entire period modeled and 0–7% during the drought period modeled (1987–
 35 1991) (Appendix 8H, Table EC-11). Average EC in the Sacramento River at Emmaton would increase
 36 1% for the entire period modeled and 10% during the drought period modeled. On average, EC
 37 would increase at Emmaton during all months, except October and November (Appendix 8H, Table
 38 EC-11).

39 In Suisun Marsh, average EC for the entire period modeled would increase under the No Action
 40 Alternative, relative to Existing Conditions, during the months of January through May by 0.1–0.7
 41 mS/cm, depending on the location and month (Appendix 8H, Table EC-21 through Table EC-25). The
 42 degree to which the average EC increases would cause exceedance of Bay-Delta WQCP objectives is
 43 unknown, because objectives are expressed as a monthly average of daily high tide EC, which does
 44 not have to be met if it can be demonstrated “equivalent or better protection will be provided at the
 45 location” (State Water Resources Control Board 2006:14). The described long-term average EC
 46 increase may, or may not, contribute to adverse effects on beneficial uses, depending on how and

1 when wetlands are flooded, soil leaching cycles, and how agricultural use of water is managed, and
2 future actions taken with respect to the Marsh. Given the Bay-Delta WQCP narrative objective
3 regarding “equivalent or better protection” in lieu of meeting specific numeric objectives, the small
4 increase in EC relative to Existing Conditions would not be expected to adversely affect beneficial
5 uses of Suisun Marsh under the No Action Alternative.

6 Given that the western Delta is Clean Water Act section 303(d) listed as impaired due to elevated EC,
7 the increase in the incidence of exceedance of EC objectives and average EC levels at western Delta
8 locations under the No Action Alternative, relative to Existing Conditions, has the potential to
9 contribute to additional impairment and adversely affect beneficial uses. While Suisun Marsh also is
10 Section 303(d) listed as impaired because of elevated EC, the potential increases in long-term
11 average EC concentrations, relative to Existing Conditions, would not be expected to contribute to
12 additional impairment, because the increase would be so small (<1 mS/cm) as to not be measurable
13 and beneficial uses would not be adversely affected.

14 ***SWP/CVP Export Service Areas***

15 At the Banks pumping plant, relative to Existing Conditions, the No Action Alternative would result
16 in no additional exceedances of the Bay-Delta WQCP’s 1,000 µmhos/cm EC objective during the
17 drought period modeled; the frequency of exceedance for both conditions would be 2% (Appendix
18 8H, Table EC-10). When the entire period modeled is considered, the frequency of exceedances of
19 the EC objective would increase slightly, from 1% under Existing Conditions to 2% under the No
20 Action Alternative (Appendix 8H, Table EC-10). Because the EC objective is for agricultural
21 beneficial use protection, for which longer-term crop exposure to elevated EC waters is a concern,
22 this minimal increase in frequency of exceedance of the EC objective would not adversely affect this
23 beneficial use.

24 For the entire period modeled, there would be no exceedance of the 1,000 µmhos/cm EC objective at
25 the Jones pumping plant under Existing Conditions and the No Action Alternative (Appendix 8H,
26 Table EC-10). Thus, there would be no adverse effect on the agricultural beneficial uses in the
27 SWP/CVP Export Service Areas using water pumped at this location under the No Action
28 Alternative.

29 Average EC levels for the entire period modeled would decrease at the Banks pumping plant by 7%
30 and at the Jones pumping plant by 5% under the No Action Alternative, relative to Existing
31 Conditions. As explained above for the Delta, long-term average levels of seawater-derived
32 constituents decrease under the No Action Alternative relative to Existing Conditions because the
33 No Action Alternative includes Fall X2, while Existing Conditions does not (Appendix 3D, 5A).
34 Therefore, even though sea level rise is included in the No Action Alternative, and not in Existing
35 Conditions, the effect of Fall X2 is generally greater than sea level rise. During the drought period
36 modeled, average EC levels would decrease at the Banks pumping plant by 6% and at the Jones
37 pumping plant by 5% under the No Action Alternative, relative to Existing Conditions. Consequently,
38 in the long-term, water delivered to the SWP/CVP Export Service Areas through these south Delta
39 pumps would be of similar or slightly better quality with regard to EC under the No Action
40 Alternative, relative to Existing Conditions. (Appendix 8H, Table EC-11) Based on the long-term
41 decreases in EC levels that would occur at the Banks and Jones pumping plants, the No Action
42 Alternative would not cause long-term degradation of EC levels in the SWP/CVP Export Service
43 Areas, relative to Existing Conditions.

1 Commensurate with the EC decrease in exported waters, an improvement in lower San Joaquin
2 River EC levels would be expected since EC in the lower San Joaquin River is, in part, related to
3 irrigation water deliveries from the Delta. While the magnitude of this expected lower San Joaquin
4 River improvement in EC is difficult to predict, the relative decrease in overall loading of EC-
5 elevating constituents to the SWP/CVP Export Service Areas would likely alleviate or lessen any
6 expected increase in EC at Vernalis related to decreased annual average San Joaquin River flows (see
7 discussion of Upstream of the Delta).

8 The export area of the Delta is listed on the state's CWA Section 303(d) list as impaired due to
9 elevated EC. The No Action Alternative would result in lower average EC levels relative to Existing
10 Conditions and, thus, would not contribute to additional impairment related to elevated EC in the
11 SWP/CVP Export Service Areas waters.

12 In summary, the increased frequency of exceedance of EC objectives and increased long-term and
13 drought period average EC levels that would occur at western Delta compliance locations under the
14 No Action Alternative would contribute to adverse effects on the agricultural beneficial uses. Given
15 that the western Delta is Clean Water Act section 303(d) listed as impaired due to elevated EC, the
16 increase in the incidence of exceedance of EC objectives and increases in long-term and drought
17 period average EC in the western Delta under the No Action Alternative has the potential to
18 contribute to additional beneficial use impairment. These increases in EC constitute an adverse
19 effect on water quality.

20 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
21 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
22 purpose of making the CEQA impact determination for this constituent. For additional details on the
23 effects assessment findings that support this CEQA impact determination, see the effects assessment
24 discussion that immediately precedes this conclusion.

25 River flow rate and reservoir storage reductions that would occur under the No Action Alternative,
26 relative to Existing Conditions, would not be expected to result in a substantial adverse change in EC
27 levels in the reservoirs and rivers upstream of the Delta, given that: changes in the quality of
28 watershed runoff and reservoir inflows would not be expected to occur in the future; the state's
29 aggressive regulation of point-source discharge effects on Delta salinity-elevating parameters and
30 the expected further regulation as salt management plans are developed; the salt-related TMDLs
31 adopted and being developed for the San Joaquin River; and the expected improvement in lower San
32 Joaquin River average EC levels commensurate with the lower EC of the irrigation water deliveries
33 from the Delta.

34 Relative to Existing Conditions, the No Action Alternative would not result in any substantial
35 increases in long-term average EC levels in the SWP/CVP Export Service Areas. There would be no
36 exceedance of the EC objective at the Jones pumping plant. At the Banks pumping plant there would
37 be only a 1% increase in exceedance of the EC objective when the entire period modeled is
38 considered, and no increase in the frequency of exceedance during the drought period. Average EC
39 levels for the entire period modeled would decrease at both plants. Because the EC objective is for
40 agricultural beneficial use protection, for which longer-term crop exposure to elevated EC waters is
41 a concern, the minimal increase in the frequency of exceedance of the EC objective at the Banks
42 pumping plant for the entire period modeled coupled with the long-term average decrease in EC
43 levels at the pumping plants would not adversely affect this beneficial use.

1 In the Plan Area, the No Action Alternative would result in an increase in the frequency with which
2 Bay-Delta WQCP EC objectives are exceeded in the Sacramento River at Emmaton for the entire
3 period modeled (1976–1991) and during the drought period modeled (1987–1991). Further, long-
4 term average EC levels would increase by 1% for the entire period modeled and 10% during the
5 drought period modeled at Emmaton. The increases in drought period average EC levels that would
6 occur in the Sacramento River at Emmaton would further degrade existing EC levels and thus
7 contribute additionally to adverse effects on the agricultural beneficial use. Because EC is not
8 bioaccumulative, the increases in long-term average EC levels would not directly cause
9 bioaccumulative problems in aquatic life or humans. The western Delta is Clean Water Act section
10 303(d) listed for elevated EC and the increases in long-term average EC and increased frequency of
11 exceedance of EC objectives that would occur in the Sacramento River at Emmaton could make
12 beneficial use impairment measurably worse. This impact is considered to be significant.

13 **Impact WQ-13: Effects on Mercury Concentrations Resulting from Facilities Operations and** 14 **Maintenance**

15 *Upstream of the Delta*

16 Under the No Action Alternative, greater water demands and climate change would alter the
17 magnitude and timing of reservoir releases and river flows upstream of the Delta in the Sacramento
18 River watershed and east-side tributaries, relative to Existing Conditions.

19 The Sacramento River at Freeport and San Joaquin River at Vernalis (as summarized for water
20 quality average concentrations in Tables 8-48 and 8-49) were examined for flow/concentration
21 relationships for mercury and methylmercury. No significant, predictive regression relationships
22 were discovered for mercury or methylmercury, except for total mercury with flow at Freeport
23 (monthly or annual) (Appendix 8I, Figures 8I-10 through 8I-13). Such a positive relationship
24 between total mercury and flow is to be expected based on the association of mercury with
25 suspended sediment and the mobilization of sediments during storm flows. However, the changes in
26 flow in the Sacramento River under the No Action Alternative relative to Existing Conditions are not
27 of the magnitude of storm flows, in which substantial sediment-associated mercury is mobilized.
28 Therefore mercury loading should not be substantially different due to changes in flow. In addition,
29 even though it may be flow-affected, total mercury concentrations remain well below criteria at
30 upstream locations. Any negligible changes in mercury concentrations that may occur in the water
31 bodies of the affected environment located upstream of the Delta would not be of frequency,
32 magnitude, and geographic extent that would adversely affect any beneficial uses or substantially
33 degrade the quality of these water bodies as related to mercury. Both waterborne methylmercury
34 concentrations and largemouth bass fillet mercury concentrations are expected to remain above
35 guidance levels at upstream of Delta locations, but will not change substantially relative to Existing
36 Conditions due to changes in flows under the No Action Alternative.

37 The upstream of Delta areas in the north will benefit from the implementation of the Cache Creek,
38 Sulfur Creek, Harley Gulch, and Clear Lake Mercury TMDLs (Central Valley Water Board 2011c, State
39 Water Resources Control Board 2003) as well as the American River methylmercury TMDL. The
40 TMDL for the American River was in process for CEQA scoping (Central Valley Water Board 2011d),
41 but now will be incorporated into a statewide mercury TMDL under development by the State Water
42 Board. These projects will target specific sources of mercury and methylation upstream of the Delta
43 and could result in net improvement to Delta mercury loading in the future. The implementation of

1 these projects could help to ensure that upstream of Delta environments will not be substantially
2 degraded for water quality with respect to mercury or methylmercury.

3 ***Delta***

4 As shown in Figures 8-53 and 8-54, comparisons in percentage change of assimilative capacity of
5 waterborne mercury concentrations relative to the 25 ng/L ecological risk benchmark under the No
6 Action Alternative compared to the Existing Condition would vary only slightly among stations. Peak
7 losses of assimilative capacity for mercury would be less than 0.1% for all sites comparing Existing
8 Conditions to the No Action Alternative. These changes are not expected to result in adverse effects
9 to beneficial uses. Peak annual average methylmercury concentrations for drought conditions
10 occurred at the San Joaquin River at Buckley Cove: 0.161 ng/L for Existing Conditions and 0.167
11 ng/L for the No Action Alternative (Appendix 8I, Table I-6). These differences are less than 5%.
12 Methylmercury concentrations exceed criteria at all locations and no assimilative capacity exists.
13 Monthly average waterborne concentrations of total and methylmercury, over the period of record,
14 are shown in Appendix 8I Figures 8I-2 and 8I-3. Note that concentrations under Existing Conditions
15 and the No Action Alternative are all very similar to each other (Appendix 8I, Figures 8I-2 and 8I-3,
16 Tables I-5 and I-6).

17 Similarly, estimates of fish tissue mercury concentrations and exceedance quotients show almost no
18 differences would occur among sites for the No Action Alternative as compared to Existing
19 Conditions for the Delta sites (Figure 8-55, Appendix 8I, Table I-7a,b). Peak exceedance quotients for
20 drought conditions are all at the San Joaquin River at Buckley Cove (4.3 for Existing Conditions; 4.5
21 for the No Action Alternative; Eq2 model, Table I-7b). These small differences of less than 10% are
22 not expected to further degrade water quality, with regards to mercury, by measurable levels, and
23 thus beneficial use impairment would not be made discernibly worse. Similar to waterborne
24 concentrations of methylmercury, the fish tissue concentrations and exceedance quotients would be
25 highest at the San Joaquin River, Buckley Cove site during drought years (Appendix 8I, Table I-7a,b).
26 All modeled fish tissue mercury concentrations exceed tissue guidelines, with exceedance quotients
27 greater than 1 (Appendix 8I, Table I-7a,b).

28 ***SWP/CVP Export Service Areas***

29 The Banks and Jones pumping plants are expected to show only very small losses of assimilative
30 capacity or changes in fish tissue concentration of mercury for the No Action Alternative in relation
31 to Existing Conditions [less than 1% for assimilative capacity decreases; greatest decrease was at
32 Jones Pumping Plant of 0.6% relative to Existing Conditions] (Figures 8-53 and 8-54, Appendix 8I,
33 Table I-7). Any increases in mercury concentrations that may occur in water exported via Banks and
34 Jones pumping plants are not expected to result in adverse effects to beneficial uses or substantially
35 degrade the quality of exported water, with regards to mercury.

36 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
37 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
38 purpose of making the CEQA impact determination for this constituent. For additional details on the
39 effects assessment findings that support this CEQA impact determination, see the effects assessment
40 discussion that immediately precedes this conclusion.

41 Under the No Action Alternative, greater water demands and climate change would alter the
42 magnitude and timing of reservoir releases and river flows upstream of the Delta in the Sacramento
43 River watershed and east-side tributaries, relative to Existing Conditions. Concentrations of mercury

1 and methylmercury upstream of the Delta will not be substantially different relative to Existing
2 Conditions due to the lack of important relationships between mercury/methylmercury
3 concentrations and flow for the major rivers.

4 Methylmercury concentrations exceed criteria at all locations in the Delta for Existing Conditions
5 and no assimilative capacity exists. However, monthly average waterborne concentrations of total
6 and methylmercury, over the period of record, are very similar to each other among Alternatives.
7 Similarly, estimates of fish tissue mercury concentrations show almost no differences would occur
8 among sites for the No Action Alternative as compared to Existing Conditions for Delta sites.

9 Assessment of effects of mercury in the SWP and CVP Export Service Areas were based on effects on
10 mercury concentrations and fish tissue mercury concentrations at the Banks and Jones pumping
11 plants. The Banks and Jones pumping plants are expected to show only very small losses of
12 assimilative capacity or changes in fish tissue concentration of mercury for the No Action
13 Alternative as compared to Existing Conditions.

14 As such, this alternative is not expected to cause additional exceedance of applicable water quality
15 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
16 on any beneficial uses of waters in the affected environment. Because mercury concentrations are
17 not expected to increase substantially, no long-term water quality degradation is expected to occur
18 and, thus, no adverse effects to beneficial uses would occur. Because any increases in mercury or
19 methylmercury concentrations are not likely to be measurable, changes in mercury concentrations
20 or fish tissue mercury concentrations would not make any existing mercury-related impairment
21 measurably worse. In comparison to Existing Conditions, the No Action Alternative would not
22 increase levels of mercury by frequency, magnitude, and geographic extent such that the affected
23 environment would be expected to have measurably higher body burdens of mercury in aquatic
24 organisms, thereby substantially increasing the health risks to wildlife (including fish) or humans
25 consuming those organisms. This impact is considered to be less than significant.

26 **Impact WQ-15: Effects on Nitrate Concentrations Resulting from Facilities Operations and** 27 **Maintenance**

28 ***Upstream of the Delta***

29 Although point sources of nitrate do exist upstream of the Delta in the Sacramento River watershed,
30 nitrate levels in the major rivers (Sacramento, Feather, American) are low, generally due to ample
31 dilution available in the rivers relative to the magnitude of the discharges. Furthermore, while many
32 dischargers have already improved facilities to remove more nitrate, many others are likely to do so
33 over the next few decades. Non-point sources of nitrate within the Sacramento watersheds are also
34 relatively low, thus resulting in generally low nitrate-N concentrations in the reservoirs and rivers
35 of the watershed. Furthermore, there is no correlation between historical water year average nitrate
36 concentrations and water year average flow in the Sacramento River at Freeport (Nitrate Appendix
37 8J, Figure 1). Consequently, any modified reservoir operations and subsequent changes in river
38 flows under the No Action Alternative, relative to Existing Conditions, are expected to have
39 negligible, if any, effects on average reservoir and river nitrate-N concentrations in the Sacramento
40 River watershed upstream of the Delta.

41 In the San Joaquin River watershed, nitrate concentrations are higher than in the Sacramento
42 watershed, owing to use of nitrate based fertilizers throughout the lower watershed. The correlation
43 between historical water year average nitrate concentrations and water year average flow in the San

1 Joaquin River at Vernalis is a weak inverse relationship—that is, generally higher flows result in
2 lower nitrate concentrations, while low flows result in higher nitrate concentrations (linear
3 regression $r^2=0.49$, Nitrate Appendix 8J, Figure 2). Under the No Action Alternative, long-term
4 average flows at Vernalis would decrease an estimated 6% relative to Existing Conditions (Appendix
5 5A). Given these relatively small decreases in flows and the weak correlation between nitrate and
6 flows in the San Joaquin River, it is expected that nitrate concentrations in the San Joaquin River
7 would be minimally affected, if at all, by anticipated changes in flow rates under the No Action
8 Alternative.

9 Any negligible changes in nitrate-N concentrations that may occur in the water bodies of the affected
10 environment located upstream of the Delta would not be of frequency, magnitude and geographic
11 extent that would adversely affect any beneficial uses or substantially degrade the quality of these
12 water bodies, with regards to nitrate.

13 **Delta**

14 Results of the mixing calculations indicate that under the No Action Alternative, relative to Existing
15 Conditions, nitrate concentrations throughout the Delta are anticipated to remain low (<1.4 mg/L-
16 N) relative to adopted objectives (Nitrate Appendix 8J, Table 4 and 5). Although changes at specific
17 Delta locations and for specific months may be substantial on a relative basis, the absolute
18 concentration of nitrate in Delta waters would remain low (<1.4 mg/L-N) in relation to the drinking
19 water MCL of 10 mg/L-N, as well as all other thresholds identified in Table 8-50. Long-term average
20 nitrate concentrations are anticipated to remain below 1 mg/L-N at all 11 assessment locations
21 except the San Joaquin River at Buckley Cove, where long-term average concentrations would be
22 somewhat above 1 mg/L-N. Nevertheless, at this location, long-term average nitrate concentration
23 would be somewhat reduced under the no Action Alternative, relative to Existing Conditions. No
24 additional exceedances of the MCL are anticipated at any location (Nitrate Appendix 8J, Table 4). On
25 a monthly average basis and on a long term annual average basis, for all modeled years and for the
26 drought period (1987–1991) only, use of assimilative capacity available under Existing Conditions,
27 relative to the drinking water MCL of 10 mg/L-N, was low or negligible (i.e., <3%) for all locations
28 and months (Nitrate Appendix 8J, Table 6).

29 Nitrate concentrations will likely be higher than the modeling results indicate in certain locations.
30 This includes in the Sacramento River between Freeport and Mallard Island and other areas in the
31 Delta downstream of Freeport that are influenced by Sacramento River water. These increases are
32 associated with ammonia and nitrate that are discharged from the SRWTP, which are not included in
33 the modeling.

- 34 • Under Existing Conditions, most of the ammonia discharged from the SRWTP is converted to
35 nitrate downstream of the facility's discharge at Freeport, and thus, nitrate concentrations
36 under Existing Conditions in these areas are expected to be higher than the modeling
37 predicts, the increase becoming greater with increasing distance downstream. However, the
38 increase in nitrate concentrations downstream of the SRWTP is expected to be small—the
39 existing increase appears to be from approximately 0.1 mg/L-N to approximately 0.4–0.5
40 mg/L-N over this reach, due to approximately a 1:1 conversion of ammonia-N to nitrate-N
41 (Central Valley Water Board 2010a:32).
- 42 • Under the No Action Alternative, the planned upgrades to the SRWTP, which include
43 nitrification/partial denitrification, would substantially decrease ammonia concentrations

1 in the discharge, but would increase nitrate concentrations in the discharge up to 10 mg/L-
2 N, which is substantially higher than under Existing Conditions.

- 3 • Overall, under the No Action Alternative, the nitrogen load from the SRWTP discharge is
4 expected to decrease (by up to 50%), relative to Existing Conditions, due to
5 nitrification/partial denitrification upgrades at the SRWTP facility. Thus, while concentrations
6 of nitrate downstream of the facility are expected to be higher than modeling results
7 indicate for both Existing Conditions and the No Action Alternative, the increase is expected
8 to be greater under Existing Conditions than for the No Action Alternative due to the
9 upgrades that are assumed under the No Action Alternative.

10 The other areas in which nitrate concentrations will be higher than the modeling results indicate are
11 immediately downstream of other wastewater treatment plants that practice nitrification, but not
12 denitrification (e.g., City of Rio Vista Beach WWTF, Town of Discovery Bay WWTF, City of Stockton
13 RWCF). For all such facilities in the Delta, the Regional Water Boards have issued NPDES permits
14 that allow discharge of wastewater containing nitrate into the Delta, and under these permits, the
15 State has determined that no beneficial uses are adversely affected by the discharge, and that the
16 discharger's use of available assimilative capacity of the water body is acceptable. When dilution is
17 necessary in order for the discharge to be in compliance with the Basin Plans (which incorporate the
18 10 mg/L-N MCL by reference), not all of the assimilative capacity of the receiving water is granted to
19 the discharger. Thus, limited decreases in flows are not anticipated to result in systemic
20 exceedances of the MCLs by these POTWs. Furthermore, NPDES permits are renewed on a 5-year
21 basis, and thus, if under changes in flows, dilution was no longer sufficient to maintain nitrate below
22 the MCL in the receiving water, the NPDES permit renewal process would address such cases.

23 Therefore, any increases in nitrate-N concentrations that may occur at certain locations within the
24 Delta would not be of frequency, magnitude and geographic extent that would adversely affect any
25 beneficial uses or substantially degrade the water quality at these locations, with regards to nitrate.

26 ***SWP/CVP Export Service Areas***

27 Assessment of effects of nitrate in the SWP and CVP Export Service Areas is based on effects on
28 nitrate-N at the Banks and Jones pumping plants.

29 Results of the mixing calculations indicate that under the No Action Alternative, relative to Existing
30 Conditions, long-term average nitrate concentrations at Banks and Jones pumping plants are
31 anticipated to change negligibly (Nitrate Appendix 8J, Table 4 and 5). No additional exceedances of
32 the MCL are anticipated (Nitrate Appendix 8J, Table 4). On a monthly average basis and on a long
33 term annual average basis, for all modeled years and for the drought period (1987–1991) only, use
34 of assimilative capacity available under Existing Conditions relative to the MCL was negligible (i.e.,
35 <3%) for both Banks and Jones pumping plants (Nitrate Appendix 8J, Table 6). As discussed above in
36 the Delta region, nitrate-N concentrations would be higher than indicated in the mixing modeling
37 results for areas receiving Sacramento River water, including Banks and Jones pumping plants,
38 downstream of the SRWTP discharge at Freeport in the Existing Conditions (by < 1 mg/L-N), due to
39 conversion of ammonia to nitrate within the Delta. For the No Action Alternative, nitrate levels
40 would also be slightly higher than the mixing modeling results suggests because full
41 nitrification/partial denitrification of the SRWTP discharge was not accounted for. Nonetheless, the
42 total nitrogen load from the SRWTP is expected to decrease substantially due the facility's upgrades.
43 Hence, long-term average nitrate-N concentrations would be expected to decrease under the No
44 Action Alternative, relative to Existing Conditions.

1 Any short-term, negligible increases in nitrate-N concentrations that may occur in water exported
2 via Banks and Jones pumping plants are not expected to result in adverse effects to beneficial uses of
3 exported water or substantially degrade the quality of exported water, with regards to nitrate.

4 In summary, based on the discussion above, effects on nitrate of facilities operation and
5 maintenance are considered to be not adverse.

6 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
7 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
8 purpose of making the CEQA impact determination for this constituent. For additional details on the
9 effects assessment findings that support this CEQA impact determination, see the effects assessment
10 discussion that immediately precedes this conclusion.

11 Nitrate-N concentrations are generally low in the reservoirs and rivers of the watersheds, owing to
12 substantial dilution available for point sources and the lack of substantial nonpoint sources of
13 nitrate-N upstream of the SRWTP in the Sacramento River watershed, and in the watersheds of the
14 eastern tributaries (Cosumnes, Mokelumne, and Calaveras Rivers). Although higher in the San
15 Joaquin River watershed, nitrate-N concentrations are not well-correlated with flow rates.
16 Consequently, any modified reservoir operations and subsequent changes in river flows under the
17 No Action Alternative, relative to Existing Conditions, are expected to have negligible, if any, effects
18 on reservoir and river nitrate-N concentrations upstream of Freeport in the Sacramento River
19 watershed and upstream of the Delta in the San Joaquin River watershed.

20 In the Delta, results of the mixing calculations indicate that under the No Action Alternative, relative
21 to Existing Conditions, nitrate concentrations throughout the Delta are anticipated to remain low
22 (<1.4 mg/L-N) relative to adopted objectives. No additional exceedances of the MCL are anticipated
23 at any location, and use of assimilative capacity available under Existing Conditions, relative to the
24 drinking water MCL of 10 mg/L-N, was low or negligible (i.e., <3%) for all locations and months.

25 Assessment of effects of nitrate in the SWP and CVP Export Service Areas is based on effects on
26 nitrate-N concentrations at the Banks and Jones pumping plants. Results of the mixing calculations
27 indicate that under the No Action Alternative, relative to Existing Conditions, long-term average
28 nitrate concentrations at Banks and Jones pumping plants are anticipated to change negligibly. No
29 additional exceedances of the MCL are anticipated, and use of assimilative capacity available under
30 Existing Conditions, relative to the MCL was negligible (i.e., <3%) for both Banks and Jones pumping
31 plants for all months.

32 Based on the above, there would be no substantial, long-term increase in nitrate-N concentrations in
33 the rivers and reservoirs upstream of the Delta, in the Delta Region, or the waters exported to the
34 CVP and SWP service areas under the No Action Alternative relative to Existing Conditions. As such,
35 this alternative is not expected to cause additional exceedance of applicable water quality
36 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
37 on any beneficial uses of waters in the affected environment from nitrate. Because nitrate
38 concentrations are not expected to increase substantially, no long-term water quality degradation is
39 expected to occur and, thus, no adverse effects to beneficial uses would occur. Nitrate is not 303(d)
40 listed within the affected environment and thus any minor increases that may occur in some areas
41 would not make any existing nitrate-related impairment measurably worse because no such
42 impairments currently exist. Because nitrate is not bioaccumulative, minor increases that may occur
43 in some areas would not bioaccumulate to greater levels in aquatic organisms that would, in turn,

1 pose substantial health risks to fish, wildlife, or humans. This impact is considered to be less than
2 significant.

3 **Impact WQ-17: Effects on Dissolved Organic Carbon Concentrations Resulting from Facilities** 4 **Operations and Maintenance**

5 *Upstream of the Delta*

6 Under the No Action Alternative, greater water demands (see Table 8-55) will alter the magnitude
7 and timing of reservoir releases upstream of the Delta, relative to Existing Conditions. While greater
8 water demands under the No Action Alternative would alter the magnitude and timing of reservoir
9 releases north, south and east of the Delta, these activities would have no substantial effect on the
10 various watershed sources of DOC. Moreover, long-term average flow and DOC at Sacramento River
11 at Hood and San Joaquin River at Vernalis are poorly correlated; therefore, changes in river flows
12 would not be expected to cause a substantial long-term change in DOC concentrations upstream of
13 the Delta. Consequently, long-term average DOC concentrations under the No Action Alternative
14 would not be expected to change by frequency, magnitude and geographic extent, relative to
15 Existing Conditions and, and thus, would not adversely affect the MUN beneficial use, or any other
16 beneficial uses, in water bodies of the affected environment located upstream of the Delta.

17 *Delta*

18 Relative to Existing Conditions, the No Action Alternative would result in mostly minor changes (i.e.,
19 up to 4% increases and 6% decreases) in long-term average DOC concentrations at all Delta
20 assessment locations. Increases in long-term average DOC concentrations for the 16-year (1976–
21 1991) hydrologic period modeled would not be greater than 0.1 mg/L, with the largest predicted
22 change occurring at Rock Slough during the 1987–1991 drought period modeled, where average
23 DOC concentration would be predicted to increase by approximately 4% (Appendix 8K, DOC Table
24 1). At all 11 assessment locations, modeled long-term average DOC concentrations under the No
25 Action Alternative would exceed 2 mg/L 94–100% of the time. The frequency with which average
26 DOC concentration exceeds the 3 mg/L threshold would change only slightly, with exception to
27 predicted changes at both the Banks and Jones pumping plants.

28 At the Banks pumping plant, the frequency with which average DOC concentration would exceed 3
29 mg/L would increase from 64% under Existing Conditions to 71% under the No Action Alternative
30 (an increase from 57% to 75% during the drought year period of 1987–1991) (Appendix 8K, DOC
31 Table 1). At the Jones pumping plant, the frequency that long-term average DOC concentration
32 would exceed 3 mg/L would increase from 71% under Existing Conditions to 80% under the No
33 Action Alternative (an increase from 72% to 90% for the drought period modeled). In contrast,
34 however, the relative frequency long-term average DOC concentrations would exceed 4 mg/L at the
35 Banks and Jones pumping plants would be small. At the Banks pumping plant, the frequency long-
36 term average DOC concentrations would exceed 4 mg/L would increase from 33% under Existing
37 Conditions to 35% under the No Action Alternative (an increase from 42% to 43% for the drought
38 period), while at the Jones pumping plant the modeled exceedance frequency would rise from 26%
39 to 28% (with no predicted change in frequency of exceedance for the drought period). Trends in
40 concentration threshold exceedances at the other assessment locations would follow that described
41 for the Banks and Jones pumping plants, but the overall magnitude of threshold exceedance change
42 would be less. While the No Action Alternative would generally lead to slightly higher long-term
43 average DOC concentration in the western and southern Delta, the predicted change would not be

1 expected to be of magnitude that would adversely affect MUN beneficial uses, or any other beneficial
2 use, particularly when considering the relatively small change in long-term annual average
3 concentration (i.e., ≤ 0.1 mg/L).

4 ***SWP/CVP Export Service Areas***

5 With respect to the potential for effects resulting from No Action Alternative induced changes on
6 long-term average DOC concentrations in the water exported via the Banks and Jones pumping
7 plants, long-term average DOC concentrations would increase only slightly. Under the No Action
8 Alternative, long-term average DOC concentrations at the Banks and Jones pumping plants would
9 increase by as much as 3% relative to Existing Conditions (Appendix 8K, DOC Table 1). A greater
10 frequency of exports greater than 3 and 4 mg/L would be predicted to occur at both Banks and Jones
11 pumping plants, as previously discussed for the Delta, although the increased frequency of 4 mg/L
12 would be comparatively small (see Delta discussion above). As previously stated, the predicted
13 change in long-term average DOC concentrations relative to existing conditions would not be
14 expected to be of sufficient magnitude to adversely affect the MUN beneficial use, or any other
15 beneficial use, within the SWP and CVP Service Area.

16 Maintenance of SWP and CVP facilities under the No Action Alternative would not be expected to
17 create new sources of DOC or contribute towards a substantial change in existing sources of DOC in
18 the affected environment. Maintenance activities would not be expected to cause any substantial
19 change in long-term average DOC concentrations such that the MUN beneficial use, or any other
20 beneficial use, would be adversely affected anywhere in the affected environment.

21 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
22 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
23 purpose of making the CEQA impact determination for this constituent. For additional details on the
24 effects assessment findings that support this CEQA impact determination, see the effects assessment
25 discussion that immediately precedes this conclusion.

26 While greater water demands under the No Action Alternative would alter the magnitude and
27 timing of reservoir releases north, south and east of the Delta, these activities would have no
28 substantial effect on the various watershed sources of DOC. Moreover, long-term average flow and
29 DOC at Sacramento River at Hood and San Joaquin River at Vernalis are poorly correlated; therefore,
30 changes in river flows would not be expected to cause a substantial long-term change in DOC
31 concentrations upstream of the Delta.

32 Relative to Existing Conditions, the No Action Alternative would result in mostly minor changes (i.e.,
33 up to 4% increases and 6% decreases) in long-term average DOC concentrations at all Delta
34 assessment locations, with the largest increase (i.e., 4%) occurring at Rock Slough during the
35 modeled drought period. While the No Action Alternative would generally lead to slightly higher
36 long-term average DOC concentration (i.e., ≤ 0.1 mg/L) in the western and southern Delta, the
37 predicted change would not be expected to be of magnitude that would adversely affect MUN
38 beneficial uses, or any other beneficial use.

39 The assessment of No Action Alternative effects on DOC in the SWP/CVP Export Service Areas is
40 based on assessment of changes in DOC concentrations at Banks and Jones pumping plants. Relative
41 to existing condition, long-term average DOC concentrations would increase only slightly at Banks
42 and Jones pumping plants. The predicted change in long-term average DOC concentrations relative

1 to Existing Conditions would not be expected to be of sufficient magnitude to adversely affect MUN
2 beneficial uses, or any other beneficial use, within the SWP and CVP Service Area.

3 Based on the above, the No Action Alternative would not result in any substantial change in long-
4 term average DOC concentration upstream of the Delta or result in substantial increase in the
5 frequency with which long-term average DOC concentrations exceeds 2, 3, or 4 mg/L levels at the 11
6 assessment locations analyzed for the Delta. Modeled long-term average DOC concentrations would
7 increase by no more than 0.1 mg/L at any single Delta assessment location (i.e., $\leq 4\%$ relative
8 increase). The increases in long-term average DOC concentration that could occur within the Delta
9 would not be of sufficient magnitude to adversely affect the MUN beneficial use, or any other
10 beneficial uses, of Delta waters or waters of the SWP and CVP Service Area. Because DOC is not
11 bioaccumulative, the increases in long-term average DOC concentrations would not directly cause
12 bioaccumulative problems in aquatic life or humans. Finally, DOC is not causing beneficial use
13 impairments and thus is not 303(d) listed for any water body within the affected environment. Thus,
14 the increases in long-term average DOC that could occur at various locations would not make any
15 beneficial use impairment measurably worse. Because long-term average DOC concentrations would
16 not be expected to increase substantially, no long-term water quality degradation with respect to
17 DOC would be expected to occur and, thus, no significant impacts on beneficial uses would occur.
18 This impact would be less than significant.

19 **Impact WQ-19: Effects on Pathogens Resulting from Facilities Operations and Maintenance**

20 ***Upstream of the Delta***

21 Under the No Action Alternative, the only pathogen sources expected to change in the watersheds
22 upstream of the Delta relative to Existing Conditions would be associated with population growth,
23 i.e., increased municipal wastewater discharges and development contributing to increased urban
24 runoff.

25 Increased municipal wastewater discharges resulting from future population growth would not be
26 expected to measurably increase pathogen concentrations in receiving waters due to state and
27 federal water quality regulations requiring disinfection of effluent discharges and the state's
28 implementation of Title 22 filtration requirements for many wastewater dischargers in the
29 Sacramento River and San Joaquin River watersheds.

30 Pathogen loading from urban areas would generally occur in association with both dry and wet
31 weather runoff from urban landscapes. Municipal stormwater regulations and permits have become
32 increasingly stringent in recent years, and such further regulation of urban stormwater runoff is
33 expected to continue in the future. Municipalities may implement BMPs for reducing pollutant
34 loadings from urban runoff, particularly in response to NPDES stormwater-related regulations
35 requiring reduction of pollutant loading in urban runoff. The ability of these BMPs to consistently
36 reduce pathogen loadings and the extent of future implementation is uncertain, but would be
37 expected to improve as new technologies are continually tested and implemented. Also, some of the
38 urbanization may occur on lands used by other pathogen sources, such as grazing lands, resulting
39 in a change in pathogen source, but not necessarily an increase (and possibly a decrease) in
40 pathogen loading.

41 Pathogen concentrations in the Sacramento and San Joaquin Rivers have a minimal relationship to
42 flow rate in these rivers, although most of the high concentrations observed have been during the
43 wet months (Tetra Tech 2007). Further, urban runoff contributions during the dry season would be

1 expected to be a relatively small fraction of the rivers' total flow rates. During wet weather events,
 2 when urban runoff contributions would be higher, the flows in the rivers also would be higher.
 3 Given the small magnitude of urban runoff contributions relative to the magnitude of river flows,
 4 that pathogen concentrations in the rivers have a minimal relationship to river flow rate, and the
 5 expected reduced pollutant loadings in response to NPDES stormwater-related regulations, river
 6 flow rate and reservoir storage reductions that would occur under the No Action Alternative,
 7 relative to Existing Conditions, would not be expected to result in a substantial adverse change in
 8 pathogen concentrations in the reservoirs and rivers upstream of the Delta. As such, the No Action
 9 Alternative would not be expected to substantially increase the frequency with which applicable
 10 Basin Plan objectives or U.S. EPA-recommended pathogen criteria would be exceeded in water
 11 bodies of the affected environment located upstream of the Delta or substantially degrade the
 12 quality of these water bodies, with regard to pathogens.

13 **Delta**

14 The *Conceptual Model for Pathogens and Pathogen Indicators in the Central Valley and Sacramento-*
 15 *San Joaquin Delta* (Tetra Tech 2007) provides a comprehensive evaluation of factors affecting
 16 pathogen levels in the Delta. The Pathogens Conceptual Model characterizes relative pathogen
 17 contributions to the Delta from the Sacramento and San Joaquin Rivers and various pathogen
 18 sources, including wastewater discharges and urban runoff. Contributions from the San Francisco
 19 Bay to the Delta are not addressed. The Pathogens Conceptual Model is based on a database
 20 compiled by the Central Valley Drinking Water Policy Group in 2004–2005, supplemented with data
 21 from Natomas East Main Drainage Canal Studies, North Bay Aqueduct sampling, and the USGS. Data
 22 for multiple sites in the Sacramento River and San Joaquin River watersheds, and in the Delta were
 23 compiled. Indicator species evaluated include fecal coliforms, total coliforms, and *E. coli*. Because of
 24 its availability, *Cryptosporidium* and *Giardia* data for the Sacramento River also were evaluated. Key
 25 results of the data evaluation are:

26 **Total Coliform**

- 27 ● In the Sacramento Valley, the highest total coliform concentrations (>10,000 MPN/100 ml)
 28 were located near urban areas.
- 29 ● Similarly high total coliform concentrations were not observed in the San Joaquin Valley,
 30 because reported results were capped at about 2,400 MPN/100 ml, though a large number of
 31 results were reported as being greater than this value.
- 32 ● The data should not to be interpreted to conclude that Sacramento River has higher total
 33 coliform concentrations; rather, the “appearance” of the lower total coliform concentrations in
 34 the San Joaquin Valley is attributed to a lower upper limit of reporting (2,400 MPN/100 ml
 35 versus 10,000 MPN/100 ml).

36 ***E. coli***

- 37 ● Comparably high concentrations observed in the Sacramento River and San Joaquin River
 38 watersheds for waters affected by urban environments and intensive agriculture.
- 39 ● The highest concentrations in the San Joaquin River were not at the most downstream location
 40 monitored, but rather at an intermediate location near Hills Ferry.

- 1 • *E. coli* concentrations in the Delta were somewhat higher than in the San Joaquin River and
- 2 Sacramento River, indicating the importance of in-Delta sources and influence of distance of
- 3 pathogen source on concentrations at a particular location in the receiving waters.
- 4 • Temporal (seasonal) trends were weak, however, the highest concentrations in the Sacramento
- 5 River were observed during the wet months and the lowest concentrations were observed in
- 6 July and August.

7 **Fecal Coliform**

- 8 • There was limited data from which to make comparisons/observations.

9 **Cryptosporidium and Giardia**

- 10 • Data were available only for the Sacramento River, limiting the ability to make comparisons
- 11 between sources.
- 12 • Often not detected and when detected, concentrations typically less than 1 organism per liter.
- 13 • There may be natural/artificial barriers/processes that limit transport to water. Significant die
- 14 off of those that reach the water contribute to the low frequency of detection.

15 The Pathogens Conceptual Model found that coliform indicators vary by orders of magnitudes over
 16 small distances and short time-scales. Concentrations appear to be more closely related to what
 17 happens in the proximity of a sampling station, rather than what happens in the larger watershed
 18 where significant travel time and concomitant pathogen die-off can occur. Sites in the Delta close to
 19 urban discharges had elevated concentrations of coliform organisms. The highest total coliform and
 20 *E. coli* concentrations were observed in the discharge from the Natomas East Main Drainage Canal
 21 and several stations near sloughs, indicating the relative influence of urban and wildlife pathogen
 22 sources on receiving water concentrations.

23 The effects of the No Action Alternative relative to Existing Conditions would be changes in the
 24 relative percentage of water throughout the Delta being comprised of various source waters (i.e.,
 25 water from the Sacramento River, San Joaquin River, Bay water, eastside tributaries, and
 26 agricultural return flow), due to potential changes in inflows particularly from the Sacramento River
 27 watershed due to increased water demands (see Table 8-55) and somewhat modified SWP and CVP
 28 operations. However, it is expected there would be no substantial change in Delta pathogen
 29 concentrations in response to a shift in the Delta source water percentages under this alternative or
 30 substantial degradation of these water bodies, with regard to pathogens. This conclusion is based on
 31 the Pathogens Conceptual Model, which found that pathogen sources in close proximity to a Delta
 32 site appear to have the greatest influence on pathogen levels at the site, rather than the primary
 33 source(s) of water to the site. In-Delta potential pathogen sources, including water-based recreation,
 34 tidal habitat, wildlife, and livestock-related uses, would continue under this alternative.

35 **SWP/CVP Export Service Areas**

36 The No Action Alternative is not expected to result in substantial changes in pathogen levels in Delta
 37 waters, relative to Existing Conditions. As such, there is not expected to be substantial, if even
 38 measurable, changes in pathogen concentrations in the SWP/CVP Export Service Areas waters
 39 under the No Action Alternative relative to Existing Conditions.

40 The effects on pathogens from implementing the No Action Alternative is determined to not be
 41 adverse.

1 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
2 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
3 purpose of making the CEQA impact determination for this constituent. For additional details on the
4 effects assessment findings that support this CEQA impact determination, see the effects assessment
5 discussion that immediately precedes this conclusion.

6 River flow rate and reservoir storage reductions that would occur under the No Action Alternative,
7 relative to Existing Conditions, would not be expected to result in a substantial adverse change in
8 pathogen concentrations in the reservoirs and rivers upstream of the Delta, given the small
9 magnitude of urban runoff contributions relative to the magnitude of river flows, that pathogen
10 concentrations in the rivers have a minimal relationship to river flow rate, and the expected reduced
11 pollutant loadings in response to NPDES stormwater-related regulations.

12 It is expected there would be no substantial change in Delta pathogen concentrations in response to
13 a shift in the Delta source water percentages under this alternative or substantial degradation of
14 these water bodies, with regard to pathogens. This conclusion is based on the Pathogens Conceptual
15 Model, which found that pathogen sources in close proximity to a Delta site appear to have the
16 greatest influence on pathogen levels at the site, rather than the primary source(s) of water to the
17 site. In-Delta potential pathogen sources, including water-based recreation, tidal habitat, wildlife,
18 and livestock-related uses, would continue under this alternative.

19 There is not expected to be substantial, if even measurable, changes in pathogen concentrations in
20 the SWP/CVP Export Service Areas waters under the No Action Alternative, relative to Existing
21 Conditions, because the No Action Alternative is not expected to result in substantial changes in
22 pathogen levels in Delta waters relative to Existing Conditions.

23 As such, this alternative is not expected to cause additional exceedance of applicable water quality
24 objectives by frequency, magnitude, and geographic extent that would cause adverse effects on any
25 beneficial uses of waters in the affected environment. Because pathogen concentrations are not
26 expected to increase substantially, no long-term water quality degradation for pathogens is
27 expected to occur and, thus, no adverse effects on beneficial uses would occur. The San Joaquin
28 River in the Stockton Deep Water Ship Channel is Clean Water Act section 303(d) listed for
29 pathogens. Because no measurable increase in Deep Water Ship Channel pathogen concentrations
30 are expected to occur on a long-term basis, further degradation and impairment of this area is not
31 expected to occur. Finally, pathogens are not bioaccumulative constituents. This impact is
32 considered to be less than significant.

33 **Impact WQ-21: Effects on Pesticide Concentrations Resulting from Facilities Operations and** 34 **Maintenance**

35 Residues of “legacy” OC pesticides enter rivers primarily through surface runoff and erosion of
36 terrestrial soils during storm events, and through resuspension of riverine bottom sediments, the
37 combination of which to this day may contribute to excursions above water quality objectives
38 (Central Valley Water Board 2010c). Operation of the CVP/SWP does not affect terrestrial sources,
39 but may result in geomorphic changes to the affected environment that ultimately could result in
40 changes to sediment suspension and deposition. However, as discussed in greater detail for
41 Turbidity/TSS, operations under any alternative would not be expected to change TSS or turbidity
42 levels (highs, lows, typical conditions) to any substantial degree. Changes in the magnitude,
43 frequency, and geographic distribution of legacy pesticides in water bodies of the affected
44 environment that would result in new or more severe adverse effects on aquatic life or other

1 beneficial uses, relative to Existing Conditions or the No Action Alternative, would not be expected
2 to occur. Therefore, the pesticide assessment focuses on the present use pesticides for which
3 substantial information is available, namely diazinon, chlorpyrifos, pyrethroids, and diuron.

4 ***Upstream of the Delta***

5 Pyrethroid and OP insecticides are applied to agricultural fields, orchards, row crops, and confined
6 animal facilities on an annual basis, with peaks in agricultural application during the winter
7 dormant season (January–February) and during field cropping in the spring and summer.
8 Applications of diuron occur year-round, but the majority of diuron is applied to road rights-of-way
9 as a pre-emergent and early post emergent weed treatment during the late fall and early winter
10 (Green and Young 2006). Pyrethroid insecticides and urban use herbicides are additionally applied
11 around urban and residential structures and landscapes on an annual basis. These applications
12 throughout the upstream watershed represent the source and potential pool of these pesticides that
13 may enter the rivers upstream of the Delta by way of surface runoff and/or drift. Principal factors
14 contributing to pesticide loading in the Sacramento River watershed include the amount of pesticide
15 used and amount of precipitation (Guo et al. 2004). Although urban dry weather runoff occurs, this
16 is generally believed to be less significant source of pesticides to main stem receiving waters, but for
17 pyrethroids a recent study concluded that municipal wastewater treatment plants in Sacramento
18 and Stockton represent a continuous year-round source of pyrethroids to the lower Sacramento and
19 San Joaquin River's (Weston and Lydy 2010).

20 Pesticide-related toxicity has historically been observed throughout the affected environment
21 regardless of season or water year type; however, toxicity is generally observed with increased
22 incidence during spring and summer months of April to June, coincident with the peak in irrigated
23 agriculture in the Sacramento and San Joaquin Valleys, as well as the winter rainy season,
24 particularly December through February, coincident with urban and agricultural storm-water runoff
25 and the orchard dormant spraying season (Fox and Archibald 1997). Although OP insecticide
26 incidence and related toxicity can be observed throughout the year, diazinon is most frequently
27 observed during the winter months and chlorpyrifos is most frequently observed in the summer
28 irrigation months (Central Valley Water Board 2007). These seasonal trends coincide with their use,
29 where diazinon is principally used as an orchard dormant season spray, and chlorpyrifos is
30 primarily used on crops during the summer.

31 Application of diuron peaks in the late fall and early winter. Coincidentally, diuron is found most
32 frequently in surface waters during the winter precipitation and runoff months of January through
33 March (Green and Young 2006), although diuron can be found much less frequently in surface
34 waters throughout the year (Johnson et al. 2010).

35 Monitoring for pyrethroid insecticides in main-stem rivers is limited and detections are rather few.
36 With the replacement of many traditionally OP related uses, however, it is conservatively assumed
37 that pyrethroid incidence and associated toxicity could ultimately take a pattern of seasonality
38 similar to that of the chlorpyrifos or diazinon.

39 In comparison to the Valley floor, relatively small amounts of pesticides are used in watersheds
40 upstream of project reservoirs. Water released from reservoirs flow through urban and agricultural
41 areas at which point these waters may acquire a burden of pesticide from agricultural or urban
42 sourced discharges. These discharges with their potential burden of pesticides are effectively
43 diluted by reservoir water. Under the No Action Alternative, no activity of the SWP or CVP would
44 substantially drive a change in pesticide use, and thus pesticide sources would remain unaffected.

1 Nevertheless, changes in the timing and magnitude of reservoir releases could have an effect on
2 available dilution capacity along river segments such as the Sacramento, Feather, American, and San
3 Joaquin Rivers.

4 Under the No Action Alternative, winter (November–March) and summer (April–October) season
5 average flow rates on the Sacramento River at Freeport, American River at Nimbus, Feather River at
6 Thermalito and the San Joaquin River at Vernalis would change relative to Existing Conditions.
7 Averaged over the entire period of record, seasonal mean flow rates would largely remain
8 unchanged on the Sacramento River and Feather Rivers (Appendix 8L, Seasonal average flows
9 Tables 1-4). Summer average flow rates on the American River would decrease by 16% relative to
10 Existing Conditions. During the winter months, however, average flow rates would increase by as
11 much as 9% on the American River. Similarly, summer average flow rates on the San Joaquin River
12 would decrease by 12% relative to Existing Conditions, while winter average flow rates would
13 increase slightly.

14 As previously stated, historically chlorpyrifos is used in greater amounts in agriculture in the
15 summer, and consequently observed in surface waters with greater frequency in the summer, while
16 diazinon and diuron are used and observed in surface water with greater frequency in the winter.
17 While flow reductions in the summer on the American River would not coincide with urban
18 stormwater discharges, summer flow reductions on the San Joaquin River would correspond to the
19 agricultural irrigation season. However, summer average flow reductions of up to 12%, relative to
20 Existing Conditions, are not considered of sufficient magnitude to substantially increase in-river
21 concentrations or alter the long-term risk of pesticide-related effects on aquatic life beneficial uses.
22 Greater long-term average flow reductions, and corresponding reductions in dilution/assimilative
23 capacity, would be necessary before long-term risk of pesticide related effects on aquatic life
24 beneficial uses would be adversely altered.

25 ***Delta***

26 Sources of diuron, OP and pyrethroid insecticides to the Plan Area include direct input of surface
27 runoff from in-Delta agriculture and Delta urbanized areas as well as inputs from rivers upstream of
28 the Delta. Similar to Upstream of the Delta, CVP/SWP operations would not affect these sources.

29 Studies documenting pesticide associated toxicity in the Delta demonstrate the dynamic nature of
30 pesticide input. Pesticide loads entering the Delta, but originating outside of the Delta, do so
31 typically in pulses and particularly after significant precipitation induced surface runoff events
32 (Kuivila and Foe 1995). Through the greater hydraulic capacity of the Delta, and through tidal
33 mixing, these pulses become diluted and spread about the Delta. Although it is difficult to
34 definitively conclude that either the Sacramento River or San Joaquin River is a consistently
35 dominant source of pesticide, a compilation of Delta diazinon and chlorpyrifos data suggest that
36 these two OP insecticides have both been more frequently observed in the San Joaquin River, and at
37 concentrations more frequently exceeding OP specific aquatic life criteria (Central Valley Water
38 Board 2006).

39 No similar observation as to incidence frequency can be made regarding pyrethroid insecticides,
40 primarily owing to a dearth of monitoring data. Pyrethroid insecticides have been observed in Delta
41 waterways, but there is little evidence supporting any particular geographic or seasonal trend
42 (Werner et al. 2010). Unlike that for chlorpyrifos and diazinon, data for pyrethroids are insufficient
43 to determine the relative loading from particular source waters.

1 Diuron has been detected in the Delta throughout the year, but with greater magnitude and
2 frequency during the winter storm season. Unlike that for chlorpyrifos and diazation, data for
3 diuron are insufficient to determine the relative loading from particular source waters.

4 Granting the assessment challenges imposed by data limitations, there does appear sufficient
5 information to suggest that the San Joaquin River, in comparison to the Sacramento River, is a
6 greater contributor of OP insecticides in terms of greater frequency of incidence and presence at
7 concentrations exceeding water quality benchmarks. Although data is insufficient to make similar
8 observations pertaining to diuron, trends in pyrethroid use suggest that pyrethroid insecticides may
9 in the near future reflect the historic trends of OP insecticides, namely that of relative frequency,
10 magnitude, seasonality and geographic distribution. Based on these general observations, this
11 assessment utilizes source water fingerprinting to make qualitative judgments as to increased risk
12 of pesticide related aquatic life toxicity and judgments as to the possibility of associated long-term
13 degradation to water quality.

14 Percent change in monthly average source water fraction were evaluated for the modeled 16-year
15 (1976–1991) hydrologic period and a representative drought period (1987–1991), with special
16 attention given to changes in San Joaquin River, Sacramento River and Delta Agriculture sources
17 water fractions. For the No Action Alternative, San Joaquin River fractions would not increase more
18 than 10% at any of the 11 modeled assessment locations, with exception to Jones pumping plant
19 during the modeled drought period, where San Joaquin River fraction would increase 12–14% in
20 October and November relative to Existing Conditions, yet would continue to represent less than
21 43% of the total source water volume (Appendix 8D, Source Water Fingerprinting). Similarly,
22 Sacramento River fractions would not increase more than 10% at any of the 11 modeled assessment
23 locations. However, these large fractional increases in Sacramento River occur through near equal
24 replacement of San Joaquin River water and, as such, would likely represent an overall decrease in
25 risk of pesticide-related toxicity to aquatic life. There would be no modeled increases in Delta
26 agricultural fractions greater than 2%.

27 These modeled changes in the source water fractions of Sacramento, San Joaquin and Delta
28 agriculture water are not of sufficient magnitude to substantially alter the long-term risk of
29 pesticide-related toxicity to aquatic life within the Delta, nor would such changes result in adverse
30 pesticide-related effects on any other beneficial uses of Delta waters.

31 ***SWP/CVP Export Service Areas***

32 Assessment of effects in SWP and CVP Export Service Areas is based on effects seen in the Delta at
33 the Banks and Jones pumping plants. Under the No Action Alternative, Sacramento, San Joaquin and
34 in-Delta Agricultural source water fractions at Banks would not increase more than 5% in any
35 month relative to Existing Conditions (Appendix 8D, Source Water Fingerprinting). At Jones during
36 the modeled drought period, San Joaquin River source water fractions would increase by as much as
37 12–14% in October and November relative to Existing Conditions, yet would continue to represent
38 less than 43% of the total source water volume. These modeled changes in the source water
39 fractions of Sacramento, San Joaquin and Delta agriculture water are not of sufficient magnitude to
40 substantially alter the long-term risk of pesticide-related toxicity to aquatic life beneficial uses, or
41 any other beneficial uses, in water bodies of the SWP and CVP service area.

42 ***CEQA Conclusion:*** Key findings discussed in the effects assessment relative to Existing Conditions is
43 provided above are summarized here, and are then compared to the CEQA thresholds of significance
44 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this

1 constituent. For additional details on the effects assessment findings that support this CEQA impact
2 determination, see the effects assessment discussion that immediately precedes this conclusion.

3 Sources of pesticides upstream of the Delta include direct input of pesticide containing surface
4 runoff from agriculture and urbanized areas. Flows in rivers receiving these discharges dilute these
5 pesticide inputs. Relative to Existing Conditions, however, modeled changes in long-term average
6 flows on the Sacramento, Feather, American, and San Joaquin Rivers are of insufficient magnitude to
7 substantially increase the long-term risk of pesticide-related water quality degradation and related
8 toxicity to aquatic life in these water bodies upstream of the Delta.

9 In the Delta, sources of pesticides include direct input of surface runoff from Delta agriculture and
10 Delta urbanized areas as well as inputs from rivers upstream of the Delta. While facilities operations
11 and maintenance activities would not affect these sources, changes in Delta source water fraction
12 could change the relative risk associated with pesticide related toxicity to aquatic life. Under the No
13 Action Alternative, however, modeled changes in source water fractions relative to Existing
14 Conditions are of insufficient magnitude to substantially alter the long-term risk of pesticide-related
15 toxicity to aquatic life within the Delta, nor would such changes result in adverse pesticide-related
16 effects on any other beneficial uses of Delta waters.

17 The assessment of the No Action Alternative effects on pesticides in the SWP/CVP Export Service
18 Areas is based on assessment of changes predicted at Banks and Jones pumping plants. As just
19 discussed regarding effects to pesticides in the Delta, modeled changes in source water fractions at
20 the Banks and Jones pumping plants are of insufficient magnitude to substantially alter the long-
21 term risk of pesticide-related toxicity to aquatic life beneficial uses, or any other beneficial uses, in
22 water bodies of the SWP and CVP export service area.

23 Based on the above, the No Action Alternative would not result in any substantial change in long-
24 term average pesticide concentration or result in substantial increase in the anticipated frequency
25 with which long-term average pesticide concentrations would exceed aquatic life toxicity thresholds
26 or other beneficial use effect thresholds upstream of the Delta, at the 11 assessment locations
27 analyzed for the Delta, or the SWP and CVP service area. Numerous pesticides are currently used
28 throughout the affected environment, and while some of these pesticides may be bioaccumulative,
29 those present-use pesticides for which there is sufficient evidence for their presence in waters
30 affected by SWP and CVP operations (i.e., diazinon, chlorpyrifos, diuron, and pyrethroids) are not
31 considered bioaccumulative, and thus changes in their concentrations would not directly cause
32 bioaccumulative problems in aquatic life or humans. Furthermore, while there are numerous 303(d)
33 listings throughout the affected environment that name pesticides as the cause for beneficial use
34 impairment, the modeled changes in upstream river flows and Delta source water fractions would
35 not be expected to make any of these beneficial use impairments measurably worse. Because long-
36 term average pesticide concentrations are not expected to increase substantially, no long-term
37 water quality degradation with respect to pesticides is expected to occur and, thus, no adverse
38 effects on beneficial uses would occur. This impact is considered to be less than significant.

39 **Impact WQ-23: Effects on Phosphorus Concentrations Resulting from Facilities Operations** 40 **and Maintenance**

41 ***Upstream of the Delta***

42 A conceptual model of nutrients in the Delta stated that: “previous attempts to relate concentration
43 data to flow data in the Central Valley and Delta showed little correlation between the two variables

1 (Tetra Tech 2006b, *Conceptual Model for Organic Carbon in the Central Valley*). One possible reason
2 is that the Central Valley and Delta system is a highly managed system with flows controlled by
3 major reservoirs on most rivers” (Tetra Tech 2006b:4-1 to 4-2). Attempts made in the Nitrate
4 section of this chapter also showed weak correlation between nitrate and flows for major source
5 waters to the Delta. The linear regressions between average dissolved ortho-phosphate
6 concentrations and average flows in the San Joaquin and Sacramento Rivers were derived for this
7 analysis (Figure 8-58). As expected, neither relationship is very strong, although over the large
8 range in flows for the Sacramento River, the relationship is stronger than for the San Joaquin River.
9 However, over smaller changes in flows, neither relationship can function as a predictor of
10 phosphorus concentrations because the variability in the data over small to medium ranges of flows
11 (i.e., < 10,000 CFS) is large.

12 Because phosphorus loading to waters upstream of the Delta is not anticipated to change, and
13 because changes in flows do not necessarily result in changes in concentrations or loading of
14 phosphorus to these water bodies, substantial changes in phosphorus concentration are not
15 anticipated for the No Action Alternative, relative to Existing Conditions. Any negligible changes in
16 phosphorus concentrations that may occur in the water bodies of the affected environment located
17 upstream of the Delta would not be of frequency, magnitude and geographic extent that would
18 adversely affect any beneficial uses or substantially degrade the quality of these water bodies, with
19 regards to phosphorus.

20 **Delta**

21 Because phosphorus concentrations in the major source waters to the Delta are similar for much of
22 the year, phosphorus concentrations in the Delta are not anticipated to change substantially on a
23 long term-average basis. Phosphorus concentrations may increase during January through March at
24 locations where the source fraction of San Joaquin River water increases, due to the higher
25 concentration of phosphorus in the San Joaquin River during these months compared to Sacramento
26 River water or San Francisco Bay water. Based on the DSM2 fingerprinting results (see Appendix
27 8D), together with source water concentrations shown in Figure 8-56, the magnitude of increases
28 during these months may range from negligible up to approximately 0.05 mg/L. However, there are
29 no state or federal objectives/criteria for phosphorus and thus any increases would not cause
30 exceedances of objectives/criteria. Because algal growth rates are limited by availability of light in
31 the Delta, increases in phosphorus levels that may occur at some locations and times within the
32 Delta would be expected to have little effect on primary productivity in the Delta. Moreover, such
33 increases in concentrations would not be anticipated to be of frequency, magnitude and geographic
34 extent that would adversely affect any beneficial uses or substantially degrade the water quality at
35 these locations, with regards to phosphorus.

36 **SWP/CVP Export Service Areas**

37 The assessment of effects of phosphorus under the No Action Alternative in the SWP and CVP Export
38 Service Areas is based on effects on phosphorus at the Banks and Jones pumping plants.

39 As noted in the Delta Region section above, phosphorus concentrations in the Delta (including Banks
40 and Jones pumping plants) are not anticipated to change substantially on a long term-average basis.
41 During January through March, phosphorus concentrations may increase as a result of more San
42 Joaquin River water reaching Banks and Jones pumping plants and the higher concentration of
43 phosphorus in the San Joaquin River. However, based on the DSM2 fingerprinting results (see
44 Appendix 8D), together with source water concentrations shown in Figure 8-56, the magnitude of

1 this increase is expected to be negligible (<0.01 mg/L-P). Additionally, there are no state or federal
2 objectives for phosphorus. Moreover, given the many factors that contribute to potential algal
3 blooms in the SWP and CVP canals within the Export Service Area, and the lack of studies that have
4 shown a direct relationship between nutrient concentrations in the canals and reservoirs and
5 problematic algal blooms in these water bodies, there is no basis to conclude that any seasonal
6 increases in phosphorus concentrations at the levels expected under this alternative, should they
7 occur, would increase the potential for problem algal blooms in the SWP and CVP Export Service
8 Area.

9 Any increases in phosphorus concentrations that may occur in water exported via Banks and Jones
10 pumping plants are not expected to result in adverse effects to beneficial uses of exported water or
11 substantially degrade the quality of exported water, with regards to phosphorus.

12 In summary, based on the discussion above, effects on phosphorus of facilities operations and
13 maintenance are considered to be not adverse.

14 **CEQA Conclusion:** Key findings discussed in the effects assessment relative to Existing Conditions is
15 provided above are summarized here, and are then compared to the CEQA thresholds of significance
16 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this
17 constituent. For additional details on the effects assessment findings that support this CEQA impact
18 determination, see the effects assessment discussion that immediately precedes this conclusion.

19 Because phosphorus loading to waters upstream of the Delta is not anticipated to change, and
20 because changes in flows do not necessarily result in changes in concentrations or loading of
21 phosphorus to these water bodies, substantial changes in phosphorus concentration upstream of the
22 Delta are not anticipated for the No Action Alternative, relative to Existing Conditions.

23 Because phosphorus concentrations in the major source waters to the Delta are similar for much of
24 the year, phosphorus concentrations in the Delta are not anticipated to change substantially on a
25 long term-average basis under the No Action Alternative, relative to Existing Conditions. Algal
26 growth rates are limited by availability of light in the Delta, and therefore any minor increases in
27 phosphorus levels that may occur at some locations and times within the Delta would be expected to
28 have little effect on primary productivity in the Delta.

29 The assessment of effects of phosphorus under the No Action Alternative in the SWP and CVP Export
30 Service Areas is based on effects on phosphorus at the Banks and Jones pumping plants. As noted
31 above, phosphorus concentrations in the Delta (including Banks and Jones pumping plants) are not
32 anticipated to change substantially on a long term-average basis.

33 Based on the above, there would be no substantial, long-term increase in phosphorus concentrations
34 in the rivers and reservoirs upstream of the Delta, in the Delta Region, or the waters exported to the
35 CVP and SWP service areas under the No Action Alternative relative to Existing Conditions. As such,
36 this alternative is not expected to cause additional exceedance of applicable water quality
37 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
38 on any beneficial uses of waters in the affected environment. Because phosphorus concentrations
39 are not expected to increase substantially, no long-term water quality degradation is expected to
40 occur and, thus, no adverse effects to beneficial uses would occur. Phosphorus is not 303(d) listed
41 within the affected environment and thus any minor increases that may occur in some areas would
42 not make any existing phosphorus-related impairment measurably worse because no such
43 impairments currently exist. Because phosphorus is not bioaccumulative, minor increases that may

1 occur in some areas would not bioaccumulate to greater levels in aquatic organisms that would, in
2 turn, pose substantial health risks to fish, wildlife, or humans. This impact is considered to be less
3 than significant.

4 **Impact WQ-25: Effects on Selenium Concentrations Resulting from Facilities Operations and** 5 **Maintenance**

6 *Upstream of the Delta*

7 Substantial point sources of selenium do not exist upstream in the Sacramento River watershed, in
8 the watersheds of the eastern tributaries (Cosumnes, Mokelumne, and Calaveras Rivers), or
9 upstream of the Delta in the San Joaquin River watershed. Nonpoint sources of selenium within the
10 watersheds of the Sacramento River and the eastern tributaries also are relatively low, resulting in
11 generally low selenium concentrations in the reservoirs and rivers of those watersheds.
12 Consequently, any modified reservoir operations and subsequent changes in river flows under the
13 No Action Alternative, relative to Existing Conditions, are expected to have negligible, if any, effects
14 on reservoir and river selenium concentrations upstream of Freeport in the Sacramento River
15 watershed or in the eastern tributaries upstream of the Delta.

16 Non-point sources of selenium in the San Joaquin River watershed are associated with discharges of
17 subsurface agricultural drainage to the river or its tributaries. Selenium concentrations in the San
18 Joaquin River upstream of the Delta comply with NTR criteria and Basin Plan objectives at Vernalis
19 under Existing Conditions, and they are expected to do so under the No Action Alternative. This is
20 because a TMDL has been developed by the Central Valley Water Board (2001), the Grassland
21 Bypass Project has established limits that will result in reduced inputs of selenium to the Delta, and
22 the Central Valley Water Board (2010a) and State Water Board (2010d, 2010e) have established
23 Basin Plan objectives that are expected to result in decreasing discharges of selenium from the San
24 Joaquin River to the Delta, as previously discussed in 8.1.1.10. Selenium concentrations at Vernalis
25 are generally higher during lower San Joaquin River flows, with considerable variability in
26 concentrations below about 3,000 cubic feet per second (cfs), as shown in Appendix 8M (Table 31
27 and Figures 4 through 17). The only three monthly average selenium concentrations greater than 2
28 µg/L were in March 2002 (2.3 µg/L) and February and March 2003 (2.1 and 2.3 µg/L), when
29 monthly average flows were 1,879 to 2,193 cfs. Modeling of flows for the San Joaquin River at
30 Vernalis indicates that average annual flows under the No Action Alternative will vary by less than
31 10 percent from Existing Conditions (Appendix 5A). Given these relatively small decreases in flows
32 and the considerable variability in the relationship between selenium concentrations and flows in
33 the San Joaquin River, it is expected that selenium concentrations in the San Joaquin River would be
34 minimally affected, if at all, by anticipated changes in flow rates under the No Action Alternative.
35 Thus, available information indicates selenium concentrations are well below the Basin Plan
36 objective and are likely to remain so. Any negligible changes in selenium concentrations that may
37 occur in the water bodies of the affected environment located upstream of the Delta would not be of
38 frequency, magnitude, and geographic extent that would adversely affect any beneficial uses or
39 substantially degrade the quality of these water bodies as related to selenium.

40 *Delta*

41 Selenium concentrations for each of the 11 modeled assessment locations under Existing Conditions,
42 the No Action Alternative, and all action alternatives, are presented in Table M-10A/B for water,
43 Tables M-11 through M-20 for most biota (whole-body fish, bird eggs [invertebrate diet], bird eggs

1 [fish diet], and fish fillets), and Table M.A-2 for sturgeon at the two western Delta locations. Figures
2 8-59 and 8-60 present graphical distributions of predicted selenium concentration changes (shown
3 as changes in available assimilative capacity based on 2 µg/L) in water at each modeled assessment
4 location for all years. Appendix 8M (Figures 8M-4 through 8M-6) provides more detail in the form of
5 monthly patterns of selenium concentrations in water during the modeling period.

6 Toxicity Level Exceedance Quotients (i.e., modeled tissue concentration divided by Toxicity Level
7 benchmarks) for selenium concentrations in all biota for all years and for drought years, and Level
8 of Concern Exceedance Quotients (i.e., modeled tissue divided by Level of Concern benchmarks) for
9 selenium concentrations in all biota for all years are less than 1.0 (indicating low probability of
10 adverse effects) except for sturgeon in the western Delta. Level of Concern Exceedance Quotients for
11 selenium concentrations in whole-body fish, bird eggs (invertebrate diet), and bird eggs (fish diet)
12 for drought years are greater than 1.0 for some locations; however, Advisory Tissue Level
13 Exceedance Quotients for selenium concentrations in fish fillets for drought years are less than 1.0.
14 Figures 8-61 through 8-64 show the Exceedance Quotients based on the lowest benchmarks for
15 whole-body fish, bird eggs (invertebrate diet), bird eggs (fish diet), and fish fillets in drought years,
16 respectively, at each modeled location. For sturgeon in the western Delta, whole-body selenium
17 concentrations exceed both the low and high toxicity benchmarks (Table M.A-2). Detailed analyses
18 of selenium concentrations in biota are presented in Appendix 8M (Tables M-1 through M-30) and
19 Addendum M.A to Appendix 8M (Table M.A-2).

20 Relative to Existing Conditions, the No Action Alternative would result in small changes in average
21 selenium concentrations in water at all modeled Delta assessment locations with the largest
22 increase being at the Contra Costa Pumping Plant #1 (hereafter Contra Costa PP) for drought years
23 and largest decrease being in the San Joaquin River at Buckley Cove (Buckley Cove) for all and
24 drought years (Table M-10A). These small changes in selenium concentrations in water are reflected
25 in small percent changes in available assimilative capacity (10% or less) for selenium (based on 2
26 µg/L ecological risk benchmark). Relative to Existing Conditions, the No Action Alternative would
27 result in the largest modeled increase in available assimilative capacity at Buckley Cove (5%) and
28 the largest decrease at Contra Costa PP (0.4%) (Figure 8-59). Although some small negative changes
29 in selenium concentrations in water are expected, the effect of the No Action Alternative would
30 generally be minimal for the Delta locations. Furthermore, the modeled selenium concentrations in
31 water (Table M-10A) for Existing Conditions (range 0.21–0.76 µg/L) and the No Action Alternative
32 (range 0.21–0.69 µg/L) would be below the ecological risk benchmark (2 µg/L).

33 Relative to Existing Conditions, the No Action Alternative would result in small changes in estimated
34 selenium concentrations in biota (whole-body fish, bird eggs [invertebrate diet], bird eggs [fish diet],
35 and fish fillets), with the largest increase being at Contra Costa PP for drought years, and the largest
36 decrease at Buckley Cove for drought years (Table M-11). Except for sturgeon in the western Delta,
37 concentrations of selenium in whole-body fish and bird eggs (invertebrate and fish diets) would
38 exceed only the lower benchmarks (4 and 6 mg/kg dry weight, respectively, indicating a low
39 potential for effects), under drought conditions, at Buckley Cove for Existing Conditions and the No
40 Action Alternative (Figures 8-61 through 8-63). However, Exceedance Quotients for these
41 exceedances of the lower benchmarks are between 1.0 and 1.5, indicating a low risk to biota in the
42 Delta. Selenium concentrations in fish fillets would not exceed the screening value for protection of
43 human health (Figure 8-64). For sturgeon in the western Delta, whole-body selenium concentrations
44 would exceed both the low and high toxicity benchmarks, but there would be essentially no change
45 relative to Existing Conditions (Table M.A-2).

1 Relative to Existing Conditions, the No Action Alternative would result in essentially no change in
 2 selenium concentrations throughout the Delta, though conditions would slightly improve at Buckley
 3 Cove. The No Action Alternative would not be expected to substantially increase the frequency with
 4 which applicable benchmarks would be exceeded in the Delta or substantially degrade the quality of
 5 water in the Delta, with regard to selenium.

6 ***SWP/CVP Export Service Areas***

7 Relative to Existing Conditions, the No Action Alternative would result in small changes in average
 8 selenium concentrations in water at both modeled Export Service Area assessment locations with
 9 the largest increase being at the Jones Pumping Plant (Jones PP) and largest decrease being at the
 10 Banks Pumping Plant (Banks PP) (Table M-11). These small changes in selenium concentrations in
 11 water are reflected in small percent changes (10% or less) in available assimilative capacity for
 12 selenium for all years. Relative to Existing Conditions, the No Action Alternative would result in less
 13 than a 1% change in assimilative capacity at both Export Service Area locations for all and drought
 14 years (Figures 8-60 and 8-61). The effect of the No Action Alternative on selenium concentrations in
 15 water is minimal for both locations. Furthermore, the modeled selenium concentrations in water
 16 (Table M-10A) for Existing Conditions (range 0.37–0.58 µg/L) and the No Action Alternative (range
 17 0.37–0.59 µg/L) would be below the ecological risk benchmark (2 µg/L).

18 Relative to Existing Conditions, the No Action Alternative would result in small changes in estimated
 19 selenium concentrations in biota (whole-body fish, bird eggs [invertebrate diet], bird eggs [fish diet],
 20 and fish fillets), with the largest increase being at Jones PP for drought years, and the largest
 21 decrease at Banks PP for all years (Table M-11). Concentrations of selenium in biota would be
 22 expected to exceed only the lower benchmark (6 mg/kg dry weight, indicating a low potential for
 23 effects) for bird eggs (fish diets), under drought conditions, at Jones PP for Existing Conditions and
 24 the No Action Alternative (Figure 8-63). However, Exceedance Quotients for these exceedances of
 25 the lower benchmarks are between 1.0 and 1.1, indicating a low risk to biota in the Export Service
 26 Areas, and they do not differ substantially among Existing Conditions and the No Action Alternative.
 27 Selenium concentrations in whole-body fish, bird eggs (invertebrate diet), and fish fillets would not
 28 exceed the screening value of the lower benchmarks (Figures 8-61, 8-62, and 8-64).

29 Relative to Existing Conditions, the No Action Alternative would result in essentially no change in
 30 selenium concentrations at the Export Service Area locations. The No Action Alternative would not
 31 be expected to substantially increase the frequency with which applicable benchmarks would be
 32 exceeded in the Export Service Areas or substantially degrade the quality of water in the Export
 33 Service Areas, with regard to selenium.

34 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
 35 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
 36 purpose of making the CEQA impact determination for selenium. For additional details on the effects
 37 assessment findings that support this CEQA impact determination, see the effects assessment
 38 discussion that immediately precedes this conclusion.

39 There are no substantial point sources of selenium in watersheds upstream of the Delta, and no
 40 substantial nonpoint sources of selenium in the watersheds of the Sacramento River and the eastern
 41 tributaries. Nonpoint sources in the San Joaquin Valley that contribute selenium to the Delta will be
 42 controlled through a TMDL developed by the Central Valley Water Board (2001) for the lower San
 43 Joaquin River, established limits for the Grassland Bypass Project, and Basin Plan objectives (Central
 44 Valley Water Board 2010d) and State Water Board (2010d, 2010e) that are expected to result in

1 decreasing discharges of selenium from the San Joaquin River to the Delta. Consequently, any
2 modified reservoir operations and subsequent changes in river flows under the No Action
3 Alternative, relative to Existing Conditions, are expected to cause negligible changes in selenium
4 concentrations in water. Any negligible changes in selenium concentrations that may occur in the
5 water bodies of the affected environment located upstream of the Delta would not be of frequency,
6 magnitude, and geographic extent that would adversely affect any beneficial uses or substantially
7 degrade the quality of these water bodies as related to selenium.

8 Relative to Existing Conditions, modeling estimates indicate that the No Action Alternative would
9 result in essentially no change in selenium concentrations throughout the Delta, though conditions
10 would slightly improve at Buckley Cove.

11 Assessment of effects of selenium in the SWP and CVP Export Service Areas is based on effects on
12 selenium concentrations at the Banks and Jones pumping plants. Relative to Existing Conditions, the
13 No Action Alternative would result in essentially no change in selenium concentrations at those two
14 pumping plant locations.

15 Based on the above, selenium concentrations that would occur in water under this alternative would
16 not cause additional exceedances of applicable state or federal numeric or narrative water quality
17 objectives/criteria, or other relevant water quality effects thresholds identified for this assessment
18 (Table 8-54), by frequency, magnitude, and geographic extent that would result in adverse effects to
19 one or more beneficial uses within affected water bodies. In comparison to Existing Conditions,
20 water quality conditions under this alternative would not increase levels of selenium by frequency,
21 magnitude, and geographic extent such that the affected environment would be expected to have
22 measurably higher body burdens of selenium in aquatic organisms, thereby substantially increasing
23 the health risks to wildlife (including fish) or humans consuming those organisms. Water quality
24 conditions under this alternative with respect to selenium would not cause long-term degradation of
25 water quality in the affected environment, and therefore would not result in use of available
26 assimilative capacity such that exceedances of water quality objectives/criteria would be likely and
27 would result in substantially increased risk for adverse effects to one or more beneficial uses. This
28 alternative would not further degrade water quality by measurable levels, on a long-term basis, for
29 selenium and, thus, cause the 303(d)-listed impairment of beneficial use to be made discernibly
30 worse. This impact is considered to be less than significant.

31 **Impact WQ-27: Effects on Trace Metal Concentrations Resulting from Facilities Operations** 32 **and Maintenance**

33 ***Upstream of the Delta***

34 Relative to Existing Conditions, under the No Action Alternative sources of trace metals would not
35 be expected to change substantially with exception to sources related to population growth, such as
36 increased municipal wastewater discharges and development contributing to increased urban
37 runoff. Facility operations could have an effect on these sources if concentrations of dissolved metals
38 were closely correlated to river flow, suggesting that changes in river flow, and the related capacity
39 to dilute these sources, could ultimately have a substantial effect on long-term metals
40 concentrations.

41 On the Sacramento River, available dissolved trace metals data and river flow at Freeport are poorly
42 associated (Appendix 8N, Figure 1). Similarly, dissolved copper, iron, and manganese concentrations
43 on the San Joaquin River at Vernalis are poorly associated (Appendix 8N, Figure 2). While there is an

1 insufficient number of data for the other trace metals to observe trends at Vernalis, it is reasonable
2 to assume that these metals similarly show poor association to San Joaquin River flow, as shown for
3 the corresponding dissolved metals on the Sacramento River.

4 Given the poor association of dissolved trace metal concentrations with flow, river flow rate and
5 reservoir storage reductions that would occur under the No Action Alternative, relative to Existing
6 Conditions, would not be expected to result in a substantial adverse change in trace metal
7 concentrations in the reservoirs and rivers upstream of the Delta. As such, the No Action Alternative
8 would not be expected to substantially increase the frequency with which applicable Basin Plan
9 objectives or CTR criteria would be exceeded in water bodies of the affected environment located
10 upstream of the Delta or substantially degrade the quality of these water bodies, with regard to trace
11 metals.

12 **Delta**

13 For metals of primarily aquatic life concern (copper, cadmium, chromium, lead, nickel, silver, and
14 zinc), average and 95th percentile trace metal concentrations of the primary source waters to the
15 Delta are very similar, with difference typically not greater than a factor of 2 to 5 (Appendix 8N,
16 Table 1-7). For example, average dissolved copper concentrations on the Sacramento River, San
17 Joaquin River, and Bay (Martinez) are 1.7 µg/L, 2.4 µg/L, and 1.7 µg/L, respectively. The 95th
18 percentile dissolved copper concentrations on the Sacramento River, San Joaquin River, and Bay
19 (Martinez) are 3.4 µg/L, 4.5 µg/L, and 2.4 µg/L, respectively. Given this similarity, very large
20 changes in source water fraction would be necessary to effect a relatively small change in trace
21 metal concentration at a particular Delta location. Moreover, average and 95th percentile trace metal
22 concentrations for these primary source waters are all below their respective water quality criteria,
23 including those that are hardness-based without a WER adjustment (Tables 8-51 and 8-52). No
24 mixing of these three source waters could result in a metal concentration greater than the highest
25 source water concentration, and given that the average and 95th percentile source water
26 concentrations for copper, cadmium, chromium, led, nickel, silver, and zinc do not exceed their
27 respective criteria, more frequent exceedances of criteria in the Delta would not occur under the
28 operational scenario for this alternative.

29 For metals of primarily human health and drinking water concern (arsenic, iron, manganese),
30 average and 95th percentile concentrations are also very similar (Appendix 8N, Table 8-10). The
31 arsenic criterion was established to protect human health from the effects of long-term chronic
32 exposure, while secondary maximum contaminant levels for iron and manganese were established
33 as reasonable goals for drinking water quality. The primary source water average concentrations for
34 arsenic, iron, and manganese are below these criteria. No mixing of these three source waters could
35 result in a metal concentration greater than the highest source water concentration, and given that
36 the average water concentrations for arsenic, iron, and manganese do not exceed water quality
37 criteria, more frequent exceedances of drinking water criteria in the Delta would not be expected to
38 occur under this alternative.

39 Relative to Existing Conditions, facilities operation under the No Action Alternative would result in
40 negligible change in trace metal concentrations throughout the Delta. The No Action Alternative
41 would not be expected to substantially increase the frequency with which applicable Basin Plan
42 objectives or CTR criteria would be exceeded in the Delta or substantially degrade the quality of
43 water in the Delta, with regard to trace metals.

1 **SWP/CVP Export Service Areas**

2 The No Action Alternative is not expected to result in substantial changes in trace metal
3 concentrations in Delta waters. As such, there is not expected to be substantial changes in trace
4 metal concentrations in the SWP/CVP export service area waters, exported from the Delta through
5 the south Delta pumps, under the No Action Alternative.

6 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
7 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
8 purpose of making the CEQA impact determination for this constituent. For additional details on the
9 effects assessment findings that support this CEQA impact determination, see the effects assessment
10 discussion that immediately precedes this conclusion.

11 While greater water demands under the No Action Alternative would alter the magnitude and
12 timing of reservoir releases north, south and east of the Delta, these activities would have no
13 substantial effect on the various watershed sources of trace metals. Moreover, long-term average
14 flow and trace metals at Sacramento River at Hood and San Joaquin River at Vernalis are poorly
15 correlated; therefore, changes in river flows would not be expected to cause a substantial long-term
16 change in trace metal concentrations upstream of the Delta.

17 Average and 95th percentile trace metal concentrations are very similar across the primary source
18 waters to the Delta. Given this similarity, very large changes in source water fraction would be
19 necessary to effect a relatively small change in trace metal concentration at a particular Delta
20 location. Moreover, average and 95th percentile trace metal concentrations for these primary source
21 waters are all below their respective water quality criteria, including those that are hardness-based
22 without a WER adjustment. No mixing of these three source waters could result in a metal
23 concentration greater than the highest source water concentration, and given that trace metals do
24 not already exceed water quality criteria, more frequent exceedances of criteria in the Delta would
25 not be expected to occur under the No Action Alternative.

26 The assessment of the No Action Alternative effects on trace metals in the SWP/CVP Export Service
27 Areas is based on assessment of changes in trace metal concentrations at Banks and Jones pumping
28 plants. As just discussed regarding similarities in Delta source water trace metal concentrations, the
29 No Action Alternative is not expected to result in substantial changes in trace metal concentrations
30 in Delta waters, including Banks and Jones pumping plants, therefore effects on trace metal
31 concentrations in the SWP/CVP Export Service Area are expected to be negligible.

32 Based on the above, there would be no substantial long-term increase in trace metal concentrations
33 in the rivers and reservoirs upstream of the Delta, in the Delta Region, or the SWP/CVP export
34 service area waters under the No Action Alternative relative to Existing Conditions. As such, this
35 alternative is not expected to cause additional exceedance of applicable water quality
36 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
37 on any beneficial uses of waters in the affected environment. Because trace metal concentrations are
38 not expected to increase substantially, no long-term water quality degradation for trace metals is
39 expected to occur and, thus, no adverse effects to beneficial uses would occur. Furthermore,
40 negligible change in long-term trace metal concentrations throughout the affected environment
41 would not be expected to make any existing beneficial use impairments measurably worse. The
42 trace metals discussed in this assessment are not considered bioaccumulative, and thus would not
43 directly cause bioaccumulative problems in aquatic life or humans. This impact is considered to be
44 less than significant.

1 **Impact WQ-29: Effects on TSS and Turbidity Resulting from Facilities Operations and**
2 **Maintenance**

3 ***Upstream of the Delta***

4 TSS concentrations and turbidity levels in rivers upstream of the Delta are affected primarily by: 1)
5 TSS concentrations and turbidity levels of the water released from the upstream reservoirs, 2)
6 erosion occurring within the river channel beds, which is affected by river flow velocity and bank
7 protection, 3) TSS concentrations and turbidity levels of tributary inflows, point-source inputs, and
8 nonpoint runoff as influenced by surrounding land uses; and 4) phytoplankton, zooplankton and
9 other biological material in the water.

10 The No Action Alternative would alter the magnitude and timing of water releases from reservoirs
11 upstream of the Delta relative to Existing Conditions, altering downstream river flows relative to
12 Existing Conditions. With respect to TSS and turbidity, an increase in river flow is generally the
13 concern, as this increases shear stress on the channel, suspending particles resulting in higher TSS
14 concentrations and turbidity levels. Schoellhamer et al. (2007b) noted that suspended sediment
15 concentration was more affected by season than flow, with the higher concentrations for a given
16 flow rate occurring during “first flush events” and lower concentrations occurring during spring
17 snowmelt events. Because of such a relationship, the changes in mean monthly average river flows
18 under the No Action Alternative are not expected to cause river TSS concentrations or turbidity
19 levels (highs, lows, typical conditions) to be outside the ranges occurring under Existing Conditions.
20 Consequently, this alternative is expected to have minimal effect on TSS concentrations and
21 turbidity levels in the reservoirs and rivers upstream of the Delta, relative to Existing Conditions.

22 Changes in land use that would occur relative to Existing Conditions could have minor effects on TSS
23 concentrations and turbidity levels throughout this portion of the affected environment. Site-specific
24 and temporal exceptions may occur due to localized temporary construction activities, dredging
25 activities, development, or other land use changes. These localized actions would generally require
26 agency permits that would regulate and limit both their short-term and long-term effects on TSS
27 concentrations and turbidity levels to less-than-substantial levels.

28 ***Delta***

29 TSS concentrations and turbidity levels in Delta waters are affected by TSS concentrations and
30 turbidity levels of the Delta inflows (and associated sediment load). TSS concentrations and
31 turbidity levels within Delta waters also are affected by fluctuation in flows within the channels due
32 to the tides, with sediments depositing as flow velocities and turbulence are low at periods of slack
33 tide, and sediments becoming suspended when flow velocities and turbulence increase when tides
34 are near the maximum. TSS and turbidity variations can also be attributed to phytoplankton,
35 zooplankton and other biological material in the water.

36 Under the No Action Alternative there would be no project actions implemented within or affecting
37 the Delta region of the affected environment. Any land use changes that may occur under this
38 alternative would not be expected to have permanent, substantial effects on TSS concentrations and
39 turbidity levels of Delta waters, relative to Existing Conditions. Furthermore, this alternative would
40 not cause the TSS concentrations or turbidity levels in the rivers contributing inflows to the Delta to
41 be outside the ranges occurring under Existing Conditions. Consequently, this alternative is
42 expected to have minimal effect on TSS concentrations and turbidity levels in the Delta region,
43 relative to Existing Conditions. As such, any minor TSS and turbidity changes that may occur under

1 the No Action Alternative would not be of sufficient frequency, magnitude, and geographic extent
2 that would result in adverse effects on beneficial uses in the Delta region, or substantially degrade
3 the quality of these water bodies, with regard to TSS and turbidity.

4 ***SWP/CVP Export Service Areas***

5 The No Action Alternative is expected to have minimal effect on TSS concentrations and turbidity
6 levels in Delta waters, including water exported at the south Delta pumps, relative to Existing
7 Conditions. As such, the No Action Alternative is expected to have minimal effect on TSS
8 concentrations and turbidity levels in the SWP/CVP Export Service Areas waters relative to Existing
9 Conditions.

10 The effects on TSS and turbidity from implementing the No Action Alternative is determined to not
11 be adverse.

12 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
13 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
14 purpose of making the CEQA impact determination for this constituent. For additional details on the
15 effects assessment findings that support this CEQA impact determination, see the effects assessment
16 discussion that immediately precedes this conclusion.

17 Changes river flow rate and reservoir storage that would occur under the No Action Alternative,
18 relative to Existing Conditions, would not be expected to result in a substantial adverse change in
19 TSS concentrations and turbidity levels in the reservoirs and rivers upstream of the Delta, given that
20 suspended sediment concentrations are more affected by season than flow. Site-specific and
21 temporal exceptions may occur due to localized temporary construction activities, dredging
22 activities, development, or other land use changes would be site-specific and temporal, which would
23 be regulated to limit both their short-term and long-term effects on TSS and turbidity levels to less
24 than substantial levels.

25 Within the Delta, any land use changes that may occur would not be expected to have permanent,
26 substantial effects on TSS concentrations and turbidity levels. Furthermore, this alternative would
27 not cause the TSS concentrations or turbidity levels in the river contributing inflows to the Delta to
28 be outside the ranges occurring under Existing Conditions. Consequently, this alternative is
29 expected to have minimal effect on TSS concentrations and turbidity levels in the Delta region,
30 relative to Existing Conditions.

31 There is not expected to be substantial, if even measurable, changes in TSS concentrations and
32 turbidity levels in the SWP/CVP Export Service Areas waters under the No Action Alternative,
33 relative to Existing Conditions, because the No Action Alternative is not expected to result in
34 substantial changes in TSS concentrations and turbidity levels in Delta waters, relative to Existing
35 Conditions.

36 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
37 objectives where such objectives are not exceeded under Existing Conditions. Because TSS
38 concentrations and turbidity levels are not expected to be substantially different from Existing
39 Conditions, long-term water quality degradation is not expected, and, thus, beneficial uses are not
40 expected to be adversely affected. Finally, TSS and turbidity are neither bioaccumulative nor Clean
41 Water Act section 303(d) listed constituents. This impact is considered to be less than significant.

1 **Impact WQ-31: Water Quality Effects Resulting from Construction-Related Activities**

2 Under the No Action Alternative, existing facilities and operations would be continued and none of
3 the Conservation Measures 1–22 associated with the BDCP alternatives would be implemented.
4 However, construction activities would occur in the affected environment over time that are not
5 directly associated with the BDCP alternatives (herein termed “non-BDCP” effects). Routine non-
6 BDCP construction activities that may occur for urbanization and infrastructure to accommodate
7 population growth would generally be anticipated to involve relatively dispersed, temporary, and
8 intermittent land disturbances across the affected environment. Major, or more complex, non-BDCP
9 infrastructure construction projects that are identified under the No Action Alternative which may
10 involve substantial construction activities and potential construction-related water quality effects
11 are identified in Appendix 3D, *Defining Existing Conditions, the No Action/No Project Alternative, and*
12 *Cumulative Impact Conditions* and include:

- 13 • Levee rehabilitation projects in the Delta by DWR and local reclamation districts.
- 14 • Suisun Channel (Slough) Operations and Maintenance (shipping channel dredging)
- 15 • Sacramento Deep Water Ship Channel Project (shipping channel dredging).
- 16 • San Joaquin River Restoration Program.
- 17 • Dutch Slough Tidal Marsh Restoration Project.
- 18 • Suisun Marsh restoration activities (tidal marsh restoration)
- 19 • Yolo Bypass Salmonid Habitat Restoration and Fish Passage.

20 Potential construction-related water quality effects associated with non-BDCP activities may include
21 discharges of turbidity/TSS due to the erosion of disturbed soils and associated sedimentation
22 entering surface water bodies or other construction-related wastes (e.g., concrete, asphalt, cleaning
23 agents, paint, and trash). Construction activities also may result in temporary or permanent changes
24 in stormwater generation or drainage and runoff patterns (i.e., velocity, volume, and direction) that
25 may cause or contribute to soil erosion and offsite sedimentation, such as creation of additional
26 impervious surfaces (e.g., pavement, buildings, compacted soils), blockage or restriction of existing
27 drainage channels, or general surface drainage changes from grading and excavation activity.
28 Additionally, the use of heavy earthmoving equipment may result in spills and leakage of oils,
29 gasoline, diesel fuel, and related petroleum contaminants used in the fueling and operation of such
30 construction equipment.

31 Some construction-related contaminants, such as PAHs that may be in some fuel and oil petroleum
32 byproducts, may be bioaccumulative in aquatic and terrestrial organisms. Construction activities
33 also may disturb areas where bioaccumulative constituents are present in the soil (e.g., mercury,
34 selenium, organochlorine pesticides, PCBs, dioxin/furan compounds), or may disturb soils that
35 contain constituents included on the Section 303(d) lists of impaired water bodies in the affected
36 environment. While the 303(d)-listed Delta channels impaired by mercury are widespread,
37 impairment by selenium, pesticides, PCBs, and dioxin/furan compounds is more limited, and there
38 are no 303(d) listings for PAH impairment. Bioaccumulation of constituents in the aquatic
39 foodchain, and 303(d)-related impaired water bodies, arise as a result of long-term loading of a
40 constituent or a pervasive and widespread source of constituent discharge (e.g., mercury). However,
41 as a result of the generally localized disturbances, and intermittent and temporary nature of
42 construction-related activities, construction would not be anticipated to result in contaminant
43 discharges of substantial magnitude or duration to contribute to long-term bioaccumulation

1 processes, or cause measureable long-term degradation such that existing 303(d) impairments
2 would be made discernibly worse or TMDL actions to reduce loading would be adversely affected.

3 It is assumed that non-BDCP construction activities would be regulated, as necessary, under state
4 grading and erosion control regulations, proponent-defined CEQA-NEPA mitigation measures and
5 BMPs, and applicable environmental permits such as the State Water Board's NPDES Stormwater
6 General Permit for Stormwater Discharges Associated with Construction and Land Disturbance
7 Activities (Order No. 2009-0009-DWQ/NPDES Permit No. CAS000002, as amended by Order No.
8 2010-0014-DWQ), project-specific waste discharge requirements (WDRs) or CWA Section 401
9 water quality certification from the appropriate Regional Water Board, CDFW Streambed Alteration
10 Agreements, and USACE CWA Section 404 dredge and fill permits. Consequently, relative to the
11 Existing Conditions, the potential contaminant discharges associated with construction-related
12 activities that may occur under the No Action Alternative would be avoided and minimized upon
13 implementation of BMPs and adherence to permit terms and conditions. Consequently,
14 construction-related activities would not be expected to cause constituent discharges of sufficient
15 magnitude to result in a substantial increased frequency of exceedances of water quality
16 objectives/criteria, or substantially degrade water quality with respect to the constituents of
17 concern, and thus would not adversely affect any beneficial uses in water bodies upstream of the
18 Delta, within the Delta, or in the SWP and CVP service area.

19 **CEQA Conclusion:** BDCP construction-related contaminant discharges under the No Action
20 Alternative would not occur. Other reasonably foreseeable projects that are independent from BDCP
21 would result in construction related impacts that are temporary and intermittent in nature and
22 would involve negligible, if any, discharges of bioaccumulative or 303(d) listed constituents to water
23 bodies of the affected environment. As such, construction activities would therefore not contribute
24 to bioaccumulation of contaminants in organisms or humans or cause 303(d) impairments to be
25 discernibly worse. Relative to Existing Conditions, the construction-related effects of other projects
26 in the Delta would not be expected to cause or contribute to a substantial increased frequency of
27 exceedances of water quality objectives/criteria, or substantially degrade water quality on a long-
28 term average basis with respect to the constituents of concern, and thus would not adversely affect
29 any beneficial uses in water bodies upstream of the Delta, within the Delta, or in the SWP and CVP
30 service area. Based on these findings, this impact is determined to be less than significant.

31 **8.4.3.2 Alternative 1A—Dual Conveyance with Pipeline/Tunnel and** 32 **Intakes 1–5 (15,000 cfs; Operational Scenario A)**

33 Alternative 1A would convey up to 15,000 cfs of water from the north Delta to the south Delta
34 through pipelines/tunnels via five screened intakes on the east bank of the Sacramento River
35 between Clarksburg and Walnut Grove (i.e., Intakes 1 through 5). Intakes 1 through 5 would
36 introduce large, multi-story industrial concrete and steel structures approximately 55 feet in height
37 from river bottom to the top of the structure with a length of 900–1,600 feet depending on the
38 location. A new 600 acre Byron Tract Forebay, adjacent to and south of Clifton Court Forebay, would
39 be constructed which would provide water to the south Delta pumping plants. Construction of a 750
40 acre Intermediate Forebay near Hood is also included in this Alternative.

41 Construction of all structural components under Alternative 1A could potentially occur over a
42 period of 9 or more years, although construction of individual components would occur on shorter
43 time scales (See Appendix 3C). Water supply and conveyance operations would follow the
44 guidelines described as Scenario A, which does not include fall X2. CM1–CM3 would manage the

1 routing, timing, and amount of flow through the Delta. CM4–CM11 would restore, enhance, and
 2 manage physical habitats on a natural community scale. CM11–CM22 are designed to reduce other
 3 stressors on a species scale. See Chapter 3, *Description of Alternatives*, Section 3.5.2, for additional
 4 details on Alternative 1A.

5 **Effects of the Alternative on Delta Hydrodynamics**

6 Under the No Action Alternative and Alternatives 1–9, the following two primary factors can
 7 substantially affect water quality within the Delta:

- 8 • Within the south, west, and interior Delta, a decrease in the percentage of Sacramento River-
 9 sourced water and a concurrent increase in San Joaquin River-sourced water can increase the
 10 concentrations of numerous constituents (e.g., boron, bromide, chloride, electrical conductivity,
 11 nitrate, organic carbon, some pesticides, selenium). This source water replacement is caused by
 12 decreased exports of San Joaquin River water (due to increased Sacramento River water
 13 exports), or effects of climate change on timing of flows in the rivers. Changes in channel flows
 14 also can affect water residence time and many related physical, chemical, and biological
 15 variables.
- 16 • Particularly in the west Delta, sea water intrusion as a result of sea level rise or decreased Delta
 17 outflow can increase the concentration of salts (bromide, chloride) and levels of electrical
 18 conductivity. Conversely, increased Delta outflow (e.g., as a result of Fall X2 operations in wet
 19 and above normal water years) will decrease levels of these constituents, particularly in the
 20 west Delta.

21 Under Alternative 1A, over the long term, average annual delta exports are anticipated to increase
 22 by 312 TAF relative to Existing Conditions, and by 1016 TAF relative to the No Action Alternative.
 23 Since, over the long-term, approximately 50% of the exported water will be from the new north
 24 Delta intakes, average monthly diversions at the south Delta intakes would be decreased because of
 25 the shift in diversions to the north Delta intakes (see Chapter 5, *Water Supply*, for more
 26 information). The result of this is increased San Joaquin River water influence throughout the south,
 27 west, and interior Delta, and a corresponding decrease in Sacramento River water influence. This
 28 can be seen, for example, in Appendix 8D, ALT 1–Old River at Rock Slough for ALL years (1976–
 29 1991), which shows increased SJR percentage and decreased SAC percentage under the alternative,
 30 relative to Existing Conditions and the No Action Alternative.

31 Under Alternative 1A, long-term average annual Delta outflow is anticipated to decrease 323 TAF
 32 relative to Existing Conditions due to both changes in operations (including north Delta intake
 33 capacity of 15,000 cfs and numerous other operational components of Scenario A) and climate
 34 change/sea level rise (see Chapter 5, *Water Supply*, for more information). The result of this is
 35 increased sea water intrusion in the west Delta. The increase of sea water intrusion in the west Delta
 36 under Alternative 1A is greater relative to the No Action alternative because the No Action
 37 alternative includes operations to meet Fall X2, whereas Existing Conditions and Alternative 1A do
 38 not. Long-term average annual Delta outflow is anticipated to decrease under Alternative 1A by
 39 1072 TAF relative to the No Action Alternative, due only to changes in operations. The increases in
 40 sea water intrusion (represented by an increase in BAY percentage) can be seen, for example, in
 41 Appendix 8D, ALT 1A–Sacramento River at Mallard Island for ALL years (1976–1991).

1 **Impact WQ-1: Effects on Ammonia Concentrations Resulting from Facilities Operations and**
 2 **Maintenance (CM1)**

3 ***Upstream of the Delta***

4 For the same reasons stated for the No Action Alternative, Alternative 1A would have negligible, if
 5 any, effect on ammonia concentrations in the rivers and reservoirs upstream of the Delta relative to
 6 Existing Conditions and the No Action Alternative. Any negligible increases in ammonia-N
 7 concentrations that could occur in the water bodies of the affected environment in the Upstream of
 8 the Delta Region would not be of frequency, magnitude, and geographic extent that would adversely
 9 affect any beneficial uses or substantially degrade the quality of these water bodies, with regard to
 10 ammonia.

11 ***Delta***

12 As summarized in Table 8-40, it is assumed that SRWTP effluent ammonia concentrations would be
 13 substantially lower under Alternative 1A than under Existing Conditions, and would be the same as
 14 would occur under the No Action Alternative. Thus, for the same reasons stated for the No Action
 15 Alternative, Alternative 1A would not result in substantial increases in ammonia concentrations in
 16 the Plan Area, relative to Existing Conditions.

17 Because the SRWTP discharge ammonia concentrations are assumed to be the same under
 18 Alternative 1A as would occur under the No Action Alternative, the primary mechanism that could
 19 potentially increase ammonia concentrations in the Delta under Alternative 1A, relative to the No
 20 Action Alternative, is decreased flows in the Sacramento River, which would lower dilution available
 21 to the SRWTP discharge. This change would be attributable only to operations of Alternative 1A,
 22 since the same assumptions regarding water demands, climate change, and sea level rise are
 23 included in both Alternative 1A and the No Action Alternative.

24 **Table 8-64. Estimated Ammonia-N (mg-L as N) Concentrations in the Sacramento River Downstream of**
 25 **the Sacramento Regional Wastewater Treatment Plant for the No Action Alternative and Alternative**
 26 **1A**

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual Average
No Action Alternative	0.074	0.084	0.069	0.060	0.057	0.060	0.058	0.064	0.067	0.060	0.067	0.064	0.065
Alternative 1A	0.068	0.089	0.068	0.060	0.057	0.060	0.058	0.062	0.063	0.065	0.073	0.077	0.067

27
 28 To address this possibility, a simple mixing calculation was performed to assess concentrations of
 29 ammonia downstream of the SRWTP discharge (i.e., downstream of Freeport) under Alternative 1A
 30 and the No Action Alternative. Monthly average CALSIM II flows at Freeport and the upstream
 31 ammonia concentration (0.04 mg/L-N; Central Valley Water Board 2010a:5) were used, together
 32 with the SRWTP permitted average dry weather flow (181 mgd) and seasonal ammonia
 33 concentration (1.5 mg/L-N in Apr-Oct, 2.4 mg/L-N in Nov-Mar), to estimate the average change in
 34 ammonia concentrations downstream of the SRWTP. Table 8-64 shows monthly average and long
 35 term annual average predicted concentrations under the two scenarios.

1 As Table 8-64 shows, estimated ammonia-N concentrations in the Sacramento River downstream of
2 Freeport (upon full mixing of the SRWTP discharge with river water) under Alternative 1A and the
3 No Action Alternative are expected to be similar. Minor increases in ammonia-N concentrations
4 would occur during July through September and in November, and remaining months would be
5 unchanged or have a minor decrease. A minor increase in the annual average concentration would
6 occur under Alternative 1A, compared to the No Action Alternative. Moreover, the estimated
7 concentrations downstream of Freeport under Alternative 1A would be similar to existing source
8 water concentrations for the San Francisco Bay and San Joaquin River. Consequently, changes in
9 source water fraction anticipated under Alternative 1A, relative to the No Action Alternative, would
10 not be expected to substantially increase ammonia concentrations at any Delta locations.

11 Any negligible increases in ammonia-N concentrations that could occur at certain locations in the
12 Delta would not be of frequency, magnitude, and geographic extent that would adversely affect any
13 beneficial uses or substantially degrade the water quality at these locations, with regards to
14 ammonia.

15 ***SWP/CVP Export Service Areas***

16 The assessment of effects on ammonia in the SWP and CVP Export Service Area is based on
17 assessment of ammonia-N concentrations at Banks and Jones pumping plants. The dominant source
18 waters influencing the Banks and Jones pumping plants are the Sacramento and San Joaquin Rivers
19 (see Appendix 8D). As discussed above for the Plan Area, for areas of the Delta that are influenced by
20 Sacramento River water, including Banks and Jones pumping plants, ammonia-N concentrations are
21 expected to decrease under Alternative 1A, relative to Existing Conditions (in association with less
22 diversion of water influenced by the SRWTP). This decrease in ammonia-N concentrations for water
23 exported via the south Delta pumps is not expected to result in an adverse effect on beneficial uses
24 or substantially degrade water quality of exported water, with regards to ammonia.

25 ***NEPA Effects:*** As discussed above for the Plan Area, for all areas of the Delta, including Banks and
26 Jones pumping plants, ammonia-N concentrations would not be expected to substantially differ
27 under Alternative 1A, relative to No Action Alternative. Any negligible increases in ammonia-N
28 concentrations that could occur at Banks and Jones pumping plants would not be of frequency,
29 magnitude, and geographic extent that would adversely affect any beneficial uses or substantially
30 degrade the water quality at these locations, with regards to ammonia. In summary, based on the
31 discussion above, effects on ammonia from implementation of CM1 are considered to be not
32 adverse.

33 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
34 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
35 purpose of making the CEQA impact determination for this constituent. For additional details on the
36 effects assessment findings that support this CEQA impact determination, see the effects assessment
37 discussion that immediately precedes this conclusion.

38 Ammonia-N concentrations are generally low in the reservoirs and rivers of the watersheds, owing
39 to the lack of substantial point and nonpoint sources of ammonia-N upstream of the SRWTP in the
40 Sacramento River watershed, in the watersheds of the eastern tributaries (Cosumnes, Mokelumne,
41 and Calaveras Rivers), or upstream of the Delta in the San Joaquin River watershed. Consequently,
42 any modified reservoir operations and subsequent changes in river flows under Alternative 1A,
43 relative to Existing Conditions, are expected to have negligible, if any, effects on reservoir and river

1 ammonia-N concentrations upstream of Freeport in the Sacramento River watershed and upstream
2 of the Delta in the San Joaquin River watershed.

3 Ammonia-N concentrations in the Sacramento River downstream of the SRWTP would be
4 substantially lower under Alternative 1A, relative to Existing Conditions, due to upgrades to the
5 SRWTP that are assumed to be in place, and thus, ammonia concentrations for all areas of the Delta
6 that are influenced by Sacramento River water are expected to decrease. At locations which are not
7 influenced notably by Sacramento River water, concentrations are expected to remain relatively
8 unchanged, due to the similarity in SJR and BAY concentrations and the lack of expected changes in
9 either of these concentrations.

10 The assessment of effects on ammonia in the SWP/CVP Export Service Areas is based on assessment
11 of ammonia-N concentrations at Banks and Jones pumping plants. As discussed above for the Plan
12 Area, for areas of the Delta that are influenced by Sacramento River water, including Banks and
13 Jones pumping plants, ammonia-N concentrations are expected to decrease under the Alternative
14 1A, relative to Existing Conditions.

15 Based on the above, there would be no substantial, long-term increase in ammonia-N concentrations
16 in the rivers and reservoirs upstream of the Delta, in the Plan Area, or the waters exported to the
17 CVP and SWP service areas under Alternative 1A relative to Existing Conditions. As such, this
18 alternative would not be expected to cause additional exceedance of applicable water quality
19 objectives/criteria by frequency, magnitude, and geographic extent that would cause significant
20 impacts on any beneficial uses of waters in the affected environment. Because ammonia
21 concentrations would not be expected to increase substantially, no long-term water quality
22 degradation would be expected to occur and, thus, no significant impacts on beneficial uses would
23 occur. Ammonia is not 303(d) listed within the affected environment and thus any minor increases
24 that could occur in some areas would not make any existing ammonia-related impairment
25 measurably worse because no such impairments currently exist. Because ammonia-N is not
26 bioaccumulative, minor increases that could occur in some areas would not bioaccumulate to
27 greater levels in aquatic organisms that would, in turn, pose substantial health risks to fish, wildlife,
28 or humans. This impact would be considered less than significant. No mitigation is required.

29 **Impact WQ-2: Effects on Ammonia Concentrations Resulting from Implementation of CM2- 30 CM22**

31 **NEPA Effects:** Some habitat restoration activities would occur on lands in the Delta formerly used
32 for irrigated agriculture. Although this may decrease ammonia loading to the Delta from agriculture,
33 increased biota in those areas as a result of restored habitat may increase ammonia loading
34 originating from flora and fauna. Ammonia loaded from organisms is expected to be converted
35 rapidly to nitrate by established microbial communities. Thus, these land use changes would not be
36 expected to substantially increase ammonia concentrations in the Delta. CM2-CM11 would not
37 substantially increase ammonia concentrations in the water bodies of the affected environment.
38 Additionally, implementation of CM12-CM22 would not be expected to substantially alter ammonia
39 concentrations in the affected environment. The effects of ammonia from implementation of CM2-
40 22 are considered to be not adverse.

41 **CEQA Conclusion:** There would be no substantial, long-term increase in ammonia-N concentrations
42 in the rivers and reservoirs upstream of the Delta, in the Plan Area, or the waters exported to the
43 CVP and SWP service areas due to implementation of CM2-CM22 relative to Existing Conditions. As
44 such, implementation of these conservations measures would not be expected to cause additional

1 exceedance of applicable water quality objectives/criteria by frequency, magnitude, and geographic
 2 extent that would cause significant impacts on any beneficial uses of waters in the affected
 3 environment. Because ammonia concentrations would not be expected to increase substantially
 4 from implementation of these conservation measures, no long-term water quality degradation
 5 would be expected to occur and, thus, no significant impact on beneficial uses would occur.
 6 Ammonia is not 303(d) listed within the affected environment and thus any minor increases that
 7 could occur in some areas would not make any existing ammonia-related impairment measurably
 8 worse because no such impairments currently exist. Because ammonia-N is not bioaccumulative,
 9 minor increases that could occur in some areas would not bioaccumulate to greater levels in aquatic
 10 organisms that would, in turn, pose substantial health risks to fish, wildlife, or humans. This impact
 11 is considered less than significant. No mitigation is required.

12 **Impact WQ-3: Effects on Boron Concentrations Resulting from Facilities Operations and** 13 **Maintenance (CM1)**

14 ***Upstream of the Delta***

15 Under Alternative 1A there would be no expected change to the sources of boron in the Sacramento
 16 and east-side tributary watersheds. Boron loading in these watersheds would remain unchanged
 17 and resultant changes in flows from altered system-wide operations would have negligible, if any,
 18 effects on the concentration of boron in the rivers and reservoirs of these watersheds. Under
 19 Alternative 1A, the modeled long-term annual average flows on the lower San Joaquin River at
 20 Vernalis would decrease by an estimated 6%, relative to Existing Conditions (in association with
 21 changed operations, climate change, and increased water demands), and would remain virtually the
 22 same relative to the No Action Alternative considering only changes associated with Alternative 1A
 23 operations (Appendix 5A). The reduced flow would result in possible increases in long-term average
 24 boron concentrations of about 2%, relative to the Existing Conditions, with no change relative to the
 25 No Action Alternative (Appendix 8F, Table 24). However, the small increases in lower San Joaquin
 26 River boron levels that may occur under Alternative 1A, relative to Existing Conditions would not
 27 result in an increased frequency of exceedances of any applicable objectives or criteria. Moreover,
 28 any negligible change in boron concentration would not be expected to cause further degradation at
 29 measurable levels in the lower San Joaquin River, and thus would not cause the existing impairment
 30 there to be discernibly worse. Consequently, Alternative 1A would not be expected to cause
 31 exceedance of boron objectives/criteria or substantially degrade water quality with respect to
 32 boron, and thus would not adversely affect any beneficial uses of the Sacramento River, the east-side
 33 tributaries, associated reservoirs upstream of the Delta, or the lower San Joaquin River.

34 ***Delta***

35 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 36 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 37 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 38 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 39 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
 40 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

41 Relative to the Existing Conditions and the No Action Alternative, Alternative 1A would result in
 42 similar or reduced long-term average boron concentrations for the 16-year period modeled at
 43 northern and eastern Delta locations (i.e., 14% reduction at North Bay Aqueduct at Barker Slough

1 and 6% reduction at the San Joaquin River at Buckley Cove, compared to Existing Conditions)
2 (Appendix 8F, Table Bo-6). Moreover, the direction and magnitude of predicted changes for
3 Alternative 1A are similar between the alternatives, thus, the effects relative to Existing Conditions
4 and the No Action Alternative are discussed together. The comparison to Existing Conditions reflects
5 changes due to both Alternative 1A operations (including north Delta intake capacity of 15,000 cfs
6 and numerous other operational components of Scenario A) and climate change/sea level rise. The
7 comparison to the No Action Alternative reflects changes due only to operations.

8 The long-term average boron concentrations for the 16-year period modeled would increase at
9 interior and western Delta locations (by as much as 8% at the SF Mokelumne River at Staten Island,
10 13% at Franks Tract, 10% at Old River at Rock Slough, and 9% at the Sacramento River at
11 Emmaton) (Appendix 8F, Table Bo-6). Additionally, implementation of tidal habitat restoration
12 under CM4 would increase the tidal exchange volume in the Delta, and thus may contribute to
13 increased boron concentrations in the Bay source water as a result of increased salinity intrusion.
14 More discussion of the assessment methods for changes in source water concentrations caused by
15 project-related hydrodynamic changes is included in Section 8.3.1.3. While uncertain, the magnitude
16 of boron increases may be greater than indicated herein and would affect the western Delta
17 assessment locations the most (since they are influenced to the greatest extent by the Bay source
18 water), and thus would not be anticipated to substantially affect agricultural use of water because
19 diversions occur primarily at interior Delta locations.

20 The long-term annual average and monthly average boron concentrations, for either the 16-year
21 period or drought period modeled, would never exceed the 2,000 µg/L human health advisory
22 objective (i.e., for children) or 500 µg/L agricultural objective at any of the eleven Delta assessment
23 locations, which represents no change from the Existing Conditions and No Action Alternative
24 conditions (Appendix 8F, Table Bo-3A). Increased boron concentrations would result in minor
25 reductions in the modeled long-term average assimilative capacity with respect to the 2,000 µg/L
26 human health advisory objective. The reductions in long-term average assimilative capacity of up to
27 6% at interior Delta locations (i.e., Franks Tract and Old River at Rock Slough) also would be small
28 with respect to the 500 µg/L agricultural objective (Appendix 8F, Table Bo-7). However, because the
29 absolute boron concentrations would still be well below the lowest 500 µg/L objective for the
30 protection of the agricultural beneficial use under Alternative 1A, the levels of boron degradation
31 would not be of sufficient magnitude to substantially increase the risk of exceeding objectives or
32 cause adverse effects to municipal and agricultural water supply beneficial uses, or any other
33 beneficial uses, in the Delta (Appendix 8F, Figure Bo-2).

34 ***SWP/CVP Export Service Areas***

35 Under Alternative 1A, improvement in long-term average boron concentrations would occur at the
36 Banks and Jones pumping plants as a result of export of a greater proportion of low-boron
37 Sacramento River water. Long-term average boron concentrations for the modeled 16-year
38 hydrologic period at these locations would decrease by as much as 22% at Banks and by as much as
39 18% at Jones relative to Existing Conditions and No Action Alternative (Appendix 8F, Table Bo-6).
40 Commensurate with the decrease in boron concentrations in exported water to the San Joaquin
41 River basin, there could be reduced boron loading and concentrations in the lower San Joaquin River
42 related to irrigation water deliveries from the Delta. While the magnitude of this expected lower San
43 Joaquin River improvement in boron is difficult to predict, the relative decrease in overall loading of
44 boron to the export service area would likely alleviate or lessen any expected increase in boron
45 concentrations at Vernalis associated with flow reductions (see discussion of Upstream of the Delta),

1 as well as locations in the Delta receiving a large fraction of San Joaquin River water, such as much of
2 the south Delta. Reduced export boron concentrations also may contribute to reducing the existing
3 303(d) impairment in the lower San Joaquin River and associated TMDL actions for reducing boron
4 loading.

5 Maintenance of SWP and CVP facilities under Alternative 1A would not be expected to create new
6 sources of boron or contribute towards a substantial change in existing sources of boron in the
7 affected environment. Maintenance activities would not be expected to cause any substantial
8 increases in boron concentrations or degradation with respect to boron such that objectives would
9 be exceeded more frequently, or any beneficial uses would be adversely affected anywhere in the
10 affected environment.

11 **NEPA Effects:** In summary, relative to the No Action Alternative conditions, Alternative 1A would
12 result in relatively small increases in long-term average boron concentrations in the Delta and not
13 appreciably change boron levels in the lower San Joaquin River. However, the predicted changes
14 would not be expected to cause exceedances of applicable objectives or further measurable water
15 quality degradation, and thus would not constitute an adverse effect on water quality.

16 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
17 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
18 purpose of making the CEQA impact determination for this constituent. For additional details on the
19 effects assessment findings that support this CEQA impact determination, see the effects assessment
20 discussion that immediately precedes this conclusion.

21 Boron is not a constituent of concern in the Sacramento River watershed upstream of the Delta, thus
22 river flow rate and reservoir storage reductions that would occur under the Alternative 1A, relative
23 to Existing Conditions, would not be expected to result in a substantial adverse change in boron
24 levels. Additionally, relative to Existing Conditions, Alternative 1A would not result in reductions in
25 river flow rates (i.e., less dilution) or increased boron loading such that there would be any
26 substantial increases in boron concentration upstream of the Delta in the San Joaquin River
27 watershed.

28 Small increased boron levels predicted for interior and western Delta locations (i.e., up to 13%
29 increase) in response to a shift in the Delta source water percentages and tidal habitat restoration
30 under this alternative would not be expected to cause exceedances of objectives, or substantial
31 degradation of these water bodies. Alternative 1A maintenance also would not result in any
32 substantial increases in boron concentrations in the affected environment. Boron concentrations
33 would be reduced in water exported from the Delta to the CVP/SWP Export Service Areas, thus
34 reflecting a potential improvement to boron loading in the lower San Joaquin River.

35 Boron is not a bioaccumulative constituent, thus any increased concentrations under Alternative 1A
36 would not result in adverse boron bioaccumulation effects to aquatic life or humans. Relative to
37 Existing Conditions, Alternative 1A would not result in substantially increased boron concentrations
38 such that frequency of exceedances of municipal and agricultural water supply objectives would
39 increase. The levels of boron degradation that may occur under Alternative 1A would not be of
40 sufficient magnitude to cause substantially increased risk for adverse effects to municipal or
41 agricultural beneficial uses within the affected environment. Long-term average boron
42 concentrations would decrease in Delta water exports to the SWP and CVP service area, which may
43 contribute to reducing the existing 303(d) impairment of agricultural beneficial uses in the lower

1 San Joaquin River. Based on these findings, this impact is determined to be less than significant. No
2 mitigation is required.

3 **Impact WQ-4: Effects on Boron Concentrations Resulting from Implementation of CM2–CM22**

4 **NEPA Effects:** The implementation of the other conservation measures (i.e., CM2–CM22), of which
5 most do not involve land disturbance, present no new direct sources of boron to the affected
6 environment, including areas Upstream of the Delta, within the Plan Area, and the SWP/CVP Export
7 Service Area, nor would they affect channel flows or Delta hydrodynamic conditions. As noted
8 above, the potential effects of implementation of tidal habitat restoration (i.e., CM4) on Delta
9 hydrodynamic conditions is addressed above in the discussion of Impact WQ-3. The potential
10 channel flow effects of CM2 for actions in the Yolo Bypass also were accounted for in the CALSIM II
11 and DSM2 modeling, and thus were addressed in the discussion for Impact WQ-3. Habitat
12 restoration activities in the Delta (i.e., CM4–10), including restored tidal wetlands, floodplain, and
13 related channel margin and off-channel habitats, while involving increased land and water
14 interaction within these habitats, would not be anticipated to contribute boron which is primarily
15 associated with source water inflows to the Delta (i.e., San Joaquin River, agricultural drainage, and
16 Bay source water). Moreover, some habitat restoration conservation measures (CM4–CM10) would
17 occur on lands within the Delta currently used for irrigated agriculture, thus replacing agricultural
18 land uses with restored habitats. The potential reduction in irrigated lands within the Delta may
19 result in reduced discharges of agricultural field drainage with elevated boron concentrations,
20 which would be considered an improvement compared to Existing Conditions. CM3 and CM11
21 provide the mechanism, guidance, and planning for the land acquisition and thus would not,
22 themselves, affect boron levels in the Delta. CM12–CM22 involve actions that target reduction in
23 other stressors at the species level involving actions such as methylmercury reduction management
24 (CM12), improving DO in the Stockton Deep Water Ship Channel (CM14), and urban stormwater
25 treatment (CM19). None of the CM12–CM22 actions would contribute to substantially increasing
26 boron levels in the Delta. Consequently, as they pertain to boron, implementation of CM2–CM22
27 would not be expected to adversely affect any of the beneficial uses of the affected environment.

28 **CEQA Conclusion:** Implementation of the CM2–CM22 for Alternative 1A would not present new or
29 substantially changed sources of boron to the affected environment upstream of the Delta, within
30 Delta, or in the SWP and CVP service area. As such, their implementation would not be expected to
31 substantially increase the frequency with which applicable Basin Plan objectives or other criteria
32 would be exceeded in water bodies of the affected environment located upstream of the Delta,
33 within the Delta, or in the SWP and CVP Service Area or substantially degrade the quality of these
34 water bodies, with regard to boron. Based on these findings, this impact is considered to be less than
35 significant. No mitigation is required.

36 **Impact WQ-5: Effects on Bromide Concentrations Resulting from Facilities Operations and** 37 **Maintenance (CM1)**

38 ***Upstream of the Delta***

39 Under Alternative 1A there would be no expected change to the sources of bromide in the
40 Sacramento River and eastside tributary watersheds. Bromide loading in these watersheds would
41 remain unchanged and resultant changes in flows from altered system-wide operations under
42 Alternative 1A would have negligible, if any, effects on the concentration of bromide in the rivers
43 and reservoirs of these watersheds. Consequently, Alternative 1A would not be expected to

1 adversely affect the MUN beneficial use, or any other beneficial uses, of the Sacramento River, the
2 eastside tributaries, or their associated reservoirs upstream of the Delta.

3 Under Alternative 1A, modeling indicates that long-term annual average flows on the San Joaquin
4 River would decrease by 6% relative to Existing Conditions and would remain virtually the same
5 relative to No Action Alternative (Appendix 5A). These decreases in flow would result in possible
6 increases in long-term average bromide concentrations of about 3%, relative to Existing Conditions
7 and less than <1% relative to the No Action Alternative (Appendix 8E, Bromide Table 22). The small
8 increases in lower San Joaquin River bromide levels that may occur under Alternative 1A, relative to
9 existing and No Action Alternative conditions would not be expected to adversely affect the MUN
10 beneficial use, or any other beneficial uses, of the lower San Joaquin River.

11 **Delta**

12 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
13 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
14 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
15 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
16 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
17 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

18 Using the mass-balance modeling approach for bromide (see Section 8.3.1.3), relative to Existing
19 Conditions, Alternative 1A would result in small decreases in long-term average bromide
20 concentration at most Delta assessment locations, with the exceptions being the North Bay
21 Aqueduct at Barker Slough, Staten Island, and Emmaton on the Sacramento River (Appendix 8E,
22 *Bromide*, Table 4). Overall effects would be greatest at Barker Slough, where predicted long-term
23 average bromide concentrations would increase from 51 µg/L to 71 µg/L (38% relative increase)
24 for the modeled 16-year hydrologic period and would increase from 54 µg/L to 104 µg/L (94%
25 relative increase) for the modeled drought period. At Barker Slough, the predicted 50 µg/L bromide
26 threshold exceedance frequency would increase from 49% under Existing Conditions to 51% under
27 Alternative 1A (55% to 75% during the modeled drought period) and the predicted 100 µg/L
28 exceedance frequency would increase from 0% under Existing Conditions to 22% under Alternative
29 1A (0% to 48% during the modeled drought period). In contrast, increases in bromide at Staten
30 Island would result in a 50 µg/L bromide threshold exceedance increase from 47% under Existing
31 Conditions to 73% under Alternative 1A (52% to 75% during the modeled drought period).
32 However, unlike Barker Slough, modeling shows that the long-term average bromide concentrations
33 at Staten Island would exceed the 100 µg/L assessment threshold concentration 1% under Existing
34 Conditions and 3% under Alternative 1A (0% to 2% during the modeled drought period) (Appendix
35 8E, *Bromide*, Table 4). The long-term average bromide concentrations would be about 61 µg/L (62
36 µg/L during the modeled drought period) at Staten Island under Alternative 1A. Changes in
37 exceedance frequency of the 50 µg/L and 100 µg/L concentration thresholds, as well as relative
38 change in long-term average concentration, at other assessment locations would be less substantial.
39 The comparison to Existing Conditions reflects changes in bromide due to both Alternative 1A
40 operations (including north Delta intake capacity of 15,000 cfs and numerous other operational
41 components of Scenario A) and climate change/sea level rise.

42 In comparison, Alternative 1A relative to the No Action Alternative would result in predicted
43 increases in long-term average bromide concentrations at all locations with the exception of the
44 Banks and Jones pumping plants (Appendix 8E, *Bromide*, Table 4). Increases would be greatest at

1 Barker Slough, where long-term average concentrations are predicted to increase by about 43%
2 (93% for the modeled drought period). Increases in long-term average bromide concentrations
3 would be less than 27% at the remaining assessment locations. Due to the relatively small
4 differences between modeled Existing Conditions and No Action Alternative, changes in the
5 frequency with which concentration thresholds of 50 µg/L and 100 µg/L are exceeded are of similar
6 magnitude to those previously described for the existing condition comparison (Appendix 8E,
7 *Bromide*, Table 4). Unlike the comparison to Existing Conditions, the comparison to the No Action
8 Alternative reflects changes in bromide due only to operations.

9 At Barker Slough, modeled long-term average bromide concentrations for the two baseline
10 conditions are very similar (Appendix 8E, Bromide Table 4-5). Such similarity demonstrates that the
11 modeled Alternative 1A change in bromide is almost entirely due to Alternative 1A operations, and
12 not climate change/sea level rise. Therefore, operations are the primary driver of effects on bromide
13 at Barker Slough, regardless of whether Alternative 1A is compared to Existing Conditions, or
14 compared to the No Action Alternative. Results of the modeling approach, which used relationships
15 between EC and chloride and between chloride and bromide (see Section 8.3.1.3), differed
16 somewhat from what is presented above for the mass-balance approach (see Appendix 8E, *Bromide*,
17 Table 5). For most locations, the frequency of exceedance of the 50 µg/L and 100 µg/L were similar.
18 The greatest difference between the methods was predicted for Barker Slough. The increases in
19 frequency of exceedance of the 100 µg/L threshold, relative to Existing Conditions and the No Action
20 Alternative, were not as great using this alternative EC to chloride and chloride to bromide
21 relationship modeling approach as compared to that presented above from the mass-balance
22 modeling approach. However, there were still substantial increases, resulting in 10% exceedance
23 over the modeled period under Alternative 1A, as compared to 1% under Existing Conditions, and
24 2% under the No Action Alternative. For the drought period, exceedance frequency increased from
25 0% under Existing Conditions and the No Action Alternative, to 22% under Alternative 1A. Because
26 the mass-balance approach predicts a greater level of impact at Barker Slough, determination of
27 impacts was based on the mass-balance results.

28 The increase in long-term average bromide concentrations predicted at Barker Slough, principally
29 the relative increase in the 100 µg/L exceedance frequency, would result in a substantial change in
30 source water quality to existing drinking water treatment plants drawing water from the North Bay
31 Aqueduct. Drinking water treatment plants in this region utilize a variety of conventional and
32 enhanced treatment systems to achieve DBP drinking water criteria. Depending on the necessary
33 disinfection requirements surrounding removal of pathogenic organisms, as well as the aggregate
34 quality of water such as pH and alkalinity, a change in long-term average bromide of the magnitude
35 predicted may necessitate changes in treatment plant operation or treatment plant facilities in order
36 to maintain DBP compliance. For example, for a water treatment plant utilizing ozone to achieve
37 disinfection equivalent to 1 or 2 log inactivation of *Giardia*, an increase in long-term average
38 bromide above 50 µg/L may require pH control systems (California Urban Water Agencies 1998:4-
39 18). For a water treatment plant utilizing chlorine to achieve 1 or 2 log inactivation of *Giardia*, an
40 increased frequency of bromide in excess 100 µg/L may require a switch to ozonation with pH
41 control (California Urban Water Agencies 1998: 4-20). While the implications of such a modeled
42 change in bromide at Barker Slough are difficult to predict, the substantial modeled increases could
43 lead to adverse changes in the formation of disinfection byproducts such that considerable water
44 treatment plant upgrades would be necessary in order to achieve equivalent levels of health
45 protection. This would be an adverse effect. Because many of the other modeled locations already
46 frequently exceed the 100 µg/L threshold under Existing Conditions and the No Action Alternative,

1 these locations likely already require treatment plant technologies to achieve equivalent levels of
2 health protection, and thus no additional treatment technologies would be triggered by the small
3 increases in the frequency of exceeding the 100 µg/L threshold. Hence, no further impact on the
4 drinking water beneficial use would be expected at these locations.

5 The seasonal intakes at Mallard Slough and city of Antioch are infrequently used because of water
6 quality constraints related to sea water intrusion. On a long-term average, bromide at these
7 locations exceeds 3,000 µg/L, but during seasonal periods of high Delta outflow levels can be <300
8 µg/L. Based on modeling using the mass-balance approach, use of the seasonal intakes at Mallard
9 Slough and city of Antioch under Alternative 1A would experience a period average increase in
10 bromide during the months when these intakes would most likely be utilized. For those wet and
11 above normal water year types where mass balance modeling would predict water quality typically
12 suitable for diversion, predicted long-term average bromide would increase from 103 µg/L to 173
13 µg/L (68% increase) at city of Antioch and would increase from 150 µg/L to 204 µg/L (36%
14 increase) at Mallard Slough relative to Existing Conditions (Appendix 8E, *Bromide*, Table 23).
15 Increases would be similar for the No Action Alternative comparison. Modeling results using the EC
16 to chloride and chloride to bromide relationships show increases during these months, but the
17 relative magnitude of the increases is much lower (Appendix 8E, *Bromide* Table 24). Regardless of
18 the differences in the data between the two modeling approaches, the decisions surrounding the use
19 of these seasonal intakes is largely driven by acceptable water quality, and thus have historically
20 been opportunistic. Opportunity to use these intakes would remain, and the predicted increases in
21 bromide concentrations at the city of Antioch and Mallard Slough intake would not be expected to
22 adversely affect MUN beneficial uses, or any other beneficial use, at these locations.

23 ***SWP/CVP Export Service Areas***

24 Under Alternative 1A, improvement in long-term average bromide concentrations would occur at
25 the Banks and Jones pumping plants. Long-term average bromide concentrations for the modeled
26 16-year hydrologic period at these locations would decrease by as much as 37% relative to Existing
27 Conditions and 28% relative to the No Action Alternative. Relative changes in long-term average
28 bromide concentrations would be less during drought conditions ($\leq 31\%$), but would still represent
29 considerable improvement (Appendix 8E, *Bromide* Table 4). As a result, less frequent bromide
30 concentration exceedances of the 50 µg/L and 100 µg/L assessment thresholds would be predicted
31 and an overall improvement in water quality would be experienced respective to bromide in the
32 SWP/CVP Export Service Areas. Commensurate with the decrease in exported bromide, an
33 improvement in lower San Joaquin River bromide would also be observed because bromide in the
34 lower San Joaquin River is principally related to irrigation water deliveries from the Delta. While the
35 magnitude of this expected lower San Joaquin River improvement in bromide is difficult to predict,
36 the relative decrease in overall loading of bromide to the Export Service Areas would likely alleviate
37 or lessen any expected increase in bromide concentrations at Vernalis (see discussion of Upstream
38 of the Delta) as well as locations in the Delta receiving a large fraction of San Joaquin River water,
39 such as much of the south Delta.

40 The discussion above is based on results of the mass-balance modeling approach. Results of the
41 modeling approach which used relationships between EC and chloride and between chloride and
42 bromide (see Section 8.3.1.3) were consistent with the discussion above, and assessment of bromide
43 using these data results in the same conclusions as are presented above for the mass-balance
44 approach (see Appendix 8E, *Bromide*, Table 5).

1 Similar to the discussion pertaining to the No Action Alternative, maintenance of SWP and CVP
2 facilities under Alternative 1A would not be expected to create new sources of bromide or
3 contribute a substantial change in existing sources of bromide in the affected environment.
4 Maintenance activities would not be expected to cause any substantial change in bromide such that
5 MUN beneficial uses, or any other beneficial use, would be adversely affected anywhere in the
6 affected environment.

7 **NEPA Effects:** In summary, Alternative 1A operations and maintenance, relative to the No Action
8 Alternative, would result in small increases (i.e., <1%) in long-term average bromide concentrations
9 at Vernalis related to relatively small declines in long-term average flow on the San Joaquin River.
10 However, Alternative 1A operation and maintenance activities would cause substantial degradation
11 to water quality with respect to bromide at Barker Slough, source of the North Bay Aqueduct.
12 Resultant substantial change in long-term average bromide at Barker Slough could necessitate
13 changes in water treatment plant operations or require treatment plant upgrades in order to
14 maintain DBP compliance, and thus would constitute an adverse effect on water quality. Mitigation
15 Measure WQ-5 is available to reduce these effects (implementation of this measure along with a
16 separate, non-environmental commitment as set forth in EIR/EIS Appendix 3B, *Environmental*
17 *Commitments*, relating to the potential increased treatment costs associated with bromide-related
18 changes would reduce these effects).

19 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
20 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
21 purpose of making the CEQA impact determination for this constituent. For additional details on the
22 effects assessment findings that support this CEQA impact determination, see the effects assessment
23 discussion that immediately precedes this conclusion.

24 Under Alternative 1A there would be no expected change to the sources of bromide in the
25 Sacramento and eastside tributary watersheds. Bromide loading in these watersheds would remain
26 unchanged and resultant changes in flows from altered system-wide operations under Alternative
27 1A would have negligible, if any, effects on the concentration of bromide in the rivers and reservoirs
28 of these watersheds. However, south of the Delta, the San Joaquin River is a substantial source of
29 bromide, primarily due to the use of irrigation water imported from the southern Delta.
30 Concentrations of bromide at Vernalis are inversely correlated to net river flow. Under Alternative
31 1A, long-term average flows at Vernalis would decrease only slightly, resulting in less than
32 substantial predicted increases in long-term average bromide of about 3% relative to Existing
33 Conditions.

34 Relative to Existing Conditions, Alternative 1A would result in small decreases in long-term average
35 bromide concentration at most Delta assessment locations, with principal exceptions being the
36 North Bay Aqueduct at Barker Slough, Staten Island, and Emmaton on the Sacramento River. Overall
37 effects would be greatest at Barker Slough, where substantial increases in long-term average
38 bromide concentrations would be predicted. The increase in long-term average bromide
39 concentrations predicted for Barker Slough would result in a substantial change in source water
40 quality to existing drinking water treatment plants drawing water from the North Bay Aqueduct.
41 These modeled increases in bromide at Barker Slough could lead to adverse changes in the
42 formation of disinfection byproducts at drinking water treatment plants such that considerable
43 water treatment plant upgrades would be necessary in order to achieve equivalent levels of drinking
44 water health protection.

1 The assessment of effects on bromide in the SWP/CVP Export Service Areas is based on assessment
2 of changes in bromide concentrations at Banks and Jones pumping plants. Under Alternative 1A,
3 substantial improvement would occur at the Banks and Jones pumping plants, where predicted
4 long-term average bromide concentrations are predicted to decrease by as much as 37% relative to
5 Existing Conditions. An overall improvement in bromide-related water quality would be predicted
6 in the SWP/CVP Export Service Areas.

7 Based on the above, Alternative 1A operation and maintenance would not result in any substantial
8 change in long-term average bromide concentration upstream of the Delta. Furthermore, under
9 Alternative 1A, water exported from the Delta to the SWP/CVP Export Service Areas would be
10 substantially improved relative to bromide. Bromide is not bioaccumulative, therefore change in
11 long-term average bromide concentrations would not directly cause bioaccumulative problems in
12 aquatic life or humans. Additionally, bromide is not a constituent related to any 303(d) listings.
13 Alternative 1A operation and maintenance activities would not cause substantial degradation to
14 water quality respective to bromide in the Plan Area with the exception of water quality at Barker
15 Slough, source of the North Bay Aqueduct. At Barker Slough, modeled long-term annual average
16 concentrations of bromide would increase by 38%, and 94% during the modeled drought period.
17 For the modeled 16-year hydrologic period the frequency of predicted bromide concentrations
18 exceeding 100 µg/L would increase from 0% under Existing Conditions to 22% under Alternative
19 1A, while for the modeled drought period, the frequency would increase from 0% to 48%.
20 Substantial changes in long-term average bromide could necessitate changes in water treatment
21 plant operation or require treatment plant upgrades in order to maintain DBP compliance. The
22 modeled change at Barker Slough is substantial and, therefore, would represent a substantially
23 increased risk for significant impacts on existing MUN beneficial uses should treatment upgrades
24 not be undertaken. The impact would be significant.

25 Implementation of Mitigation Measure WQ-5 along with a separate, non-environmental
26 commitment relating to the potential increased treatment costs associated with bromide-related
27 changes would reduce these effects. While mitigation measures to reduce these water quality effects
28 in affected water bodies to less than significant levels are not available, implementation of
29 Mitigation Measure WQ-5 is recommended to attempt to reduce the effect that increased bromide
30 concentrations may have on Delta beneficial uses. However, because the effectiveness of this
31 mitigation measure to result in feasible measures for reducing water quality effects is uncertain, this
32 impact is considered to remain significant and unavoidable.

33 In addition to and to supplement Mitigation Measure WQ-5, the BDCP proponents have incorporated
34 into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*, a separate, non-
35 environmental commitment to address the potential increased water treatment costs that could
36 result from bromide-related concentration effects on municipal water purveyor operations.
37 Potential options for making use of this financial commitment include funding or providing other
38 assistance towards implementation of the North Bay Aqueduct Alternative Intake Project (AIP),
39 acquiring alternative water supplies, or other actions to indirectly reduce the effects of elevated
40 bromide and DOC in existing water supply diversion facilities. Please refer to Appendix 3B,
41 *Environmental Commitments*, for the full list of potential actions that could be taken pursuant to this
42 commitment in order to reduce the water quality treatment costs associated with water quality
43 effects relating to chloride, electrical conductivity, and bromide.

1 **Mitigation Measure WQ-5: Avoid, Minimize, or Offset, as Feasible, Adverse Water Quality**
 2 **Conditions**

3 It remains to be determined whether, or to what degree, the available and existing salinity
 4 response and countermeasure actions of SWP and CVP facilities or municipal water purveyors
 5 would be capable of offsetting the actual level of changes in bromide that may occur from
 6 implementation of Alternative 1A. Therefore, to determine the feasibility of reducing the effects
 7 of increased bromide levels, and potential adverse effects on beneficial uses associated with
 8 CM1 operations (and hydrodynamic effects of tidal restoration under CM4), the proposed
 9 mitigation requires a series of phased actions to identify and evaluate existing and possible
 10 feasible actions, followed by development and implementation of the actions, if determined to
 11 be necessary. The development and implementation of any mitigation actions shall be focused
 12 on those incremental effects attributable to implementation of Alternative 1A operations only.
 13 Development of mitigation actions for the incremental bromide effects attributable to climate
 14 change/sea level rise are not required because these changed conditions would occur with or
 15 without implementation of Alternative 1A. The goal of specific actions would be to reduce/avoid
 16 additional degradation of Barker Slough water quality conditions with respect to the CALFED
 17 bromide goal.

18 Following commencement of initial operations of CM1, the BDCP proponents will conduct
 19 additional evaluations described herein, and develop additional modeling (as necessary), to
 20 define the extent to which modified operations could reduce or eliminate the increased bromide
 21 concentrations currently modeled to occur under Alternative 1A. The additional evaluations
 22 should also consider specifically the changes in Delta hydrodynamic conditions associated with
 23 tidal habitat restoration under CM4 (in particular the potential for increased bromide
 24 concentrations that could result from increased tidal exchange) once the specific restoration
 25 locations are identified and designed. If sufficient operational flexibility to offset bromide
 26 increases is not practicable/feasible under Alternative 1A operations, achieving bromide
 27 reduction pursuant to this mitigation measure would not be feasible under this alternative.

28 **Impact WQ-6: Effects on Bromide Concentrations Resulting from Implementation of CM2–**
 29 **CM22**

30 **NEPA Effects:** CM2–CM22 would present no new sources of bromide to the affected environment,
 31 including areas Upstream of the Delta, within the Plan Area, and the SWP/CVP Export Service Areas.
 32 As they pertain to bromide, implementation of these conservation measures would not be expected
 33 to adversely affect MUN beneficial use, or any other beneficial uses, of the affected environment.

34 With exception to habitat restoration areas that would effectively alter Delta hydrodynamics, habitat
 35 restoration and the various land-disturbing conservation measures proposed for Alternative 1A
 36 would not present new or substantially changed sources of bromide to the study area. Modeling
 37 scenarios included assumptions regarding how certain habitat restoration activities would affect
 38 Delta hydrodynamics (CM2 and CM4), and thus such hydrodynamic effects of these restoration
 39 measures were included in the assessment of CM1 facilities operations and maintenance (see Impact
 40 WQ-1).

41 Some habitat restoration activities would occur on lands in the Delta formerly used for irrigated
 42 agriculture. Such replacement or substitution of land use activity would not be expected to result in
 43 new or increased sources of bromide to the Delta. Implementation of CM2–CM11 would not be

1 expected to adversely affect MUN beneficial use, or any other beneficial uses, within the affected
2 environment.

3 In summary, implementation of CM2–CM22 under Alternative 1A, relative to the No Action
4 Alternative, would have negligible, if any, effects on bromide concentrations. The effects on bromide
5 from implementing CM2–CM22 are determined to not be adverse.

6 **CEQA Conclusion:** Implementation of CM2–CM22 under Alternative 1A would not present new or
7 substantially changed sources of bromide to the study area. Some conservation measures may
8 replace or substitute for existing irrigated agriculture in the Delta. This replacement or substitution
9 would not be expected to substantially increase or present new sources of bromide. Implementation
10 of CM2–CM22 would have negligible, if any, effects on bromide concentrations throughout the
11 affected environment, would not cause exceedance of applicable state or federal numeric or
12 narrative water quality objectives/criteria because none exist for bromide, and would not cause
13 changes in bromide concentrations that would result in significant impacts on any beneficial uses
14 within affected water bodies. Implementation of CM2–CM22 would not cause significant long-term
15 water quality degradation such that there would be greater risk of significant impacts on beneficial
16 uses, would not cause greater bioaccumulation of bromide, and would not further impair any
17 beneficial uses due to bromide concentrations because no uses are currently impaired due to
18 bromide levels. This impact is therefore considered less than significant. No mitigation is required.

19 **Impact WQ-7: Effects on Chloride Concentrations Resulting from Facilities Operations and** 20 **Maintenance (CM1)**

21 ***Upstream of the Delta***

22 Under Alternative 1A there would be no expected change to the sources of chloride in the
23 Sacramento and eastside tributary watersheds. Chloride loading in these watersheds would remain
24 unchanged and resultant changes in flows from altered system-wide operations would have
25 negligible, if any, effects on the concentration of chloride in the rivers and reservoirs of these
26 watersheds. Under Alternative 1A, the modeled long-term annual average flows on the lower San
27 Joaquin River at Vernalis would decrease by an estimated 6%, relative to Existing Conditions in
28 association with climate change and increased water demands, and would remain virtually the same
29 relative to No Action Alternative (Appendix 5A). The reduced flow would result in possible increases
30 in long-term average chloride concentrations of about 2%, relative to the Existing Conditions, and
31 no change relative to No Action Alternative (Appendix 8G, Table Cl-62). However, the small
32 increases in lower San Joaquin River chloride levels that could occur under Alternative 1A, relative
33 to Existing Conditions would not result in an increased frequency of exceedances of any applicable
34 objectives or criteria. Consequently, Alternative 1A would not be expected to cause exceedance of
35 chloride objectives/criteria or substantially degrade water quality with respect to chloride, and thus
36 would not adversely affect any beneficial uses of the Sacramento River, the eastside tributaries,
37 associated reservoirs upstream of the Delta, or the San Joaquin River.

38 ***Delta***

39 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
40 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
41 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
42 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of

1 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
2 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

3 Relative to Existing Conditions, modeling predicts that Alternative 1A would result in decreased
4 long-term average chloride concentration at some assessment locations for the 16-year period
5 modeled (i.e., 1976–1991), in particular at interior and south Delta assessment locations (i.e., San
6 Joaquin River at Buckley Cove, Franks Tract, and Old River at Rock Slough) (Appendix 8G, *Chloride*,
7 Table CI-7 and Table CI-8) Long-term average chloride concentrations would remain relatively
8 unchanged at the San Joaquin River at Antioch and Contra Costa Canal at Pumping Plant #1
9 locations, and, depending on modeling approach (see Section 8.3.1.3), would increase at the
10 Sacramento River at Emmaton (i.e., $\leq 18\%$), Sacramento River at Mallard Island (i.e., $\leq 6\%$), North
11 Bay Aqueduct at Barker Slough (i.e., $\leq 32\%$), and San Joaquin River at Staten Island (i.e., $\leq 21\%$).
12 Additionally, implementation of tidal habitat restoration under CM4 would increase the tidal
13 exchange volume in the Delta, and thus may contribute to increased chloride concentrations in the
14 Bay source water as a result of increased salinity intrusion. More discussion of this the assessment
15 methods for changes in source water concentrations caused by project-related hydrodynamic
16 changes is included in Section 8.3.1.3. Consequently, while uncertain, the magnitude of chloride
17 increases may be greater than indicated herein and would have the greatest effect on the western
18 Delta assessment locations which are influenced to the greatest extent by the Bay source water. The
19 comparison to Existing Conditions reflects changes in chloride due to both Alternative 1A operations
20 (including north Delta intake capacity of 15,000 cfs and numerous other operational components of
21 Scenario A) and climate change/sea level rise.

22 Relative to the No Action Alternative conditions, the mass balance analysis of modeling results
23 indicated that Alternative 1A would result in increased long-term average chloride concentrations
24 for the 16-year period modeled at nine of the Delta assessment locations (Appendix 8G, Table CI-7).
25 The increases in long-term average chloride concentrations would be largest compared to the No
26 Action Alternative condition, ranging from 2% at the San Joaquin River at Buckley Cove to 36% at
27 the North Bay Aqueduct at Barker Slough. The comparison to the No Action Alternative reflects
28 chloride changes due only to operations.

29 The following discussion outlines the modeled chloride changes relative to Existing Conditions and
30 the No Action Alternative regarding the applicable objectives and beneficial uses of Delta waters.

31 *Municipal and Industrial Beneficial Uses—Relative to Existing Conditions*

32 Estimates of chloride concentrations generated using EC-chloride relationships and DSM2 EC output
33 (see Section 8.3.1.3) were used to evaluate the 150 mg/L Bay-Delta WQCP objective for municipal
34 and industrial beneficial uses on a basis of the percent of years the chloride objective is exceeded for
35 the modeled 16-year period. The objective is exceeded if chloride concentrations exceed 150 mg/L
36 for a specified number of days in a given water year at both the Antioch and Contra Costa Pumping
37 Plant #1 locations. For Alternative 1A, the modeled frequency of objective exceedance would
38 approximately double from 6% of modeled years under Existing Conditions, to 13% of modeled
39 years under Alternative 1A (Appendix 8G, Table CI-64).

40 Similarly, estimates of chloride concentrations generated using EC-chloride relationships and DSM2
41 EC output (see Section 8.3.1.3) were also used to evaluate the 250 mg/L Bay-Delta WQCP objective
42 for chloride at Contra Costa Pumping Plant #1 where daily average objectives apply. The basis for
43 the evaluation was the predicted number of days the objective was exceeded for the modeled 16-
44 year period. For Alternative 1A, the modeled frequency of objective exceedance would decrease by

1 approximately one half, from 6% of modeled days under Existing Conditions, to 3% of modeled days
2 under Alternative 1A (Appendix 8G, Table CI-63). Given the limitations inherent to estimating future
3 chloride concentrations (see Section 8.3.1.3), estimation of chloride concentrations through both a
4 mass balance approach and an EC-chloride relationship approach was used to evaluate the 250
5 mg/L Bay-Delta WQCP objectives in terms of both frequency of exceedance and use of assimilative
6 capacity. When utilizing the mass balance approach to model monthly average chloride
7 concentrations for the 16-year period, the predicted frequency of exceeding the 250 mg/L objective
8 would increase at the San Joaquin River at Antioch location from 66% under Existing Conditions to
9 74%, and would increase by 2% at the Sacramento River at Mallard Island location (i.e., from 85%
10 under Existing Conditions to 87%) (Appendix 8G, Table CI-9). The increased chloride concentrations
11 at the Antioch and Mallard Slough locations would occur during the months of January through June,
12 thus reducing water quality during the period of seasonal freshwater diversions (Appendix 8G,
13 Figure CI-1). The available assimilative capacity would decrease substantially at the Antioch location
14 in the months of March and April (i.e., maximum reduction of 66% for the 16-year period modeled,
15 and 100% reduction, or elimination of assimilative capacity, during the drought period modeled)
16 (Appendix 8G, Table CI-9). Similar to modeling results that predicted daily exceedance frequency,
17 the frequency of monthly average exceedances at the Contra Costa Canal at Pumping Plant #1 would
18 decrease (Appendix 8G, Table CI-9); however, available assimilative capacity would be reduced
19 compared to the Existing Conditions up to 100% in October (i.e., eliminated) (Appendix 8G, Table CI-
20 11). Additional long-term degradation at the Antioch and Contra Costa Canal at Pumping Plant #1
21 locations would occur when chloride concentrations would be near, or exceed, the objectives, thus
22 increasing the risk of exceeding objectives.

23 In comparison, when utilizing the chloride-EC relationship to model monthly average chloride
24 concentrations for the 16-year period, trends in frequency of exceedance and use of assimilative
25 capacity would be similar to that discussed when utilizing the mass balance modeling approach
26 (Appendix 8G, Table CI-10 and Table CI-12). However, the predicted magnitude change at western
27 Delta locations are substantially different when the predictions from both modeling approaches are
28 compared. For example, both modeling approaches indicated that the frequency of exceeding the
29 250 mg/L objective at Contra Costa Canal at Pumping Plant #1 on a monthly average basis would
30 decrease relative to Existing Conditions, but their predictions of the magnitude use of assimilative
31 capacity varied substantially. Modeling using the mass balance approach predicted that 100% of
32 assimilative capacity would be utilized in October, but modeling using the chloride-EC relationship
33 approach predicted that only 20% of assimilative capacity would be utilized. As discussed in Section
34 8.3.1.3, in cases of such disagreement, the approach that yielded the more conservative predictions
35 was used as the basis for determining adverse impacts.

36 Based on the additional predicted seasonal and annual exceedances of one or both Bay Delta WQCP
37 objectives for chloride, and the associated long-term water quality degradation and use of
38 assimilative capacity, the potential exists for adverse effects on the municipal and industrial
39 beneficial uses in the western Delta, particularly at the Contra Costa Pumping Plant #1 and Antioch
40 locations.

41 *303(d) Listed Water Bodies—Relative to Existing Conditions*

42 With respect to the 303(d) listing for chloride in Tom Paine Slough, the monthly average chloride
43 concentrations for the 16-year period modeled at Old River at Tracy Road would generally be
44 similar or lower compared to Existing Conditions, and thus, would not be further degraded on a
45 long-term basis (Appendix 8G, Figure CI-2). With respect to Suisun Marsh, the long-term average

1 chloride concentration at the Sacramento River at Mallard Island for the 16-year period modeled
2 would increase by 91 mg/L (4%) compared to Existing Conditions (Appendix 8G, Table CI-7) and
3 chloride concentrations would increase in some months during October through May at Mallard
4 Island (Appendix 8G, Figure CI-1) and in the Sacramento River at Collinsville (Appendix 8G, Figure
5 CI-3). Monthly average chloride concentrations at the Montezuma Slough at Beldon's Landing would
6 increase substantially compared to Existing Conditions in October through May, with over a
7 doubling of concentrations in December through February (Appendix 8G, Figure CI-4). Therefore,
8 additional, measurable long-term degradation would occur in Suisun Marsh that potentially would
9 adversely affect the necessary actions to reduce chloride loading for any TMDL that is developed.

10 *Municipal Beneficial Uses—Relative to No Action Alternative*

11 Similar to the assessment conducted for Existing Conditions, estimates of chloride concentrations
12 generated using EC-chloride relationships and DSM2 EC output (see Section 8.3.1.3) were used to
13 evaluate the 150 mg/L Bay-Delta WQCP objective for municipal and industrial beneficial uses. For
14 Alternative 1A, the modeled frequency of objective exceedance would increase by 6% under the No
15 Action Alternative to 13% of years under Alternative 1A (Appendix 8G, Table CI-64).

16 Similarly, estimates of chloride concentrations generated using EC-chloride relationships and DSM2
17 EC output (see Section 8.3.1.3) were also used to evaluate the 250 mg/L Bay-Delta WQCP objective
18 for chloride at Contra Costa Pumping Plant #1 where daily average objectives apply. For Alternative
19 1A, the modeled frequency of objective exceedance would decrease from 5% of modeled days under
20 the No Action Alternative to 3% of modeled days under Alternative 1A (Appendix 8G, Table CI-63).

21 Similar to Existing Conditions, a comparative assessment of modeling approaches was utilized to
22 evaluate the 250 mg/L Bay-Delta WQCP objectives in terms of both frequency of exceedance and use
23 of assimilative capacity on a monthly average basis. When utilizing the mass balance approach to
24 model monthly average chloride concentrations for the 16-year period, the exceedance frequency of
25 the 250 mg/L objective is predicted relative to the No Action Alternative would increase slightly by
26 1% at the Antioch location (i.e., from 73% to 74%), by 7% at the Contra Costa Canal at Pumping
27 Plant #1 (i.e., from 14% to 21%), and by 1% at Mallard Island (i.e., from 86% to 87%) (Appendix 8G,
28 Table CI-9). The available assimilative capacity for the 16-year period modeled would be reduced at
29 the Antioch location during the months of February and March by approximately 28% and 44%,
30 respectively, compared to the No Action Alternative (Appendix 8G, Table CI-11). The available
31 assimilative capacity would be reduced at the Contra Costa Canal at Pumping Plant #1 in September
32 through April compared to the No Action Alternative (i.e., reduction ranging from 18% in January up
33 to 100%, or eliminated, in October), reflecting substantial degradation during the months October
34 through December when average concentrations would be near, or exceed, the objective.

35 In comparison, when utilizing the chloride-EC relationship to model monthly average chloride
36 concentrations for the 16-year period, trends in frequency of exceedance and use of assimilative
37 capacity would be similar to that discussed when utilizing the mass balance modeling approach
38 (Appendix 8G, Table CI-10 and Table CI-12). But like the assessment relative to Existing Conditions,
39 the predicted magnitude change at western Delta locations are substantially different. For example,
40 both modeling approaches indicated that the frequency of exceeding the 250 mg/L objective at
41 Contra Costa Pumping Plant #1 on a monthly average basis would increase slightly or remain
42 unchanged relative to the No Action Alternative. Modeling using the mass balance approach
43 predicted that 100% of assimilative capacity would be utilized in October, but modeling using the
44 chloride-EC relationship approach predicted that only 35% would be utilized under the No Action

1 Alternative. As discussed in Section 8.3.1.3, in cases of such disagreement, the approach that yielded
2 the more conservative predictions was used as the basis for determining adverse impacts.

3 Based on the additional predicted seasonal and annual exceedances of one of both Bay Delta WQCP
4 objectives for chloride, and the associated long-term water quality degradation, the potential exists
5 for adverse effects on the municipal and industrial beneficial uses in the western Delta, particularly
6 at the Antioch intake, through reduced opportunity for diversion of water with acceptable chloride
7 levels.

8 *303(d) Listed Water Bodies—Relative to No Action Alternative*

9 With respect to the 303(d) listing for chloride, relative to the No Action Alternative, monthly average
10 chloride concentrations near Tom Paine Slough for the 16-year period modeled would not be
11 further degraded under Alternative 1A (Appendix 8G, Figure Cl-2); however, concentrations at
12 source water channel locations for the Suisun Marsh would increase in some months during October
13 through May compared to the No Action Alternative (Appendix 8G, Figures Cl-1, Cl-3 and Cl-4).
14 Therefore, additional, measurable long-term degradation would occur in Suisun Marsh that
15 potentially would adversely affect the necessary actions to reduce chloride loading for any TMDL
16 that is developed.

17 **SWP/CVP Export Service Areas**

18 Under Alternative 1A, long-term average chloride concentrations based on the mass balance
19 analysis of modeling results for the 16-year period modeled at the Banks and Jones pumping plants
20 would decrease by as much as 32% relative to Existing Conditions and 20% compared to No Action
21 Alternative (Appendix 8G, *Chloride*, Table Cl-7). The modeled frequency of exceedances of applicable
22 water quality objectives/criteria would decrease relative to Existing Conditions and No Action
23 Alternative, for both the 16-year period and the drought period modeled (Appendix 8G, *Chloride*,
24 Table Cl-9). Consequently, water exported to the SWP/CVP service area would generally be of
25 similar or better quality with regard to chloride relative to Existing Conditions and the No Action
26 Alternative conditions.

27 Results of the modeling approach which used relationships between EC and chloride (see Section
28 8.3.1.3) were consistent with the discussion above, and assessment of chloride using these data
29 results in the same conclusions as are presented above for the mass-balance approach (Appendix
30 8G, Table Cl-8 and Table Cl-10).

31 Commensurate with the decrease in chloride concentrations exported to the San Joaquin Valley for
32 agricultural irrigation, an improvement in lower San Joaquin River chloride would also be
33 anticipated to occur because chloride loading from agricultural drainage would be reduced. While
34 difficult to predict, the relative decrease in overall loading of chloride to the SWP/CVP Export
35 Service Areas would likely alleviate or lessen any expected increase in chloride at Vernalis related to
36 decreased annual average San Joaquin River flows (see discussion of Upstream of the Delta).

37 Maintenance of SWP and CVP facilities would not be expected to create new sources of chloride or
38 contribute a substantial change in existing sources of chloride in the affected environment.
39 Maintenance activities would not be expected to cause any substantial change in chloride such that
40 any long-term water quality degradation would occur, thus, beneficial uses would not be adversely
41 affected.

1 **NEPA Effects:** In summary, relative to the No Action Alternative, Alternative 1A would result in
2 increased water quality degradation and frequency of exceedance of the 150 mg/L objective at
3 Contra Costa Pumping Plant #1 and Antioch, the 250 mg/L municipal and industrial objective at
4 interior and western Delta locations on a monthly average chloride basis, and measureable water
5 quality degradation relative to the 303(d) impairment in Suisun Marsh. The predicted chloride
6 increases constitute an adverse effect on water quality (see Mitigation Measure WQ-7 below;
7 implementation of this measure along with a separate, non-environmental commitment relating to
8 the potential increased chloride treatment costs would reduce these effects). Additionally, the
9 predicted changes relative to the No Action Alternative indicate that implementation of CM1 and
10 CM4 under Alternative 1A would contribute substantially to the adverse water quality effects (i.e.,
11 impacts are not wholly attributable to the effects of climate change/sea level rise).

12 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
13 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
14 purpose of making the CEQA impact determination for this constituent. For additional details on the
15 effects assessment findings that support this CEQA impact determination, see the effects assessment
16 discussion that immediately precedes this conclusion.

17 Chloride is not a constituent of concern in the Sacramento River watershed upstream of the Delta,
18 thus river flow rate and reservoir storage reductions that would occur under the Alternative 1A,
19 relative to Existing Conditions, would not be expected to result in a substantial adverse change in
20 chloride levels. Additionally, relative to Existing Conditions, the Alternative 1A would not result in
21 reductions in river flow rates (i.e., less dilution) or increased chloride loading such that there would
22 be any substantial increase in chloride concentrations upstream of the Delta in the San Joaquin River
23 watershed.

24 Relative to Existing Conditions, Alternative 1A would result in substantially increased chloride
25 concentrations in the Delta such that frequency of exceedances of the 150 mg/L Bay-Delta WQCP
26 objective would approximately double. Moreover, the frequency of exceedance of the 250 mg/L Bay-
27 Delta WQCP objective would increase at Antioch (by 8%) and at Mallard Slough (by 2%) which
28 could result in significant impacts on the municipal and industrial water supply beneficial use at
29 these locations (see Mitigation Measure WQ-7 below; implementation of this measure along with a
30 separate, non-environmental commitment relating to the potential increased chloride treatment
31 costs would reduce these effects). Additionally, further long-term degradation would occur at
32 Antioch, Mallard Slough, and Contra Costa Canal at Pumping Plant #1 locations when chloride
33 concentrations would be near, or exceed, the objectives, thus increasing the risk of exceeding
34 objectives. Relative to the Existing Conditions, the modeled increased chloride concentrations and
35 degradation in the western Delta could further contribute, at measurable levels (i.e., over a doubling
36 of concentrations) to the existing 303(d) listed impairment due to chloride in Suisun Marsh for the
37 protection of fish and wildlife.

38 Chloride concentrations would be reduced in water exported from the Delta to the CVP/SWP Export
39 Service Areas, thus reflecting a potential improvement to chloride loading in the lower San Joaquin
40 River.

41 Chloride is not a bioaccumulative constituent, thus any increased concentrations under Alternative
42 1A would not result in substantial chloride bioaccumulation impacts on aquatic life or humans.
43 Alternative 1A maintenance would not result in any substantial changes in chloride concentration
44 upstream of the Delta or in the SWP/CVP Export Service Areas. However, based on these findings,

1 this impact would be significant due to increased chloride concentrations and degradation at
 2 western Delta locations and its impacts on municipal and industrial water supply and fish and
 3 wildlife beneficial uses.

4 While mitigation measures to reduce these water quality effects in affected water bodies to less than
 5 significant levels are not available, implementation of Mitigation Measure WQ-7 is recommended to
 6 attempt to reduce the effect that increased chloride concentrations may have on Delta beneficial
 7 uses. However, because the effectiveness of this mitigation measure to result in feasible measures
 8 for reducing water quality effects is uncertain, this impact is considered to remain significant and
 9 unavoidable.

10 In addition to and to supplement Mitigation Measure WQ-7, the BDCP proponents have incorporated
 11 into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*, a separate, non-
 12 environmental commitment to address the potential increased water treatment costs that could
 13 result from chloride concentration effects on municipal, industrial and agricultural water purveyor
 14 operations. Potential options for making use of this financial commitment include funding or
 15 providing other assistance towards acquiring alternative water supplies or towards modifying
 16 existing operations when chloride concentrations at a particular location reduce opportunities to
 17 operate existing water supply diversion facilities. Please refer to Appendix 3B, *Environmental*
 18 *Commitments*, for the full list of potential actions that could be taken pursuant to this commitment in
 19 order to reduce the water quality treatment costs associated with water quality effects relating to
 20 chloride, electrical conductivity, and bromide.

21 **Mitigation Measure WQ-7: Following Initial Operations of CM1, Conduct Additional**
 22 **Evaluation and Modeling of Chloride Levels to Determine Feasibility of Mitigation to**
 23 **Reduce Chloride Levels**

24 It is currently unknown whether the effects of increased chloride levels, and potential adverse
 25 effects on municipal and industrial water supply and fish and wildlife beneficial uses associated
 26 with CM1 operations (and hydrodynamic effects of tidal restoration under CM4), can be
 27 mitigated through modifications to initial operations. Specifically, it remains to be determined
 28 whether, or to what degree, the available and existing salinity response and countermeasure
 29 actions of SWP and CVP facilities, municipal water purveyors, or Suisun Marsh salinity control
 30 facilities would be capable of offsetting the actual level of changes in chloride that may occur
 31 from implementation of Alternative 1A. Therefore, the proposed mitigation measures require a
 32 series of actions to identify and evaluate potentially feasible actions, to achieve reduced chloride
 33 levels in order to reduce or avoid impacts to beneficial uses.

34 The development and implementation of any mitigation actions shall be focused on those
 35 incremental effects attributable to implementation of Alternative 1A operations only.
 36 Development of mitigation actions for the incremental chloride effects attributable to climate
 37 change/sea level rise are not required because these changed conditions would occur with or
 38 without implementation of Alternative 1A.

39 **Mitigation Measure WQ-7a: Conduct Additional Evaluation and Modeling of Increased**
 40 **Chloride Levels Following Initial Operations of CM1**

41 Following commencement of initial operations of CM1, the BDCP proponents will conduct
 42 additional evaluations described herein, and develop additional modeling (as necessary), to
 43 define the extent to which modified operations could reduce or eliminate the additional

1 exceedances of the 250 mg/L Bay-Delta WQCP objective for chloride currently modeled to occur
 2 under Alternative 1A. The additional evaluations should also consider specifically the changes in
 3 Delta hydrodynamic conditions associated with tidal habitat restoration under CM4 (in
 4 particular the potential for increased chloride concentrations that could result from increased
 5 tidal exchange) once the specific restoration locations are identified and designed. If sufficient
 6 operational flexibility to offset chloride increases is not feasible under Alternative 1A
 7 operations, achieving chloride reduction pursuant to this mitigation measure would not be
 8 feasible under this Alternative.

9 **Mitigation Measure WQ-7b: Consult with Delta Water Purveyors to Identify Means to**
 10 **Avoid, Minimize, or Offset for Reduced Seasonal Availability of Water That Meets**
 11 **Applicable Water Quality Objectives**

12 To determine the feasibility of reducing the effects of CM1/CM4 operations on increased
 13 chloride concentrations as shown in modeling estimates to occur to municipal and industrial
 14 water purveyors at the Antioch, Mallard Slough, and Contra Costa Canal at Pumping Plant #1
 15 locations, the BDCP proponents will consult with the purveyors to identify any feasible
 16 operational means to either avoid, minimize, or offset for reduced seasonal availability of water
 17 that meets applicable water quality objectives and that results in levels of degradation that do
 18 not substantially increase the risk of adversely affecting the municipal and industrial beneficial
 19 use. Any such action will be developed following, and in conjunction with, the completion of the
 20 evaluation and development of any potentially feasible actions described in Mitigation Measure
 21 WQ-7a.

22 **Mitigation Measure WQ-7c: Consult with CDFW/USFWS, and Suisun Marsh Stakeholders,**
 23 **to Identify Potential Actions to Avoid or Minimize Chloride Level Increases in the Marsh**

24 To determine the feasibility of reducing the effects of CM1/CM4 operations on increased
 25 chloride concentrations as shown in modeling estimates to occur in the Suisun Marsh, the BDCP
 26 proponents will consult with CDFW/USFWS, and Suisun Marsh stakeholders, to identify
 27 potential actions to avoid or minimize the chloride level increases in the marsh, with the goal of
 28 maintaining chloride at levels that would not further impair fish and wildlife beneficial uses in
 29 Suisun Marsh. Potential actions may include modifications of the existing Suisun Marsh Salinity
 30 Control Gates for effective salinity control and evaluation of the efficacy of additional physical
 31 salinity control facilities or operations for the marsh to reduce the effects of increased chloride
 32 levels. Based on the modeled conditions, the emphasis would be identification of potentially
 33 feasible actions to reduce adverse chloride-related effects during the seasonal period of January
 34 through May. Any such action will be developed following, and in conjunction with, the
 35 completion of the evaluation and development of any feasible actions described in Mitigation
 36 Measure WQ-7a.

37 **Impact WQ-8: Effects on Chloride Concentrations Resulting from Implementation of CM2–**
 38 **CM22**

39 **NEPA Effects:** The implementation of the other conservation measures (i.e., CM2–CM22), of which
 40 most do not involve land disturbance, present no new direct sources of chloride to the affected
 41 environment, including areas Upstream of the Delta, within the Plan Area, and the SWP/ CVP Export
 42 Service Area, nor would they affect channel flows or Delta hydrodynamic conditions. As noted
 43 above, the potential effects of implementation of tidal habitat restoration (i.e., CM4) on Delta

1 hydrodynamic conditions is addressed above in the discussion of Impact WQ-8. The potential
2 channel flow effects of CM2 for actions in the Yolo Bypass also were accounted for in the CALSIM II
3 and DSM2 modeling, and thus were addressed in the discussion for Impact WQ-8. CM3 and CM11
4 provide the mechanism, guidance, and planning for the land acquisition and thus would not,
5 themselves, affect chloride levels in the Delta. CM12–CM22 involve actions that target reduction in
6 other stressors at the species level involving actions such as methylmercury reduction management
7 (CM12), improving DO in the Stockton Deep Water Ship Channel (CM14), and urban stormwater
8 treatment (CM19). None of CM12–CM22 would contribute to substantially increasing chloride levels
9 in the Delta. Consequently, as they pertain to chloride, implementation of CM2–CM22 would not be
10 expected to adversely affect any of the beneficial uses of the affected environment. Moreover, some
11 habitat restoration conservation measures (CM4–CM10) would occur on lands within the Delta
12 currently used for irrigated agriculture, thus replacing agricultural land uses with restored tidal
13 wetlands, floodplain, and related channel margin and off-channel habitats. The potential reduction
14 in irrigated lands within the Delta may result in reduced discharges of agricultural field drainage
15 with elevated chloride concentrations, which would be considered an improvement compared to
16 Existing Conditions.

17 **CEQA Conclusion:** Implementation of the CM2–CM22 for Alternative 1A would not present new or
18 substantially changed sources of chloride to the affected environment upstream of the Delta, within
19 Delta, or in the SWP/CVP service area. Replacement of irrigated agricultural land uses in the Delta
20 with habitat restoration conservation measures may result in some reduction in discharge of
21 agricultural field drainage with elevated chloride concentrations, thus resulting in improved water
22 quality conditions. Based on these findings, this impact is considered to be less than significant. No
23 mitigation is required.

24 **Impact WQ-9: Effects on Dissolved Oxygen Resulting from Facilities Operations and** 25 **Maintenance (CM1)**

26 ***Upstream of the Delta***

27 For the same reasons stated for the No Action Alternative, Alternative 1A would not result in
28 substantial decreases in DO levels in the rivers and reservoirs upstream of the Delta relative to
29 Existing Conditions and the No Action Alternative. Any minor decreases in DO levels that could
30 occur under Alternative 1A would not be of sufficient frequency, magnitude, and geographic extent
31 to result in adverse effects on beneficial uses within the Upstream of the Delta Region, or
32 substantially degrade the quality of these water bodies, with regard to DO.

33 ***Delta***

34 For the same reasons stated for the No Action Alternative, Alternative 1A would not result in
35 substantial decreases in DO levels in the Delta relative to Existing Conditions and the No Action
36 Alternative. Any minor decreases in DO levels that could occur under Alternative 1A would not be of
37 sufficient frequency, magnitude, and geographic extent to result in adverse effects on beneficial uses
38 in the Plan Area, or substantially degrade the quality of these water bodies, with regard to DO.

39 ***SWP/CVP Export Service Areas***

40 The water delivered to the SWP/CVP Export Service Areas would differ from that under Existing
41 Conditions as it would consist of water directly withdrawn from the Delta at the current export
42 pumps and water diverted from the Sacramento River at Hood. DO levels in the vicinity of the south

1 Delta export pumps may be reduced occasionally, but would not be anticipated to be substantially
2 lower at this location on a long-term basis, relative to Existing Conditions. The DO levels in water
3 entering the canals from the new facilities that diverted the water from the Sacramento River at
4 Hood would be expected to be equal to or higher than DO levels at the south Delta export pumps,
5 and would be expected to have similar or lower levels of oxygen demanding substances. Hence, the
6 typical DO level of water entering the SWP/CVP Export Service Areas waters would not be expected
7 to be substantially lower than that under Existing Conditions. DO dynamics within the exposed
8 canals and the downstream reservoirs would remain similar to that under Existing Conditions.
9 Consequently, effects on DO levels in the SWP/CVP Export Service Areas would not be adverse
10 under Alternative 1A relative to Existing Conditions.

11 **NEPA Effects:** For the same reasons given above, substantial adverse effects on DO levels in the
12 SWP/CVP Export Service Areas are not expected to occur under Alternative 1A relative to the No
13 Action Alternative. The effects on dissolved oxygen from implementing CM1 is determined to not be
14 adverse.

15 **CEQA Conclusion:** Effects of CM1 on DO under Alternative 1A would be similar to those discussed
16 for the No Action Alternative, and are summarized here, then compared to the CEQA thresholds of
17 significance (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for
18 this constituent. For additional details on the effects assessment findings that support this CEQA
19 impact determination, see the effects assessment discussion under the No Action Alternative.

20 River flow rate and reservoir storage reductions that would occur under Alternative 1A, relative to
21 Existing Conditions, would not be expected to result in a substantial adverse change in DO levels in
22 the reservoirs and rivers upstream of the Delta, given that mean monthly flows would remain within
23 the ranges historically seen under Existing Conditions and the affected river are large and turbulent.
24 Any reduced DO saturation level that may be caused by increased water temperature would not be
25 expected to cause DO levels to be outside of the range seen historically. Finally, amounts of oxygen
26 demanding substances and salinity would not be expected to change sufficiently to affect DO levels.

27 It is expected there would be no substantial change in Delta DO levels in response to a shift in the
28 Delta source water percentages under this alternative or substantial degradation of these water
29 bodies, with regard to DO. DO levels would be affected by nutrient loading, which the state has
30 begun to aggressively regulate the discharges of, and this loading would not be expected to lower DO
31 levels relative to Existing Conditions based on historical DO levels. Further, the anticipated changes
32 in salinity would have relatively minor effects on DO levels, and tidal exchange, which contribute to
33 the reaeration of Delta waters would not be expected to change substantially.

34 There is not expected to be substantial, if even measurable, changes in DO levels in the SWP/CVP
35 Export Service Areas waters under Alternative 1A, relative to Existing Conditions, because the
36 biochemical oxygen demand of the exported water would not be expected to substantially differ
37 from that under Existing Conditions (due to ever increasing water quality regulations), canal
38 turbulence and exposure of the water to the atmosphere and the algal communities that exist within
39 the canals would establish an equilibrium for DO levels within the canals. The same would occur in
40 downstream reservoirs.

41 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
42 objectives by frequency, magnitude, and geographic extent that would result in significant impacts
43 on any beneficial uses within affected water bodies. Because no substantial changes in DO levels are
44 expected, long-term water quality degradation would not be expected to occur, and, thus, beneficial

1 uses would not be adversely affected. Various Delta waterways are 303(d)-listed for low DO, but
2 because no substantial decreases in DO levels would be expected, greater degradation and DO-
3 related impairment of these areas would not be expected. This impact would be less than significant.
4 No mitigation is required.

5 **Impact WQ-10: Effects on Dissolved Oxygen Resulting from Implementation of CM2–CM22**

6 **NEPA Effects:** CM2–CM22 would not be expected to contribute to adverse DO levels in the Delta. The
7 increased habitat provided by CM2–CM11 could contribute to an increased biochemical or sediment
8 demand, through contribution of organic carbon and the action of plants decaying. However, similar
9 habitat exists currently in the Delta and is not identified as contributing to adverse DO conditions.
10 Although additional DOC loading to the Delta may occur (see impact WQ-18), only a fraction of the
11 DOC is available to microorganisms that would consume oxygen as part of the decay and
12 mineralization process. Since decreases in dissolved organic carbon are not typically observed in
13 Delta waterways due to these processes, any increase in DOC is unlikely to contribute to adverse DO
14 levels in the Delta. CM14, an oxygen aeration facility in the Stockton Deep Water Ship Channel to
15 meet TMDL objectives established by the Central Valley Water Board, would maintain DO levels
16 above those that impair fish species when covered species are present. CM19, which would fund
17 projects to contribute to reducing pollutant discharges in stormwater, would be expected to reduce
18 biochemical oxygen demand load and, thus, would not adversely affect DO levels. The remaining
19 conservation measures would not be expected to affect DO levels because they are actions that do
20 not affect the presence of oxygen-demanding substances. The effects on dissolved oxygen from
21 implementing CM2–CM22 is determined to not be adverse.

22 **CEQA Conclusion:** It is expected that DO levels in the Upstream of the Delta Region, in the Plan Area,
23 or in the SWP/CVP Export Service Areas following implementation of CM2–CM22 under Alternative
24 1A would not be substantially different from existing DO conditions. Therefore, this alternative is
25 not expected to cause additional exceedance of applicable water quality objectives by frequency,
26 magnitude, and geographic extent that would result in significant impacts on any beneficial uses
27 within affected water bodies. Because no substantial changes in DO levels would be expected, long-
28 term water quality degradation would not be expected, and, thus, beneficial uses would not be
29 adversely affected. Various Delta waterways are 303(d)-listed for low DO, but because no
30 substantial decreases in DO levels would be expected, greater degradation and impairment of these
31 areas would not be expected. Implementation of CM14 would have a net beneficial effect on DO
32 conditions in the Stockton Deep Water Ship Channel. This impact would be less than significant. No
33 mitigation is required.

34 **Impact WQ-11: Effects on Electrical Conductivity Concentrations Resulting from Facilities** 35 **Operations and Maintenance (CM1)**

36 ***Upstream of the Delta***

37 For the same reasons stated for the No Action Alternative, EC levels (highs, lows, typical conditions)
38 in the Sacramento River and its tributaries, the eastside tributaries, their associated reservoirs, and
39 the San Joaquin River upstream of the Delta under Alternative 1A are not expected to be outside the
40 ranges occurring under Existing Conditions or would occur under the No Action Alternative. Any
41 minor changes in EC levels that may occur under Alternative 1A in water bodies upstream of the
42 Delta would not be of sufficient magnitude, frequency and geographic extent that would cause
43 adverse effects on beneficial uses or substantially degrade water quality with regard to EC.

Delta

Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2 and CM4) would affect Delta hydrodynamics. To the extent that restoration actions alter hydrodynamics within the Delta region, which affects mixing of source waters, these effects are included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

Relative to Existing Conditions, Alternative 1A would result in a fewer number of days when Bay-Delta WQCP compliance locations in the western, interior, and southern Delta would exceed EC objectives or be out of compliance with the EC objectives, with the exception of the Sacramento River at Emmaton in the western Delta, the San Joaquin River at San Andreas Landing in the interior Delta, and Brandt Bridge in the southern Delta (Appendix 8H, Table EC-1). The percent of days the Emmaton EC objective would be exceeded for the entire period modeled (1976–1991) would increase from 6% under Existing Conditions to 27% under Alternative 1A. Further, the percent of days out of compliance at Emmaton would increase from 11% under Existing Conditions to 39% under Alternative 1A. The percent of days the San Andreas Landing EC objective would be exceeded would increase from 1% under Existing Conditions to 2% under Alternative 1A. Further, the percent of days out of compliance with the EC objective would increase from 1% under Existing Conditions to 5% under Alternative 1A. At Brandt Bridge, the increase in days of EC objective exceedance and days out of compliance would be <1%. Average EC levels at the western and southern Delta compliance locations, except at Emmaton in the western Delta, would decrease from 1–27% for the entire period modeled and 2–28% during the drought period modeled (1987–1991) (Appendix 8H, Table EC-12). At Emmaton, average EC would increase 16% for both the entire period modeled and the drought period modeled. Also, at the two interior Delta compliance locations, there would be increases in average EC: the S. Fork Mokelumne River at Terminous average EC would increase 4% for the entire period modeled and 3% during the drought period modeled; and San Joaquin River at San Andreas Landing average EC would increase 12% for the entire and drought periods modeled. On average, EC would increase at Emmaton during all months except October and November. Average EC would increase at San Andreas Landing during all months except November. Average EC in the S. Fork Mokelumne River at Terminous would increase during all months (Appendix 8H, Table EC-12). Of the Clean Water Act section 303(d) listed sections of the Delta—western, northwestern, and southern—the Sacramento River at Emmaton would have a modest increase in exceedance of the Bay-Delta WQCP EC objectives (21%) and the San Joaquin River at Brandt Bridge in the southern Delta would have a slight increase (<1%) in the exceedance of the Bay-Delta WQCP EC objectives (Appendix 8H, Table EC-1). Further, long-term average EC at Emmaton would increase by 16%, whereas the long-term average EC at the San Joaquin River would decrease by 2%, relative to Existing Conditions, for the entire period modeled (Appendix 8H, Table EC-12). Thus, Alternative 1A is not expected to contribute to additional impairment and adversely affect beneficial uses for section 303(d) listed southern Delta waterways, relative to Existing Conditions. However, the increase in incidence of exceedance of EC objectives and increases in long-term and drought period average EC at Emmaton in the western Delta, relative to Existing Conditions, has the potential to contribute to additional impairment and potentially adversely affect beneficial uses. The comparison to Existing Conditions reflects changes in EC due to both Alternative 1A operations (including north Delta intake capacity of 15,000 cfs and numerous other operational components of Scenario A) and climate change/sea level rise.

1 Relative to the No Action Alternative, the percent of days exceeding EC objectives and percent of
2 days out of compliance would increase at: Sacramento River at Emmaton, San Joaquin River at
3 Jersey Point, San Andreas Landing, Brandt Bridge, and Prisoners Point; and Old River near Middle
4 River at Tracy Bridge (Appendix 8H, Table EC-1). The increase in percent of days exceeding the EC
5 objective would be 2% or less and the increase in percent of days out of compliance would be 4% or
6 less, with the exception of Emmaton, which would have a 15% increase in percent of days exceeding
7 the EC objective and 17% increase in percent of days out of compliance. Average EC would increase
8 at some compliance locations for the entire period modeled: Sacramento River at Emmaton (15%),
9 San Joaquin River at Jersey Point (3%), S. Fork Mokelumne River at Terminous (5%), San Joaquin
10 River at San Andreas Landing (18%), and San Joaquin River at Prisoners Point (9%) (Appendix 8H,
11 Table EC-12). For the drought period modeled, the locations with an average EC increase would be:
12 Sacramento River at Emmaton (5%), S. Fork Mokelumne River at Terminous (4%), San Joaquin
13 River at San Andreas Landing (13%), San Joaquin River at Brandt Bridge (1%), Old River at Tracy
14 Bridge (1%), and San Joaquin River at Prisoners Point (4%) (Appendix 8H, Table EC-12). Given that
15 the western and southern Delta are Clean Water Act section 303(d) listed as impaired due to
16 elevated EC, the increase in the incidence of exceedance of EC objectives and increases in long-term
17 and drought period average EC at the western and southern Delta locations under Alternative 1A,
18 relative to the No Action Alternative, has the potential to contribute to additional impairment and
19 potentially adversely affect beneficial uses. The comparison to the No Action Alternative reflects
20 changes in EC due only to Alternative 1A operations (including north Delta intake capacity of 15,000
21 cfs and numerous other operational components of Scenario A).

22 For Suisun Marsh, October–May is the period when Bay-Delta WQCP EC objectives for protection of
23 fish and wildlife apply. Average EC for the entire period modeled would increase under Alternative
24 1A, relative to Existing Conditions, during the months of February through May by 0.1–0.8 mS/cm in
25 the Sacramento River at Collinsville (Appendix 8H, Table EC-21). Long-term average EC would
26 decrease relative to Existing Conditions in Montezuma Slough at National Steel during October–May
27 (Appendix 8H, Table EC-22). The most substantial increase would occur near Beldon Landing, with
28 long-term average EC levels increasing by 1.8–6.1 mS/cm, depending on the month, which would be
29 a doubling or tripling of long-term average EC relative to Existing Conditions (Appendix 8H, Table
30 EC-23). Sunrise Duck Club and Volanti Slough also would have long-term average EC increases
31 during all months of 1.9–4.0 mS/cm (Appendix 8H, Tables EC-24 and EC-25). The degree to which
32 the long-term average EC increases would cause exceedance of Bay-Delta WQCP objectives is
33 unknown, because objectives are expressed as a monthly average of daily high tide EC, which does
34 not have to be met if it can be demonstrated “equivalent or better protection will be provided at the
35 location” (State Water Resources Control Board 2006:14). The described long-term average EC
36 increase may, or may not, contribute to adverse effects on beneficial uses, depending on how and
37 when wetlands are flooded, soil leaching cycles, and how agricultural use of water is managed, and
38 future actions taken with respect to the marsh. However, the EC increases at certain locations would
39 be substantial and it is uncertain the degree to which current management plans for the Suisun
40 Marsh would be able to address these substantially higher EC levels and protect beneficial uses.
41 Thus, these increased EC levels in Suisun Marsh are considered to have a potentially adverse effect
42 on marsh beneficial uses. Long-term average EC increases in Suisun Marsh under Alternative 1A
43 relative to the No Action Alternative would be similar to the increases relative to Existing
44 Conditions. Suisun Marsh is Clean Water Act section 303(d) listed as impaired due to elevated EC,
45 and the potential increases in long-term average EC concentrations could contribute to additional
46 impairment, because the increases would be double or triple that relative to Existing Conditions and
47 the No Action Alternative.

1 **SWP/CVP Export Service Areas**

2 At the Banks and Jones pumping plants, Alternative 1A would result in no exceedances of the Bay-Delta WQCP's 1,000 $\mu\text{mhos/cm}$ EC objective for the entire period modeled (Appendix 8H, Table EC-10). Thus, there would be no adverse effect on the beneficial uses in the SWP/CVP Export Service Areas using water pumped at this location under Alternative 1A.

6 At the Banks pumping plant, relative to Existing Conditions, average EC levels under Alternative 1A would decrease 22% for the entire period modeled and 18% during the drought period modeled. Relative to the No Action Alternative, average EC levels would decrease by 16% for the entire period modeled and 13% during the drought period modeled. (Appendix 8H, Table EC-12)

10 At the Jones pumping plant, relative to Existing Conditions, average EC levels under Alternative 1A would decrease 19% for the entire period modeled and 17% during the drought period modeled. Relative to the No Action Alternative, average EC levels would decrease by 15% for the entire period modeled and 13% during the drought period modeled. (Appendix 8H, Table EC-12)

14 Based on the decreases in long-term average EC levels that would occur at the Banks and Jones pumping plants, Alternative 1A would not cause degradation of water quality with respect to EC in the SWP/CVP Export Service Areas; rather, Alternative 1A would improve long-term average EC conditions in the SWP/CVP Export Service Areas.

18 Commensurate with the EC decrease in exported waters, an improvement in lower San Joaquin River average EC levels would be expected since EC in the lower San Joaquin River is, in part, related to irrigation water deliveries from the Delta. While the magnitude of this expected lower San Joaquin River improvement in EC is difficult to predict, the relative decrease in overall loading of EC-elevating constituents to the Export Service Areas would likely alleviate or lessen any expected increase in EC at Vernalis related to decreased annual average San Joaquin River flows (see EC impact discussion under the No Action Alternative).

25 The export area of the Delta is listed on the state's CWA Section 303(d) list as impaired due to elevated EC. Alternative 1A would result in lower average EC levels relative to Existing Conditions and the No Action Alternative and, thus, would not contribute to additional beneficial use impairment related to elevated EC in the SWP/CVP Export Service Areas waters.

29 **NEPA Effects:** In summary, the increased frequency of exceedance of EC objectives and increased long-term and drought period average EC levels that would occur at western and southern Delta compliance locations under Alternative 1A, relative to the No Action Alternative, would contribute to adverse effects on the agricultural beneficial uses. Given that the western and southern Delta are Clean Water Act section 303(d) listed as impaired due to elevated EC, the increase in the incidence of exceedance of EC objectives and increases in long-term and drought period average EC in the western and southern Delta under Alternative 1A has the potential to contribute to additional beneficial use impairment. The increases in long-term average EC levels that would occur in Suisun Marsh would further degrade existing EC levels and could contribute additionally to adverse effects on the fish and wildlife beneficial uses. Suisun Marsh is section 303(d) listed as impaired due to elevated EC, and the potential increases in long-term average EC levels could contribute to additional beneficial use impairment. These increases in EC constitute an adverse effect on water quality. Mitigation Measure WQ-11 would be available to reduce these effects (implementation of this measure along with a separate, non-environmental commitment as set forth in EIR/EIS

1 Appendix 3B, *Environmental Commitments*, relating to the potential EC-related changes would
2 reduce these effects).

3 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
4 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
5 purpose of making the CEQA impact determination for this constituent. For additional details on the
6 effects assessment findings that support this CEQA impact determination, see the effects assessment
7 discussion that immediately precedes this conclusion.

8 River flow rate and reservoir storage reductions that would occur under Alternative 1A, relative to
9 Existing Conditions, would not be expected to result in a substantial adverse change in EC levels in
10 the reservoirs and rivers upstream of the Delta, given that: changes in the quality of watershed
11 runoff and reservoir inflows would not be expected to occur in the future; the state's aggressive
12 regulation of point-source discharge effects on Delta salinity-elevating parameters and the expected
13 further regulation as salt management plans are developed; the salt-related TMDLs adopted and
14 being developed for the San Joaquin River; and the expected improvement in lower San Joaquin
15 River average EC levels commensurate with the lower EC of the irrigation water deliveries from the
16 Delta.

17 Relative to Existing Conditions, Alternative 1A would not result in any substantial increases in long-
18 term average EC levels in the SWP/CVP Export Service Areas. There would be no exceedance of the
19 EC objective at the Jones and Banks pumping plants. Average EC levels for the entire period modeled
20 would decrease at both plants and, thus, this alternative would not contribute to additional
21 beneficial use impairment related to elevated EC in the SWP/CVP Export Service Areas waters.
22 Rather, this alternative would improve long-term EC levels in the SWP/CVP Export Service Areas,
23 relative to Existing Conditions.

24 In the Plan Area, Alternative 1A would result in an increase in the frequency with which Bay-Delta
25 WQCP EC objectives for agricultural beneficial use protection are exceeded in the San Joaquin River
26 at San Andreas Landing (1%; interior Delta) and Sacramento River at Emmaton (21%; western
27 Delta) for the entire period modeled (1976–1991). Further, for the entire and drought periods
28 modeled, average EC levels would increase by 12% at San Andreas Landing and by 16% at
29 Emmaton. Because EC is not bioaccumulative, the increases in long-term average EC levels would
30 not directly cause bioaccumulative problems in aquatic life or humans. The interior Delta is not
31 Clean Water Act section 303(d) listed for elevated EC, however, the western Delta is. The increases
32 in long-term and drought period average EC levels and increased frequency of exceedance of EC
33 objectives that would occur in the San Joaquin River at San Andreas Landing and in the Sacramento
34 River at Emmaton would potentially contribute to adverse effects on the agricultural beneficial uses
35 in the interior and western Delta. This impact is considered to be significant.

36 Further, relative to Existing Conditions, Alternative 1A would result in substantial increases in long-
37 term average EC during the months of October through May in Suisun Marsh, such that EC levels at
38 would be up to double or triple that occurring under Existing Conditions. The increases in long-term
39 average EC levels that would occur in Suisun Marsh would further degrade existing EC levels and
40 could contribute additionally to adverse effects on the fish and wildlife beneficial uses. Because EC is
41 not bioaccumulative, the increases in long-term average EC levels would not directly cause
42 bioaccumulative problems in wildlife. Suisun Marsh is Clean Water Act section 303(d) listed for
43 elevated EC and the increases in long-term average EC that would occur in the marsh could make
44 beneficial use impairment measurably worse. This impact is considered to be significant.

1 Implementation of Mitigation Measure WQ-11 along with a separate, non-environmental
2 commitment relating to the potential increased costs associated with EC-related changes would
3 reduce these effects. While mitigation measures to reduce these water quality effects in affected
4 water bodies to less than significant levels are not available, implementation of Mitigation Measure
5 WQ-11 is recommended to attempt to reduce the effect that increased EC concentrations may have
6 on Delta beneficial uses. However, because the effectiveness of this mitigation measure to result in
7 feasible measures for reducing water quality effects is uncertain, this impact is considered to remain
8 significant and unavoidable.

9 In addition to and to supplement Mitigation Measure WQ-11, the BDCP proponents have
10 incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*, a
11 separate, non-environmental commitment to address the potential increased water treatment costs
12 that could result from EC concentration effects on municipal, industrial and agricultural water
13 purveyor operations. Potential options for making use of this financial commitment include funding
14 or providing other assistance towards acquiring alternative water supplies or towards modifying
15 existing operations when EC concentrations at a particular location reduce opportunities to operate
16 existing water supply diversion facilities. Please refer to Appendix 3B, *Environmental Commitments*,
17 for the full list of potential actions that could be taken pursuant to this commitment in order to
18 reduce the water quality treatment costs associated with water quality effects relating to chloride,
19 electrical conductivity, and bromide.

20 **Mitigation Measure WQ-11: Avoid, Minimize, or Offset, as Feasible, Reduced Water** 21 **Quality Conditions**

22 It remains to be determined whether, or to what degree, the available and existing salinity
23 response and countermeasure actions of SWP and CVP facilities, municipal water purveyors, or
24 Suisun Marsh salinity control facilities would be capable of offsetting the actual level of changes
25 in EC that may occur from implementation of Alternative 1A. Therefore, to determine the
26 feasibility of reducing the effects of increased EC levels, and potential adverse effects on
27 beneficial uses associated with CM1 operations (and hydrodynamic effects of tidal restoration
28 under CM4), the proposed mitigation requires a series of phased actions to identify and evaluate
29 existing and possible feasible actions, followed by development and implementation of the
30 actions, if determined to be necessary. The phased actions for reducing EC levels and associated
31 adverse effects on agricultural water supply also could mitigate adverse effects on fish and
32 wildlife life. The emphasis and mitigation actions would be limited to those identified as
33 necessary to avoid, reduce, or offset adverse EC effects at Delta compliance locations and the
34 Suisun Marsh. The development and implementation of any mitigation actions shall be focused
35 on those incremental effects attributable to implementation of Alternative 1A operations only.
36 Development of mitigation actions for the incremental EC effects attributable to climate
37 change/sea level rise are not required because these changed conditions would occur with or
38 without implementation of Alternative 1A. The goal of specific actions would be to reduce/avoid
39 additional exceedances of Delta EC objectives and reduce long-term average concentration
40 increases to levels that would not adversely affect beneficial uses within the Delta and Suisun
41 Marsh.

1 **Mitigation Measure WQ-11a: Conduct Additional Evaluation and Modeling of Increased EC**
2 **Levels Following Initial Operations of CM1**

3 Following commencement of initial operations of CM1, the BDCP proponents will conduct
4 additional evaluations described herein, and develop additional modeling (as necessary), to
5 define the extent to which modified operations could reduce or eliminate the additional
6 exceedances of the Bay-Delta WQCP objectives for EC currently modeled to occur under
7 Alternative 1A. The additional evaluations should also consider specifically the changes in Delta
8 hydrodynamic conditions associated with tidal habitat restoration under CM4 (in particular the
9 potential for increased EC concentrations that could result from increased tidal exchange) once
10 the specific restoration locations are identified and designed. If sufficient operational flexibility
11 to offset EC increases is not feasible under Alternative 1A operations, achieving EC reduction
12 pursuant to this mitigation measure would not be feasible under this Alternative.

13 **Mitigation Measure WQ-11b: Consult with CDFW/USFWS, and Suisun Marsh Stakeholders,**
14 **to Identify Potential Actions to Avoid or Minimize EC Level Increases in the Marsh**

15 To determine the feasibility of reducing the effects of CM1/CM4 operations on increased EC
16 concentrations as shown in modeling estimates to occur in the Suisun Marsh, the BDCP
17 proponents will consult with CDFW/USFWS, and Suisun Marsh stakeholders, to identify
18 potential actions to avoid or minimize the EC increases in the marsh, with the goal of
19 maintaining EC at levels that would not further impair fish and wildlife beneficial uses in Suisun
20 Marsh. Potential actions may include modifications of the existing Suisun Marsh Salinity Control
21 Gates for effective salinity control and evaluation of the efficacy of additional physical salinity
22 control facilities or operations for the marsh to reduce the effects of increased EC levels. Based
23 on the modeled conditions, the emphasis would be identification of potentially feasible actions
24 to reduce adverse EC-related effects. Any such action will be developed following, and in
25 conjunction with, the completion of the evaluation and development of any feasible actions
26 described in Mitigation Measure WQ-11a.

27 **Impact WQ-12: Effects on Electrical Conductivity Resulting from Implementation of CM2–**
28 **CM22**

29 **NEPA Effects:** The implementation of the other conservation measures (i.e., CM2–CM22) present no
30 new direct sources of EC to the affected environment, including areas upstream of the Delta, within
31 the Delta region, and in the SWP/CVP Export Service Areas. As they pertain to EC, implementation of
32 these conservation measures would not be expected to adversely affect any of the beneficial uses of
33 the affected environment. Moreover, some habitat restoration conservation measures would occur
34 on lands within the Delta currently used for irrigated agriculture. Such replacement or substitution
35 of land use activity is not expected to result in new or increased sources of EC to the Delta and, in
36 fact, could decrease EC through elimination of high EC agricultural runoff.

37 CM4 would result in substantial tidal habitat restoration that would increase the magnitude of daily
38 tidal water exchange at the restoration areas, and alter other hydrodynamic conditions in adjacent
39 Delta channels. The DSM2 modeling included assumptions regarding possible locations of tidal
40 habitat restoration areas, and how restoration would affect Delta hydrodynamic conditions, and
41 thus the effects of this restoration measure on Delta EC were included in the assessment of CM1
42 facilities operations and maintenance.

1 Implementation of CM2–CM22 would not be expected to adversely affect EC levels in the affected
 2 environment and thus would not adversely affect beneficial uses or substantially degrade water
 3 quality with regard to EC within the affected environment. The effects on EC from implementing
 4 CM2–CM22 is determined to not be adverse.

5 **CEQA Conclusion:** Implementation of CM2–CM22 under Alternative 1A would not present new or
 6 substantially changed sources of EC to the affected environment. Some conservation measures may
 7 replace or substitute for existing irrigated agriculture in the Delta. This replacement or substitution
 8 is not expected to substantially increase or present new sources of EC, and could actually decrease
 9 EC loads to Delta waters. Thus, implementation of CM2–CM22 would have negligible, if any, adverse
 10 effects on EC levels throughout the affected environment and would not cause exceedance of
 11 applicable state or federal numeric or narrative water quality objectives/criteria that would result
 12 in adverse effects on any beneficial uses within affected water bodies. Further, implementation of
 13 CM2–CM22 would not cause significant long-term water quality degradation such that there would
 14 be greater risk of adverse effects on beneficial uses. Based on these findings, this impact is
 15 considered to be less than significant. No mitigation is required.

16 **Impact WQ-13: Effects on Mercury Concentrations Resulting from Facilities Operations and** 17 **Maintenance (CM1)**

18 ***Upstream of the Delta***

19 Under Alternative 1A, the magnitude and timing of reservoir releases and river flows upstream of
 20 the Delta in the Sacramento River watershed and east-side tributaries would be altered, relative to
 21 Existing Conditions and the No Action Alternative.

22 The Sacramento River at Freeport and San Joaquin River at Vernalis (as summarized for water
 23 quality average concentrations in Tables 8-48 and 8-49) were examined for flow/concentration
 24 relationships for mercury and methylmercury. No significant, predictive regression relationships
 25 were discovered for mercury or methylmercury, except for total mercury with flow at Freeport
 26 (monthly or annual)(Figures I-10 through I-13, Appendix 8I). Such a positive relationship between
 27 total mercury and flow is to be expected based on the association of mercury with suspended
 28 sediment and the mobilization of sediments during storm flows. However, the changes in flow in the
 29 Sacramento River under Alternative 1A relative to Existing Conditions and the No Action Alternative
 30 are not of the magnitude of storm flows, in which substantial sediment-associated mercury is
 31 mobilized. Therefore mercury loading should not be substantially different due to changes in flow.
 32 In addition, even though it may be flow-affected, total mercury concentrations remain well below
 33 criteria at upstream locations. Any negligible changes in mercury concentrations that may occur in
 34 the water bodies of the affected environment located upstream of the Delta would not be of
 35 frequency, magnitude, and geographic extent that would adversely affect any beneficial uses or
 36 substantially degrade the quality of these water bodies as related to mercury. Both waterborne
 37 methylmercury concentrations and largemouth bass fillet mercury concentrations are expected to
 38 remain above guidance levels at upstream of Delta locations, but will not change substantially
 39 relative to Existing Conditions or the No Action Alternative due to changes in flows under
 40 Alternative 1A.

41 The upstream of Delta areas in the north will benefit from the implementation of the Cache Creek,
 42 Sulfur Creek, Harley Gulch, and Clear Lake Mercury TMDLs and the American River methylmercury
 43 TMDL. These projects will target specific sources of mercury and methylation upstream of the Delta

1 and could result in net improvement to Delta mercury loading in the future. The implementation of
2 these projects could help to ensure that upstream of Delta environments will not be substantially
3 degraded for water quality with respect to mercury or methylmercury.

4 ***Delta***

5 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
6 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
7 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
8 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
9 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
10 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

11 The water quality impacts of waterborne concentrations of mercury and methylmercury and fish
12 tissue mercury concentrations were evaluated for 9 Delta locations. The analysis of percentage
13 change in assimilative capacity of waterborne total mercury relative to the 25 ng/L ecological risk
14 benchmark of Alternative 1A showed the greatest decrease to be 1% at Franks Tract and Old River
15 relative to Existing Conditions, and 1.1% at Franks Tract relative to the No Action Alternative
16 (Figures 8-53 and 8-54). These changes are not expected to result in adverse effects to beneficial
17 uses. Similarly, changes in methylmercury concentration were very small. The greatest annual
18 average methylmercury concentration for drought conditions was 0.167 ng/L for the San Joaquin
19 River at Buckley Cove, which was slightly higher than Existing Conditions and the same as the No
20 Action Alternative (Appendix 8I, Table I-6). All modeled input concentrations exceeded the
21 methylmercury TMDL guidance objective of 0.06 ng/L, therefore percentage change in assimilative
22 capacity was not evaluated for methylmercury.

23 Fish tissue estimates show only small or no increases in exceedance quotients based on long-term
24 annual average concentrations for mercury at the Delta locations. The greatest increase was at
25 Mokelumne River (South Fork) at Staten Island (8% relative to Existing Conditions and 10% relative
26 to the No Action Alternative) (Figure 8-55, Appendix 8I, Table I-8b).

27 ***SWP/CVP Export Service Areas***

28 The analysis of mercury and methylmercury in the SWP/CVP Export Service Areas was based on
29 concentrations estimated at the Banks and Jones pumping plants. Both waterborne total and
30 methylmercury concentrations for Alternative 1A are projected to be lower than Existing Conditions
31 and the No Action Alternative at the Jones and Banks pumping plants (Appendix 8I, Figures 8I-2 and
32 8I-3). Therefore, mercury and methylmercury show increased assimilative capacity at these
33 locations (Figures 8-53 and 8-54).

34 The largest improvements in bass tissue mercury concentrations and exceedance quotients for
35 Alternative 1A, at any location within the Delta relative to Existing Conditions and the No Action
36 Alternative are expected for the export pump locations (specifically, at Banks Pumping plant, 9%
37 improvement relative to Existing Conditions, 11% relative to the No Action Alternative) (Figure 8-
38 55, Appendix 8I, Table I-8a,b).

39 ***NEPA Effects:*** Based on the above discussion, the effects of mercury and methylmercury in
40 comparison of Alternative 1A to the No Action Alternative (as waterborne and bioaccumulated
41 forms) are not considered to be adverse.

1 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
2 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
3 purpose of making the CEQA impact determination for this constituent. For additional details on the
4 effects assessment findings that support this CEQA impact determination, see the effects assessment
5 discussion that immediately precedes this conclusion.

6 Under Alternative 1A, greater water demands and climate change would alter the magnitude and
7 timing of reservoir releases and river flows upstream of the Delta in the Sacramento River
8 watershed and east-side tributaries, relative to Existing Conditions. Concentrations of mercury and
9 methylmercury upstream of the Delta will not be substantially different relative to Existing
10 Conditions due to the lack of important relationships between mercury/methylmercury
11 concentrations and flow for the major rivers.

12 Methylmercury concentrations exceed criteria at all locations in the Delta and no assimilative
13 capacity exists. However, monthly average waterborne concentrations of total and methylmercury,
14 over the period of record, are very similar to Existing Conditions. Similarly, estimates of fish tissue
15 mercury concentrations show almost no differences would occur among sites for Alternative 1A as
16 compared to Existing Conditions for Delta sites.

17 Assessment of effects of mercury in the SWP and CVP Export Service Areas were based on effects on
18 mercury concentrations and fish tissue mercury concentrations at the Banks and Jones pumping
19 plants. The Banks and Jones pumping plants are expected to show increased assimilative capacity
20 for waterborne mercury and decreased fish tissue concentrations of mercury for Alternative 1A as
21 compared to Existing Conditions.

22 As such, this alternative is not expected to cause additional exceedance of applicable water quality
23 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
24 on any beneficial uses of waters in the affected environment. Because mercury concentrations are
25 not expected to increase substantially, no long-term water quality degradation is expected to occur
26 and, thus, no adverse effects to beneficial uses would occur. Because any increases in mercury or
27 methylmercury concentrations are not likely to be measurable, changes in mercury concentrations
28 or fish tissue mercury concentrations would not make any existing mercury-related impairment
29 measurably worse. In comparison to Existing Conditions, Alternative 1A would not increase levels of
30 mercury by frequency, magnitude, and geographic extent such that the affected environment would
31 be expected to have measurably higher body burdens of mercury in aquatic organisms, thereby
32 substantially increasing the health risks to wildlife (including fish) or humans consuming those
33 organisms. This impact is considered to be less than significant. No mitigation is required.

34 **Impact WQ-14: Effects on Mercury Concentrations Resulting from Implementation of CM2-** 35 **CM22**

36 **NEPA Effects:** Some habitat restoration activities under Alternative 1A would occur on lands in the
37 Delta formerly used for irrigated agriculture. Tidal and other restoration proposed under
38 Alternative 1A have the potential to increase water residence times and increase accumulation of
39 organic sediments that are known to enhance methylmercury bioaccumulation in biota in the
40 restored habitat. Therefore, increases in mercury methylation in the habitat restoration areas is
41 possible but uncertain depending on the specific restoration design implemented at a particular
42 Delta location. Increased methylmercury due to the restoration areas would constitute an additional
43 loading of methylmercury to the Delta, independent of effects of the hydrodynamics associated with
44 the restoration areas. Models to estimate the potential for methylmercury formation in restored

1 areas are not currently available. However, DSM2 modeling for Alternative 1A operations does
 2 incorporate assumptions for certain habitat restoration activities proposed under CM2 and CM4
 3 (see Section 8.3.1.3) that result in changes to Delta hydrodynamics compared to the No Action
 4 Alternative. These modeled restoration assumptions provide some insight into potential
 5 hydrodynamic changes that could be expected related to implementing CM2 and CM4 and are
 6 considered in the evaluation of the potential for increased mercury and methylmercury
 7 concentrations under Alternative 1A.

8 BDCP Conservation Measure 12 (CM12) addresses the potential for methylmercury bioaccumulation
 9 associated with restoration activities and acknowledges the uncertainties associated with mitigating
 10 or minimizing this potential effect. CM12 proposes project-specific mercury management plans for
 11 restoration actions that will incorporate relevant approaches recommended in Phase 1
 12 Methylmercury TMDL control studies. Specific approaches recommended under CM12 that are
 13 intended to minimize or mitigate for potential increases in methylmercury bioaccumulation at
 14 future restoration sites include:

- 15 • Characterizing mercury, methylmercury, organic carbon, iron, and sulfate concentrations to
 16 better inform restoration design,
- 17 • Sequestering methylmercury at restoration sites using low intensity chemical dosing
 18 techniques,
- 19 • Minimizing microbial methylation associated with anoxic conditions by reducing the amount of
 20 organic material at a restoration site (this approach could limit the benefit of restoration areas
 21 by limiting the amount of carbon supplied by these areas to the Delta as a whole. In some cases,
 22 this would run directly counter to the goals and objectives of the BDCP. This approach should
 23 not be implemented in such a way that it reduces the benefits to the Delta ecosystem provided
 24 by restoration areas),
- 25 • Designing restoration sites to enhance photo degeneration that converts methylmercury into a
 26 biologically unavailable, inorganic form of mercury,
- 27 • Remediating restoration site soils with iron to reduce methylation in sulfide rich soils, and
- 28 • Considering capping mercury laden sediments, where possible to reduce methylation potential
 29 at a site.

30 Because of the uncertainties associated with site-specific estimates of methylmercury
 31 concentrations and the uncertainties in source modeling and tissue modeling, the effectiveness of
 32 methylmercury management proposed under CM12 to reduce methylmercury concentrations would
 33 need to be evaluated separately for each restoration effort, as part of design and implementation.
 34 Because of this uncertainty and the known potential for methylmercury creation in the Delta this
 35 potential effect of implementing CM2–CM22 is considered adverse.

36 **CEQA Conclusion:** There would be no substantial, long-term increase in mercury or methylmercury
 37 concentrations or loads in the rivers and reservoirs upstream of the Delta or the waters exported to
 38 the CVP and SWP service areas due to implementation of CM2–CM22 relative to Existing Conditions.
 39 However, uptake of mercury from water and/or methylation of inorganic mercury may increase to
 40 an unquantified degree as part of the creation of new, marshy, shallow, or organic-rich restoration
 41 areas. Methylmercury is 303(d)-listed within the affected environment, and therefore any potential
 42 measurable increase in methylmercury concentrations would make existing mercury-related
 43 impairment measurably worse. Because mercury is bioaccumulative, increases in water-borne

1 mercury or methylmercury that could occur in some areas could bioaccumulate to somewhat
 2 greater levels in aquatic organisms and would, in turn, pose health risks to fish, wildlife, or humans.
 3 Design of restoration sites under Alternative 1A would be guided by CM12 which requires
 4 development of site specific mercury management plans as restoration actions are implemented.
 5 The effectiveness of minimization and mitigation actions implemented according to the mercury
 6 management plans is not known at this time although the potential to reduce methylmercury
 7 concentrations exists based on current research. Although the BDCP will implement CM12 with the
 8 goal to reduce this potential effect the uncertainties related to site specific restoration conditions
 9 and the potential for increases in methylmercury concentrations in the Delta result in this potential
 10 impact being considered significant. No mitigation measures would be available until specific
 11 restoration actions are proposed. Therefore this programmatic impact is considered significant and
 12 unavoidable.

13 **Impact WQ-15: Effects on Nitrate Concentrations Resulting from Facilities Operations and** 14 **Maintenance (CM1)**

15 ***Upstream of the Delta***

16 For the same reasons stated for the No Action Alternative, Alternative 1A would have negligible, if
 17 any, adverse effects on nitrate concentrations in the rivers and reservoirs upstream of the Delta in
 18 the Sacramento River watershed, relative to Existing Conditions and the No Action Alternative.

19 Under Alternative 1A, modeling indicates that long-term annual average flows on the San Joaquin
 20 River would decrease by an estimated 6%, relative to Existing Conditions, and would remain
 21 virtually the same relative to the No Action Alternative (Appendix 5A). Given these relatively small
 22 decreases in flows and the weak correlation between nitrate and flows in the San Joaquin River (see
 23 Nitrate Appendix 8J, Figure 2), it is expected that nitrate concentrations in the San Joaquin River
 24 would be minimally affected, if at all, by changes in flow rates under Alternative 1A.

25 Any negligible changes in nitrate-N concentrations that may occur in the water bodies of the affected
 26 environment located upstream of the Delta would not be of frequency, magnitude and geographic
 27 extent that would adversely affect any beneficial uses or substantially degrade the quality of these
 28 water bodies, with regards to nitrate.

29 ***Delta***

30 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 31 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 32 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 33 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 34 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
 35 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

36 Results of the mixing calculations indicate that under Alternative 1A, relative to Existing Conditions,
 37 and the No Action Alternative, nitrate concentrations throughout the Delta are anticipated to remain
 38 low (<1.4 mg/L-N) relative to adopted objectives (Nitrate Appendix 8J Table 7 and 8). Although
 39 changes at specific Delta locations and for specific months may be substantial on a relative basis, the
 40 absolute concentration of nitrate in Delta waters would remain low (<1.4 mg/L-N) in relation to the
 41 drinking water MCL of 10 mg/L-N, as well as all other thresholds identified in Table 8-50. Long-term
 42 average nitrate concentrations are anticipated to remain below 1 mg/L-N at all 11 assessment

1 locations except the San Joaquin River at Buckley Cove, where long-term average concentrations
 2 would be somewhat above 1 mg/L-N. Nevertheless, at this location, long-term average nitrate
 3 concentration would be somewhat reduced under Alternative 1A, relative to Existing Conditions,
 4 and would be nearly the same (i.e., any increase would be negligible) as that under the No Action
 5 Alternative. No additional exceedances of the MCL are anticipated at any location (Nitrate Appendix
 6 8J, Table 7). On a monthly average basis and on a long term annual average basis, for all modeled
 7 years and for the drought period (1987–1991) only, use of assimilative capacity available under
 8 Existing Conditions, and the No Action Alternative, relative to the drinking water MCL of 10 mg/L-N,
 9 was low or negligible (i.e., <4%) for all locations and months (Nitrate Appendix 8J, Table 9).

10 Nitrate concentrations will likely be higher than the modeling results indicate in certain locations.
 11 This includes in the Sacramento River between Freeport and Mallard Island and other areas in the
 12 Delta downstream of Freeport that are influenced by Sacramento River water. These increases are
 13 associated with ammonia and nitrate that are discharged from the SRWTP, which are not included in
 14 the modeling.

- 15 • Under Existing Conditions, most of the ammonia discharged from the SRWTP is converted to
 16 nitrate downstream of the facility's discharge at Freeport, and thus, nitrate concentrations
 17 under Existing Conditions in these areas are expected to be higher than the modeling
 18 predicts, the increase becoming greater with increasing distance downstream. However, the
 19 increase in nitrate concentrations downstream of the SRWTP is expected to be small—the
 20 existing increase appears to be from approximately 0.1 mg/L-N to approximately 0.4–0.5
 21 mg/L-N over this reach, due to approximately a 1:1 conversion of ammonia-N to nitrate-N
 22 (Central Valley Water Board 2010a:32).
- 23 • Under Alternative 1A, the planned upgrades to the SRWTP, which include
 24 nitrification/partial denitrification, would substantially decrease ammonia concentrations
 25 in the discharge, but would increase nitrate concentrations in the discharge up to 10 mg/L-
 26 N, which is substantially higher than under Existing Conditions.
- 27 • Overall, under Alternative 1A, the nitrogen load from the SRWTP discharge is expected to
 28 decrease (by up to 50%), relative to Existing Conditions, due to nitrification/partial
 29 denitrification upgrades at the SRWTP facility. Thus, while concentrations of nitrate
 30 downstream of the facility are expected to be higher than modeling results indicate for both
 31 Existing Conditions and Alternative 1A, the increase is expected to be greater under Existing
 32 Conditions than for Alternative 1A due to the upgrades that are assumed under Alternative
 33 1A.

34 The other areas in which nitrate concentrations will be higher than the modeling results indicate are
 35 immediately downstream of other wastewater treatment plants that practice nitrification, but not
 36 denitrification (e.g., City of Rio Vista Beach WWTF, Town of Discovery Bay WWTF, City of Stockton
 37 RWCF). For all such facilities in the Delta, the Regional Water Boards have issued NPDES permits
 38 that allow discharge of wastewater containing nitrate into the Delta, and under these permits, the
 39 State has determined that no beneficial uses are adversely affected by the discharge, and that the
 40 discharger's use of available assimilative capacity of the water body is acceptable. When dilution is
 41 necessary in order for the discharge to be in compliance with the Basin Plans (which incorporate the
 42 10 mg/L-N MCL by reference), not all of the assimilative capacity of the receiving water is granted to
 43 the discharger. Thus, limited decreases in flows are not anticipated to result in systemic
 44 exceedances of the MCLs by these POTWs. Furthermore, NPDES permits are renewed on a 5-year

1 basis, and thus, if under changes in flows, dilution was no longer sufficient to maintain nitrate below
2 the MCL in the receiving water, the NPDES permit renewal process would address such cases.

3 Therefore, any increases in nitrate-N concentrations that may occur at certain locations within the
4 Delta would not be of frequency, magnitude and geographic extent that would adversely affect any
5 beneficial uses or substantially degrade the water quality at these locations, with regards to nitrate.

6 ***SWP/CVP Export Service Areas***

7 Assessment of effects of nitrate in the SWP and CVP Export Service Areas is based on effects on
8 nitrate-N at the Banks and Jones pumping plants.

9 Results of the mixing calculations indicate that under Alternative 1A, relative to Existing Conditions
10 and the No Action Alternative, nitrate concentrations at Banks and Jones pumping plants are
11 anticipated to decrease on a long-term average annual basis (Nitrate Appendix 8J, Table 7 and 8).
12 During the late summer, particularly in the drought period assessed, concentrations are expected to
13 increase substantially on a relative basis (i.e., >50%), but the absolute value of these changes (i.e., in
14 mg/L-N) is small. Additionally, given the many factors that contribute to potential algal blooms in
15 the SWP and CVP canals within the Export Service Area, and the lack of studies that have shown a
16 direct relationship between nutrient concentrations in the canals and reservoirs and problematic
17 algal blooms in these water bodies, there is no basis to conclude that these small (i.e., generally <0.3
18 mg/L-N), seasonal increases in nitrate concentrations would increase the potential for problem algal
19 blooms in the SWP and CVP Export Service Area. No additional exceedances of the MCL are
20 anticipated (Nitrate Appendix 8J, Table 7). On a monthly average basis and on a long term annual
21 average basis, for all modeled years and for the drought period (1987–1991) only, use of
22 assimilative capacity available under Existing Conditions and the No Action Alternative, relative to
23 the 10 mg/L-N MCL, was negligible (<4%) for both Banks and Jones pumping plants (Nitrate
24 Appendix 8J, Table 9).

25 Any increases in nitrate-N concentrations that may occur in water exported via Banks and Jones
26 pumping plants are not expected to result in adverse effects to beneficial uses or substantially
27 degrade the quality of exported water, with regards to nitrate.

28 ***NEPA Effects:*** In summary, based on the discussion above, the effects on nitrate from implementing
29 CM1 are considered to be not adverse.

30 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
31 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
32 purpose of making the CEQA impact determination for this constituent. For additional details on the
33 effects assessment findings that support this CEQA impact determination, see the effects assessment
34 discussion that immediately precedes this conclusion.

35 Nitrate-N concentrations are generally low in the reservoirs and rivers of the watersheds, owing to
36 substantial dilution available for point sources and the lack of substantial nonpoint sources of
37 nitrate-N upstream of the SRWTP in the Sacramento River watershed, and in the watersheds of the
38 eastern tributaries (Cosumnes, Mokelumne, and Calaveras Rivers). Although higher in the San
39 Joaquin River watershed, nitrate-N concentrations are not well-correlated with flow rates.
40 Consequently, any modified reservoir operations and subsequent changes in river flows under
41 Alternative 1A, relative to Existing Conditions, are expected to have negligible, if any, effects on
42 reservoir and river nitrate-N concentrations upstream of Freeport in the Sacramento River
43 watershed and upstream of the Delta in the San Joaquin River watershed.

1 In the Delta, results of the mixing calculations indicate that under Alternative 1A, relative to Existing
2 Conditions, nitrate concentrations throughout the Delta are anticipated to remain low (<1.4 mg/L-
3 N) relative to adopted objectives. No additional exceedances of the MCL are anticipated at any
4 location, and use of assimilative capacity available under Existing Conditions, relative to the
5 drinking water MCL of 10 mg/L-N, was low or negligible (i.e., <4%) for all locations and months.

6 Assessment of effects of nitrate in the SWP and CVP Export Service Areas is based on effects on
7 nitrate-N concentrations at the Banks and Jones pumping plants. Results of the mixing calculations
8 indicate that under Alternative 1A, relative to Existing Conditions, long-term average nitrate
9 concentrations at Banks and Jones pumping plants are anticipated to change negligibly. No
10 additional exceedances of the MCL are anticipated, and use of assimilative capacity available under
11 Existing Conditions, relative to the MCL was negligible (i.e., <4%) for both Banks and Jones pumping
12 plants for all months.

13 Based on the above, there would be no substantial, long-term increase in nitrate-N concentrations in
14 the rivers and reservoirs upstream of the Delta, in the Delta Region, or the waters exported to the
15 CVP and SWP service areas under Alternative 1A relative to Existing Conditions. As such, this
16 alternative is not expected to cause additional exceedance of applicable water quality
17 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
18 on any beneficial uses of waters in the affected environment. Because nitrate concentrations are not
19 expected to increase substantially, no long-term water quality degradation is expected to occur and,
20 thus, no adverse effects to beneficial uses would occur. Nitrate is not 303(d) listed within the
21 affected environment and thus any increases that may occur in some areas and months would not
22 make any existing nitrate-related impairment measurably worse because no such impairments
23 currently exist. Because nitrate is not bioaccumulative, increases that may occur in some areas and
24 months would not bioaccumulate to greater levels in aquatic organisms that would, in turn, pose
25 substantial health risks to fish, wildlife, or humans. This impact is considered to be less than
26 significant. No mitigation is required.

27 **Impact WQ-16: Effects on Nitrate Concentrations Resulting from Implementation of CM2- 28 CM22**

29 **NEPA Effects:** Some habitat restoration activities included in CM2–CM11 would occur on lands
30 within the Delta formerly used for agriculture. It is expected that this will decrease nitrate
31 concentrations in the Delta, due to less use of nitrate-based fertilizers, relative to the No Action
32 Alternative. Modeling scenarios included assumptions regarding how certain habitat restoration
33 activities (i.e., CM2 and CM4) would affect Delta hydrodynamics, and thus such effects of these
34 restoration measures were included in the assessment of CM1 facilities operations and maintenance
35 (see Impact WQ-1). In general, aside from changes in Delta hydrodynamics resulting from habitat
36 restoration discussed in Impact WQ-1, CM2–CM11 proposed for Alternative 1A are not expected to
37 increase nitrate concentrations in water bodies of the affected environment, relative to the No
38 Action Alternative.

39 Because urban stormwater is a source of nitrate in the affected environment, CM19, Urban
40 Stormwater Treatment, is expected to slightly reduce nitrate loading to the Delta, thus slightly
41 decreasing nitrate-N concentrations relative to the No Action Alternative. Implementation of CM12–
42 CM18 and CM20–CM22 is not expected to substantially alter nitrate concentrations in any of the
43 water bodies of the affected environment.

44 The effects on nitrate from implementing CM2–22 are considered to be not adverse.

1 **CEQA Conclusion:** There would be no substantial, long-term increase in nitrate-N concentrations in
 2 the rivers and reservoirs upstream of the Delta, in the Delta Region, or the waters exported to the
 3 CVP and SWP service areas due to implementation of CM2–CM22 under Alternative 1A, relative to
 4 Existing Conditions. Because urban stormwater is a source of nitrate in the affected environment,
 5 CM19, Urban Stormwater Treatment, is expected to slightly reduce nitrate loading to the Delta. As
 6 such, implementation of these conservation measures is not expected to cause additional
 7 exceedance of applicable water quality objectives/criteria by frequency, magnitude, and geographic
 8 extent that would cause adverse effects on any beneficial uses of waters in the affected environment.
 9 Because nitrate concentrations are not expected to increase substantially due to these conservation
 10 measures, no long-term water quality degradation is expected to occur and, thus, no adverse effects
 11 to beneficial uses would occur. Nitrate is not 303(d) listed within the affected environment and thus
 12 any minor increases that may occur in some areas would not make any existing nitrate-related
 13 impairment measurably worse because no such impairments currently exist. Because nitrate is not
 14 bioaccumulative, minor increases that may occur in some areas would not bioaccumulate to greater
 15 levels in aquatic organisms that would, in turn, pose substantial health risks to fish, wildlife, or
 16 humans. This impact is considered to be less than significant. No mitigation is required.

17 **Impact WQ-17: Effects on Dissolved Organic Carbon Concentrations Resulting from Facilities**
 18 **Operations and Maintenance (CM1)**

19 ***Upstream of the Delta***

20 Under Alternative 1A, there would be no substantial change to the sources of DOC within the
 21 watersheds upstream of the Delta. Moreover, long-term average flow and DOC levels in the
 22 Sacramento River at Hood and San Joaquin River at Vernalis are poorly correlated. Thus changes in
 23 system operations and resulting reservoir storage levels and river flows would not be expected to
 24 cause a substantial long-term change in DOC concentrations in the water bodies upstream of the
 25 Delta. Any negligible changes in DOC levels in water bodies upstream of the Delta under Alternative
 26 1A, relative to Existing Conditions and the No Action Alternative, would not be of sufficient
 27 frequency, magnitude and geographic extent that would adversely affect any beneficial uses or
 28 substantially degrade the quality of these water bodies, with regard to DOC.

29 ***Delta***

30 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 31 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 32 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 33 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 34 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
 35 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

36 Relative to Existing Conditions, Alternative 1A would result in small increases (i.e., between 1 and
 37 9%) in long-term average DOC concentrations at some interior Delta locations. In particular,
 38 modeled increases in long-term average DOC would be greatest at Franks Tract, with net average
 39 DOC concentration increases for the 16-year (1976–1991) hydrologic period modeled of 0.3 mg/L,
 40 equivalent to an approximate 9% relative increase (0.2 mg/L for the drought period, 8% relative
 41 increase) (Appendix 8K, DOC Table 2). Long-term increases of not greater than 0.3 mg/L (≤8%)
 42 would be predicted to occur at Staten Island, Rock Slough, and Contra Costa PP No. 1 as well. At all
 43 11 assessment locations, modeled long-term average DOC concentrations exceed 2 mg/L 92-100%

1 of the time. However, increases in long-term average DOC in the Delta interior would result in more
2 frequent exceedances of the 3 mg/L concentration threshold, with the largest magnitude effect
3 occurring at Rock Slough and Contra Costa PP No. 1. At Rock Slough, the frequency long-term
4 average DOC concentrations would exceed 3 mg/L would increase from 52% under Existing
5 Conditions to 66% under Alternative 1A (an increase from 47% to 63% for the drought period). At
6 Contra Costa PP No. 1, the frequency long-term average DOC concentrations would exceed 3 mg/L
7 would increase from 52% under Existing Conditions to 68% under Alternative 1A (an increase from
8 45% to 67% for the drought period). In contrast, however, the relative frequency long-term average
9 DOC concentrations would exceed 4 mg/L at Rock Slough and Contra Costa PP No. 1 would be small.
10 At Rock Slough, an increase in the frequency long-term average DOC would exceed 4 mg/L would
11 only occur for the drought period, increasing from 32% under Existing Conditions to 40% under
12 Alternative 1A, while at Contra Costa PP No. 1 the modeled exceedance frequency for the 16-year
13 hydrologic period would rise from 32% to 34% (an increase from 35% to 42% for the drought
14 period). Concentration threshold exceedances at the other assessment locations would be similar or
15 less. While Alternative 1A would generally lead to slightly higher long-term average DOC
16 concentrations (≤ 0.3 mg/L) within the Delta interior and some municipal water intakes, the
17 predicted change would not be expected to adversely affect MUN beneficial uses, or any other
18 beneficial use. This comparison to Existing Conditions reflects changes in DOC due to both
19 Alternative 1A operations (including north Delta intake capacity of 15,000 cfs and numerous other
20 operational components of Scenario A) and climate change/sea level rise.

21 In comparison, Alternative 1A relative to the No Action Alternative would generally result in a
22 similar magnitude of change to that discussed for the comparison to Existing Conditions. Maximum
23 increases of not greater than 0.3 mg/L DOC (i.e., $\leq 9\%$) would be predicted at Staten Island, Franks
24 Tract, Rock Slough, and Contra Costa PP No. 1 (Appendix 8K, DOC Table 2). Threshold concentration
25 exceedance frequency trends would also be similar to that discussed for the existing condition
26 comparison, with exception to the predicted 4 mg/L exceedance frequency at Buckley Cove. In
27 comparison to the No Action Alternative, the frequency which long-term average DOC
28 concentrations exceeded 4 mg/L at Buckley Cove would increase from 27% to 33% (42% to 62% for
29 the modeled drought period). While the Alternative 1A would generally lead to slightly higher long-
30 term average DOC concentrations at some Delta assessment locations when compared to the No
31 Action Alternative, the predicted change would not be expected to adversely affect MUN beneficial
32 uses, or any other beneficial use, particularly when considering the relatively small change in long-
33 term annual average concentration. Unlike the comparison to Existing Conditions, this comparison
34 to the No Action Alternative reflects changes in DOC due to only Alternative 1A operations.

35 The Stage 1 Disinfectants and Disinfection Byproduct Rule adopted by U.S. EPA in 1998, as part of
36 the Safe Drinking Water Act, requires drinking water utilities to reduce TOC concentrations by
37 specified percentages prior to disinfection. EPA's action thresholds begin at 2–4 mg/L TOC and,
38 depending on source water alkalinity, may require a drinking water utility to employ treatment to
39 achieve as much as a 35% reduction in TOC. These requirements were adopted because organic
40 carbon, such as DOC, can react with disinfectants during the water treatment disinfection process to
41 form DBPs, such as THMs which pose potential lifetime carcinogenic risks to humans. Moreover, a
42 CUWA convened expert panel reviewed Delta source water quality and DBP formation potential in
43 an effort to develop Delta source water quality targets for treated drinking water. This panel found
44 that source water between 4 and 7 mg/L TOC would allow continued flexibility in treatment
45 technology necessary to achieve existing drinking water criteria for DBPs.

1 Water treatment plants that utilize Delta water are currently designed and operated to meet EPA's
2 1998 requirements based on the ambient concentrations and seasonal variability that currently
3 exists in the Delta. Substantial changes in ambient DOC concentrations would need to occur for
4 significant changes in plant design or operations to be triggered. The increases in long-term average
5 DOC concentrations estimated to occur at various Delta locations under Alternative 1A are of
6 sufficiently small magnitude that they would not require existing drinking water treatment plants to
7 substantially upgrade treatment for DOC removal above levels currently employed.

8 Relative to Existing Conditions and No Action Alternative conditions, Alternative 1A would lead to
9 predicted improvements in long-term average DOC concentrations at Barker Slough, as well as
10 Banks and Jones pumping plants (discussed below). At Barker Slough, long-term average DOC
11 concentrations would be predicted to decrease by as much as 0.1–0.2 mg/L, depending on baseline
12 conditions comparison and modeling period.

13 ***SWP/CVP Export Service Areas***

14 Under Alternative 1A, modeled long-term average DOC concentrations would decrease at Banks and
15 Jones pumping plants, relative to Existing Conditions and the No Action Alternative. Relative to
16 Existing Conditions, long-term average DOC concentrations would be predicted to decrease by 0.4
17 mg/L at both pumping plants, although in drought years the decrease would be 0.1 mg/L at Banks
18 pumping plant and <0.1 mg/L at Jones pumping plant (Appendix 8K, DOC Table 2). Such decreases
19 in long-term average DOC would result in generally lower exceedance frequencies for concentration
20 thresholds, although the frequency of exceedance during the modeled drought period (i.e., 1987–
21 1991) would be predicted to increase. For the Banks pumping plant during the drought period,
22 exceedance of the 3 mg/L threshold would increase from 57% under Existing Conditions to 88%
23 under Alternative 1A, while at the Jones pumping plant, exceedance frequency would increase from
24 72% to 87%. There would be comparatively fewer increases in the frequency of exceeding the 4
25 mg/L threshold at Banks, while at Jones pumping plant the exceedance frequency for the 4 mg/L
26 threshold would decrease. Comparisons to the No Action Alternative yield similar trends, but with
27 slightly small magnitude drought period changes. Overall, modeling results for the SWP/CVP Export
28 Service Areas predict an overall improvement in Export Service Areas water quality, although
29 somewhat more frequent exports of >3 mg/L DOC water would likely occur for drought periods.

30 Similar to the discussion pertaining to the No Action Alternative, maintenance of SWP and CVP
31 facilities under Alternative 1A would not be expected to create new sources of DOC or contribute
32 towards a substantial change in existing sources of DOC in the affected area. Maintenance activities
33 would not be expected to cause any substantial change in long-term average DOC concentrations
34 such that MUN beneficial uses, or any other beneficial use, would be adversely affected.

35 ***NEPA Effects:*** In summary, Alternative 1A, relative to the No Action Alternative, would not cause a
36 substantial long-term change in DOC concentrations in the water bodies upstream of the Delta.
37 Long-term average DOC concentrations at Banks and Jones pumping plants are predicted to
38 decrease by as much as 0.5 mg/L, while long-term average DOC concentrations for some Delta
39 interior locations, including Contra Costa PP #1, are predicted to increase by as much as 0.3 mg/L.
40 The increase in long-term average DOC concentration that could occur within the Delta interior
41 would not be of sufficient magnitude to adversely affect the MUN beneficial use, or any other
42 beneficial uses, of Delta waters. The effect of Alternative 1A operations and maintenance (CM1) on
43 DOC is determined not to be adverse.

1 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
2 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
3 purpose of making the CEQA impact determination for this constituent. For additional details on the
4 effects assessment findings that support this CEQA impact determination, see the effects assessment
5 discussion that immediately precedes this conclusion.

6 While greater water demands under the Alternative 1A would alter the magnitude and timing of
7 reservoir releases north, south and east of the Delta, these activities would have no substantial effect
8 on the various watershed sources of DOC. Moreover, long-term average flow and DOC at Sacramento
9 River at Hood and San Joaquin River at Vernalis are poorly correlated; therefore, changes in river
10 flows would not be expected to cause a substantial long-term change in DOC concentrations
11 upstream of the Delta.

12 Relative to Existing Conditions, Alternative 1A would result in relatively small increases (i.e., $\leq 9\%$)
13 in long-term average DOC concentrations at some Delta interior locations, including Franks Tract,
14 Staten Island, Rock Slough, and Contra Costa PP No. 1. However, these increases would not
15 substantially increase the frequency with which long-term average DOC concentrations exceeds 2, 3,
16 or 4 mg/L. While Alternative 1A would generally lead to slightly higher long-term average DOC
17 concentrations (≤ 0.3 mg/L) within the Delta interior and some municipal water intakes, the
18 predicted change would not be expected to adversely affect MUN beneficial uses, or any other
19 beneficial use.

20 The assessment of Alternative 1A effects on DOC in the SWP/CVP Export Service Areas is based on
21 assessment of changes in DOC concentrations at Banks and Jones pumping plants. Relative to the
22 existing condition, long-term average DOC concentrations would decrease by as much as 0.4 mg/L at
23 Banks and Jones pumping plants, although slightly more frequent export of >3 mg/L DOC water is
24 predicted during periods of drought. Nevertheless, an overall improvement in DOC-related water
25 quality would be predicted in the SWP/CVP Export Service Areas.

26 Based on the above, Alternative 1A operation and maintenance would not result in any substantial
27 change in long-term average DOC concentration upstream of the Delta or result in substantial
28 increase in the frequency with which long-term average DOC concentrations exceeds 2, 3, or 4 mg/L
29 levels at the 11 assessment locations analyzed for the Delta. Modeled long-term average DOC
30 concentrations would increase by no more than 0.3 mg/L at any single Delta assessment location
31 (i.e., $\leq 9\%$ relative increase), with long-term average concentrations estimated to remain at or below
32 4.0 mg/L at all Delta locations assessed, with the exception of Buckley Cove on the San Joaquin River
33 during the drought period modeled. Nevertheless, long-term average concentrations at Buckley
34 Cove are predicted to remain the same during the drought period, relative to Existing Conditions.
35 The increases in long-term average DOC concentration that could occur within the Delta would not
36 be of sufficient magnitude to adversely affect the MUN beneficial use, or any other beneficial uses, of
37 Delta waters or waters of the SWP/CVP Service Area. Because DOC is not bioaccumulative, the
38 increases in long-term average DOC concentrations would not cause bioaccumulative problems in
39 aquatic life or humans. Finally, DOC is not causing beneficial use impairments and thus is not 303(d)
40 listed for any water body within the affected environment. Thus, the increases in long-term average
41 DOC that could occur at various locations would not make any beneficial use impairment
42 measurably worse. Because long-term average DOC concentrations are not expected to increase
43 substantially, no long-term water quality degradation with respect to DOC is expected to occur and,
44 thus, no adverse effects on beneficial uses would occur This impact is considered to be less than
45 significant. No mitigation is required.

1 **Impact WQ-18: Effects on Dissolved Organic Carbon Concentrations Resulting from**
2 **Implementation of CM2–CM22**

3 **NEPA Effects:** The mostly non-land disturbing CM12–CM22 present no new sources of DOC to the
4 affected environment, including areas Upstream of the Delta, within the Plan Area, and the SWP/CVP
5 Export Service Area. Implementation of methylmercury control measures (CM12) and urban
6 stormwater treatment measures (CM19) may result in beneficial effects, to the extent that control
7 measures treat or reduce organic carbon loading from tidal wetlands and urban land uses. Control of
8 nonnative aquatic vegetation (CM13) may include killing mature aquatic vegetation in place, leading
9 to their decay and contribution to DOC in Delta channels. However, this measure is not expected to
10 be a significant source of long-term DOC loading as vegetation control would be sporadic and on an
11 as needed basis, with decreasing need for treatments in the long-term as nonnative vegetation is
12 eventually controlled and managed. Implementation of CM12–CM22 would not be expected to have
13 substantial, if even measurable, effect on DOC concentrations upstream of the Delta, within the
14 Delta, and in the SWP/CVP service areas. Consequently, any negligible increases in DOC levels in
15 these areas of the affected environment are not expected to be of sufficient frequency, magnitude
16 and geographic extent that they would adversely affect the MUN beneficial use, or any other
17 beneficial uses, of the affected environment, nor would potential increases substantially degrade
18 water quality with regards to DOC.

19 For CM2–CM11, effects on DOC concentrations can generally be considered in terms of: (1)
20 alternative-caused change in Delta hydrodynamics, and (2) alternative-caused change in Delta DOC
21 sources. Change in Delta hydrodynamics involves a two part process, including the conveyance
22 facilities and operational scenarios of CM1, as well as the change in Delta channel geometry and
23 open water areas that would occur as a consequence of implementing tidal wetland restoration
24 measures such as that described for CM4. Modeling scenarios included assumptions regarding how
25 these habitat restoration activities would affect Delta hydrodynamics, and thus the effects of these
26 restoration measures, via their effects on delta hydrodynamics, were included in the assessment of
27 CM1 facilities operations and maintenance (see Impact WQ-17). The potential for these same
28 conservation measures to change Delta DOC sources are addressed below.

29 CM2, CM3, CM8, CM9, and CM11 could include activities that would target increasing primary
30 production (i.e., algae growth) within the Delta. Algae currently are not estimated to be a major
31 source of DOC in the Delta (CALFED Bay-Delta Program 2008a: 4, 6), and comprise mostly the
32 particulate fraction of TOC. Conventional drinking water treatment removes much of the POC from
33 raw source water; therefore, conservation measure activities targeted at increased algae production
34 are not expected to contribute substantial amounts of new DOC, or adversely affect MUN beneficial
35 use, or any other beneficial uses, of the affected environment.

36 CM4–CM7 and CM10 include land disturbing restoration activities known to be sources of DOC.
37 Research within the Delta has focused primarily on non-tidal wetlands and flooding of Delta island
38 peat soils. The dynamics of DOC production and export from wetlands and seasonally flooded soils is
39 complex, as well as highly site and circumstance specific. Age and configuration of a wetland
40 significantly affects the amount of DOC that may be generated in a wetland. In a study of a
41 permanently flooded non-tidal constructed wetland on Twitchell Island, initial DOC loading was
42 determined to be much greater (i.e., approximately 10 times greater) than equivalent area of
43 agricultural land, but trends in annual loading led researchers to estimate that loading from the
44 wetland would be equivalent to that of agriculture within about 15 years (Fleck et. al. 2007: 18). It
45 was observed that the majority of the wetland load originated from seepage through peat soils.

1 Trends in declining load were principally associated with flushing of mobile DOC from submerged
2 soils, the origins of which were related to previous agricultural activity prior to restoration to
3 wetland. Peaks in annual loading, however, would be different, where peaks in agricultural drainage
4 occur in winter months while peaks in wetland loading occur in spring and summer months. As
5 such, age, configuration, location, operation, and season all factor into DOC loading, and long-term
6 average DOC concentrations in the Delta.

7 Available evidence suggests that restoration activities establishing new tidal and non-tidal wetlands,
8 new riparian and new seasonal floodplain habitat could potentially lead to new substantial sources
9 of localized DOC loading within the Delta. If established in areas presently used for agriculture, these
10 restoration activities could result in a substitution and temporary increase in localized DOC loading
11 for years. Presently, the specific design, operational criteria, and location of these activities are not
12 well established. Depending on localized hydrodynamics, such restoration activities could
13 contribute substantial amounts of DOC to municipal raw water if established near municipal intakes.
14 Substantially increased DOC concentrations in municipal source water may create a need for
15 existing drinking water treatment plants to upgrade treatment systems in order to achieve EPA
16 Stage 1 Disinfectants and Disinfection Byproduct Rule action thresholds. While treatment
17 technologies sufficient to achieve the necessary DOC removals exist, implementation of such
18 technologies would likely require substantial investment in new or modified infrastructure.

19 In summary, the habitat restoration elements of CM4–CM7 and CM10 under Alternative 1A would
20 present new localized sources of DOC to the study area, and in some circumstances would substitute
21 for existing sources related to replaced agriculture. Depending on localized hydrodynamics and
22 proximity to municipal drinking water intakes, such restoration activities could contribute
23 substantial amounts of DOC to municipal raw water. Substantial increases in municipal raw water
24 DOC could necessitate changes in water treatment plant operations or require treatment plant
25 upgrades in order to maintain DBP compliance, and thus would constitute an adverse effect on
26 water quality. Mitigation Measure WQ-18 is available to reduce these effects.

27 **CEQA Conclusion:** Implementation of CM2, CM3, CM8, CM9, and CM11–CM22 would not present
28 new or substantially changed sources of organic carbon to the affected environment of the Delta,
29 and thus would not contribute substantially to changes in long-term average DOC concentrations in
30 the Delta. Therefore, related long-term water quality degradation would not be expected to occur
31 and, thus, no adverse effects on beneficial uses would occur through implementation of CM2, CM3,
32 CM8, CM9, and CM11–CM22. Furthermore, DOC is not bioaccumulative, therefore changes in DOC
33 concentrations would not cause bioaccumulative problems in aquatic life or humans. Nevertheless,
34 implementation of CM4–CM7 and 10 would present new localized sources of DOC to the study area,
35 and in some circumstances would substitute for existing sources related to replaced agriculture.
36 Depending on localized hydrodynamics and proximity to municipal drinking water intakes, such
37 restoration activities could contribute substantial amounts of DOC to municipal raw water. The
38 potential for substantial increases in long-term average DOC concentrations related to the habitat
39 restoration elements of CM4–CM7 and 10 could contribute to long-term water quality degradation
40 with respect to DOC and, thus, adversely affect MUN beneficial uses. The impact is considered to be
41 significant and mitigation is required. It is uncertain whether implementation of Mitigation Measure
42 WQ-18 would reduce identified impacts to a less-than-significant level. Hence, this impact remains
43 significant and unavoidable.

44 In addition to and to supplement Mitigation Measure WQ-18, the BDCP proponents have
45 incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*, a

1 separate, non-environmental commitment to address the potential increased water treatment costs
 2 that could result from DOC concentration effects on municipal and industrial water purveyor
 3 operations. Potential options for making use of this financial commitment include funding or
 4 providing other assistance towards implementing treatment for DOC and/or DBPs or DOC source
 5 control strategies. Please refer to Appendix 3B, *Environmental Commitments*, for the full list of
 6 potential actions that could be taken pursuant to this commitment in order to reduce the water
 7 quality treatment costs associated with water quality effects relating to DOC.

8 **Mitigation Measure WQ-18: Design Wetland and Riparian Habitat Features to Minimize**
 9 **Effects on Municipal Intakes**

10 Design wetland and riparian habitat features taking into consideration effects on Delta
 11 hydrodynamics and impacts on municipal intakes. Locate restoration features such that impacts
 12 on municipal intakes are minimized and habitat benefits are maximized. Incorporate design
 13 features to control the load and/or timing of DOC exports from habitat restoration features. This
 14 could include design elements to control seepage from non-tidal wetlands (e.g., incorporation of
 15 slurry walls into levees), and features to increase retention time and decrease tidal exchange in
 16 tidal wetlands and riparian and channel margin habitat designs. For restoration features directly
 17 connected to open channel waters, this could include designing wetlands with only channel
 18 margin exchanges to decrease DOC loading. Stagger construction of wetlands and channel
 19 margin/riparian sites both spatially and temporally so as to allow aging of the restoration
 20 features and associated decreased creation of localized “hot spots” and net Delta loading.

21 Establish measures to help guide the design and creation of the target wetland habitats. At a
 22 minimum, the measures should limit potential increases in long-term average DOC
 23 concentrations, and thus guide efforts to site, design, and maintain wetland and riparian habitat
 24 features, consistent with the biological goals and objectives of the BDCP. For example,
 25 restoration activities could be designed and located with the goal of preventing, consistent with
 26 the biological goals and objectives of the BDCP, net long-term average DOC concentration
 27 increases of greater than 0.5 mg/L at any municipal intake location within the Delta.

28 However, it must be noted that some of these measures could limit the benefit of restoration
 29 areas by limiting the amount of carbon supplied by these areas to the Delta as a whole. In some
 30 cases, these measures would run directly counter to the goals and objectives of the BDCP. This
 31 mitigation measure should not be implemented in such a way that it reduces the benefits to the
 32 Delta ecosystem provided by restoration areas. As mentioned above, the BDCP proponents have
 33 incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*, a
 34 separate, non-environmental commitment to address the potential increased water treatment
 35 costs that could result from DOC concentration effects on municipal and industrial water
 36 purveyor operations.

37 **Impact WQ-19: Effects on Pathogens Resulting from Facilities Operations and Maintenance**
 38 **(CM1)**

39 ***Upstream of the Delta***

40 For the same reasons stated for the No Action Alternative, Alternative 1A would not result in
 41 substantial, and would likely result in immeasurable, increases in pathogen concentrations in the
 42 rivers and reservoirs upstream of the Delta, relative to Existing Conditions and the No Action

1 Alternative. Effects due to the operation and maintenance of the conveyance facilities are expected
2 to be immeasurable, on an annual and long-term average basis.

3 **Delta**

4 For the same reasons stated for the No Action Alternative, Alternative 1A would not result in
5 substantial, and would likely result in immeasurable, increases in pathogen concentrations in the
6 Delta region relative to Existing Conditions and the No Action Alternative. Effects due to the
7 operation and maintenance of the conveyance facilities are expected to be immeasurable, on an
8 annual and long-term average basis.

9 **SWP/CVP Export Service Areas**

10 The water delivered to the SWP/CVP Export Service Areas would differ from that under Existing
11 Conditions and the No Action Alternative, as it would consist of water diverted from the Sacramento
12 River at Hood in addition to the water directly withdrawn from the Delta at the current export
13 pumps.

14 The Pathogens Conceptual Model (Tetra Tech 2007, Figure 3-7) reports the median *E. coli*
15 concentration in the Sacramento River at Hood is the same order of magnitude (10^1) as the median
16 *E. coli* concentration at the Contra Costa Water District's Pumping Plant #1 and the Delta Pumping
17 Plant Headworks (referred to herein as the Banks pumping plant), with the median Banks pumping
18 plant concentrations being higher than the Sacramento River and Pumping Plant #1 median
19 concentrations (data for comparison of total coliforms and fecal coliforms is not presented in Tetra
20 Tech 2007 and, thus, only *E. coli* is discussed). Based on the Pathogen Conceptual Model's findings
21 that Delta *E. coli* concentrations appear to be largely influenced by localized sources and that
22 Sacramento River *E. coli* concentrations are lower than Delta concentrations, the diversion of
23 Sacramento River water at Hood is not expected to measurably increase the *E. coli* concentration in
24 the SWP/CVP Export Service Areas waters.

25 Furthermore, the following average pathogen concentrations for the Sacramento River at River Mile
26 44 (which is upstream of Hood and downstream of the Sacramento Regional Wastewater Treatment
27 Plant) are reported in the Pathogens Conceptual Model (Tetra Tech 2007, Figure 3-4):

28 *Cryptosporidium*: 0.12 oocysts/L (31% of samples detected)

29 *Giardia*: 0.9 cysts/L ml (66% of samples detected)

30 Pathogen concentrations in SWP/CVP Export Service Areas waters, particularly *Giardia* and
31 *Cryptosporidium* concentrations, are of concern because the concentration of these pathogens
32 dictates the level treatment required for the drinking water supply. The *California State Water*
33 *Project Sanitary Survey, 2006 Update* (State Water Project Contractors Authority 2007) reported
34 *Giardia* and *Cryptosporidium* concentrations for locations throughout the SWP. These pathogens
35 were not frequently detected and the concentrations reported were such that the waters would be
36 classified as "Bin 1" under the Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR),
37 meaning no additional treatment required under the Rule, though some waters required additional
38 monitoring to confirm this classification. Based on the levels of *Cryptosporidium* in the Sacramento
39 River, this alternative would not be expected to adversely affect the municipal and domestic water
40 supply uses in the service areas, as the water would be classified as "Bin 1" with respect to the
41 LT2ESWTR, meaning no additional treatment required.

1 With respect to the remaining beneficial uses in the service area (e.g., recreation), an increased
2 proportion of water coming from the Sacramento River would not adversely affect those uses in the
3 SWP/CVP Export Service Areas. As described above, the pathogen levels in the Sacramento River are
4 similar to or lower than the water diverted at the Delta export pumps. Further, it is localized sources
5 of pathogens that appear to have the greatest influence on concentrations (Tetra Tech 2007). Thus,
6 an increased proportion of Sacramento River water diverted to the SWP/CVP Export Service Areas
7 would result in minimal changes in pathogen levels in the SWP/CVP Export Service Areas waters.

8 For the same reasons stated for the No Action Alternative, Alternative 1A is expected to have
9 minimal effects on pathogen concentrations in SWP/CVP Export Service Areas waters relative to
10 Existing Conditions and No Action Alternative.

11 **NEPA Effects:** The effects on pathogens from implementing CM1 is determined to not be adverse.

12 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
13 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
14 purpose of making the CEQA impact determination for this constituent. For additional details on the
15 effects assessment findings that support this CEQA impact determination, see the effects assessment
16 discussion that immediately precedes this conclusion.

17 River flow rate and reservoir storage reductions that would occur due to implementation of CM1
18 (water facilities and operations) under Alternative 1A, relative to Existing Conditions, would not be
19 expected to result in a substantial adverse change in pathogen concentrations in the reservoirs and
20 rivers upstream of the Delta, given the small magnitude of urban runoff contributions relative to the
21 magnitude of river flows, that pathogen concentrations in the rivers have a minimal relationship to
22 river flow rate, and the expected reduced pollutant loadings in response to NPDES stormwater-
23 related regulations.

24 It is expected there would be no substantial change in Delta pathogen concentrations in response to
25 a shift in the Delta source water percentages under this alternative or substantial degradation of
26 these water bodies, with regard to pathogens. This conclusion is based on the Pathogens Conceptual
27 Model, which found that pathogen sources in close proximity to a Delta site appear to have the
28 greatest influence on pathogen levels at the site, rather than the primary source(s) of water to the
29 site. In-Delta potential pathogen sources, including water-based recreation, tidal habitat, wildlife,
30 and livestock-related uses, would continue under this alternative.

31 In the SWP/CVP Export Service Areas waters, relative to Existing Conditions, an increased
32 proportion of water coming from the Sacramento River would not adversely affect beneficial uses in
33 the SWP/CVP Export Service Areas. The pathogen levels in the Sacramento River are similar to or
34 lower than the water diverted at the Delta export pumps. Further, it is localized sources of
35 pathogens that appear to have the greatest influence on concentrations. Thus, an increased
36 proportion of Sacramento River water diverted to the SWP/CVP Export Service Areas would result
37 in minimal changes in pathogen levels in the SWP/CVP Export Service Areas waters.

38 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
39 objectives by frequency, magnitude, and geographic extent that would cause adverse effects on any
40 beneficial uses of waters in the affected environment. Because pathogen concentrations are not
41 expected to increase substantially, no long-term water quality degradation for pathogens is
42 expected to occur and, thus, no adverse effects on beneficial uses would occur. The San Joaquin
43 River in the Stockton Deep Water Ship Channel is Clean Water Act section 303(d) listed for

1 pathogens. Because no measurable increase in Deep Water Ship Channel pathogen concentrations
2 are expected to occur on a long-term basis, further degradation and impairment of this area is not
3 expected to occur. Finally, pathogens are not bioaccumulative constituents. This impact is
4 considered to be less than significant. No mitigation is required.

5 **Impact WQ-20: Effects on Pathogens Resulting from Implementation of CM2–CM22**

6 **NEPA Effects:** CM2–CM11 would involve habitat restoration actions, and CM22 involves waterfowl
7 and shorebird areas. Tidal wetlands are known to be sources of coliforms originating from aquatic,
8 terrestrial, and avian wildlife that inhabit these areas (Desmarais et al. 2001, Grant et al. 2001,
9 Evanson and Ambrose 2006, Tetra Tech 2007). Specific locations of restoration areas for this
10 alternative have not yet been established. However, most low-lying land suitable for restoration is
11 unsuitable for livestock. Therefore, it is likely that the majority of land to be converted to wetlands
12 would be crop-based agriculture or fallow/idle land. Because of a great deal of scientific uncertainty
13 in the loading of coliforms from these various sources, the resulting change in coliform loading is
14 uncertain, but it is anticipated that coliform loading to Delta waters would increase. Based on
15 findings from the Pathogens Conceptual Model that pathogen concentrations are greatly influenced
16 by the proximity to the source, this could result in localized increases in wildlife-related coliforms
17 relative to the No Action Alternative. The Delta currently supports similar habitat types and, with
18 the exception of the Clean Water Act section 303(d) listing for the Stockton Deep Water Ship
19 Channel, is not recognized as exhibiting pathogen concentrations that rise to the level of adversely
20 affecting beneficial uses. As such, the potential increase in wildlife-related coliform concentrations
21 due to tidal habitat creation is not expected to adversely affect beneficial uses.

22 CM19, which would fund projects to contribute to reducing pollutant discharges in stormwater,
23 would be expected to reduce pathogen load relative to the No Action Alternative. The remaining
24 conservation measures would not be expected to affect pathogen levels, because they are actions
25 that do not affect the presence of pathogen sources. The effects on pathogens from implementing
26 CM2–CM22 is determined to not be adverse.

27 **CEQA Conclusion:** Based on findings from the Pathogens Conceptual Model that pathogen
28 concentrations are greatly influenced by the proximity to the source, implementation of CM2–CM11
29 and CM22 could result in localized increases in wildlife-related coliforms relative to Existing
30 Conditions. The Delta currently supports similar habitat types and, with the exception of the Clean
31 Water Act section 303(d) listing for the Stockton Deep Water Ship Channel, is not recognized as
32 exhibiting pathogen concentrations that rise to the level of adversely affecting beneficial uses. As
33 such, the potential increase in wildlife-related coliform concentrations due to tidal habitat creation
34 is not expected to adversely affect beneficial uses. Therefore, this alternative is not expected to cause
35 additional exceedance of applicable water quality objectives by frequency, magnitude, and
36 geographic extent that would cause adverse effects on any beneficial uses of waters in the affected
37 environment. Because pathogen concentrations are not expected to increase substantially, no long-
38 term water quality degradation for pathogens is expected to occur and, thus, no adverse effects on
39 beneficial uses would occur. The San Joaquin River in the Stockton Deep Water Ship Channel is Clean
40 Water Act section 303(d) listed for pathogens. Because no measurable increase in Deep Water Ship
41 Channel pathogen concentrations are expected to occur on a long-term basis, further degradation
42 and impairment of this area is not expected to occur. Finally, pathogens are not bioaccumulative
43 constituents. This impact is considered to be less than significant. No mitigation is required.

1 **Impact WQ-21: Effects on Pesticide Concentrations Resulting from Facilities Operations and**
2 **Maintenance (CM1)**

3 ***Upstream of the Delta***

4 For the same reasons stated for the No Action Alternative, under Alternative 1A no specific
5 operations or maintenance activity of the SWP or CVP would substantially drive a change in
6 pesticide use, and thus pesticide sources would remain unaffected upstream of the Delta.
7 Nevertheless, changes in the timing and magnitude of reservoir releases could have an effect on
8 available dilution capacity along river segments such as the Sacramento, Feather, American, and San
9 Joaquin Rivers.

10 Under Alternative 1A, winter (November–March) and summer (April–October) season average flow
11 rates on the Sacramento River at Freeport, American River at Nimbus, Feather River at Thermalito
12 and the San Joaquin River at Vernalis would change. Averaged over the entire period of record,
13 seasonal average flow rates on the Sacramento would decrease no more than 7% during the
14 summer and 2% during the winter relative to Existing Conditions (Appendix 8L, Seasonal average
15 flows Tables 1-4). On the Feather River, average flow rates would decrease by as much as 5% during
16 the summer, but would increase by as much as 12% in the winter, while on the American River
17 average flow rates would decrease by as much as 16% in the summer but would increase by as
18 much as 9% in the winter. Seasonal average flow rates on the San Joaquin River would decrease by
19 as much as 12% in the summer, but increase by as much as 1% in the winter relative to Existing
20 Conditions. In comparison to the No Action Alternative, the relative magnitude change in seasonal
21 average flows would be similar, with exception to the estimated change on the American River and
22 San Joaquin River relative to No Action Alternative. In comparison to No Action Alternative, there
23 would be no estimated change in season average flows on the San Joaquin River (i.e., 0% summer
24 and winter change) and there would only be a 1% decrease of summer average flows on the
25 American River.

26 For the same reasons stated for the No Action Alternative, decreased seasonal average flow of $\leq 16\%$
27 is not considered to be of sufficient magnitude to substantially increase pesticide concentrations or
28 alter the long-term risk of pesticide-related toxicity to aquatic life, nor adversely affect other
29 beneficial uses of water bodies upstream of the Delta.

30 ***Delta***

31 Sources of diuron, OP and pyrethroid insecticides to the Plan Area include direct input of surface
32 runoff from in-Delta agriculture and Delta urbanized areas as well as inputs from rivers upstream of
33 the Delta. Similar to Upstream of the Delta, CVP/SWP operations would not affect these sources.

34 Under Alternative 1A, the distribution and mixing of Delta source waters would change. Percent
35 change in monthly average source water fraction were evaluated for the modeled 16-year (1976–
36 1991) hydrologic period and a representative drought period (1987–1991), with special attention
37 given to changes in San Joaquin River, Sacramento River and Delta Agriculture sources water
38 fractions. Relative to Existing Conditions, under Alternative 1A modeled San Joaquin River fractions
39 would increase greater than 10% at Franks Tract, Rock Slough, and Contra Costa PP No. 1 (Appendix
40 8D, Source Water Fingerprinting). At Franks Tract, source water fractions when modeled for the 16-
41 year hydrologic period would increase 13–15% during February and March. San Joaquin River
42 source water fractions when modeled for the 16-year hydrologic period would increase 14–16%
43 during February and March at Rock Slough and 13–17% during March and April at Contra Costa PP

1 No. 1. Sacramento River fractions would increase greater than 10% at Buckley Cove as well. At
2 Buckley Cove, Sacramento River source water fractions when modeled for the 16-year hydrologic
3 period would increase by 11% during August, and 11–14% during July and August during the
4 modeled drought period. Relative to Existing Conditions, there would be no modeled increases in
5 Delta agricultural fractions greater than 7%. These modeled changes in the source water fractions of
6 Sacramento, San Joaquin and Delta agriculture water are not of sufficient magnitude to substantially
7 alter the long-term risk of pesticide-related toxicity to aquatic life, nor adversely affect other
8 beneficial uses of the Delta. This comparison to Existing Conditions reflects changes in Delta source
9 water fractions due to both Alternative 1A operations (including north Delta intake capacity of
10 15,000 cfs and numerous other operational components of Scenario A) and climate change/sea level
11 rise.

12 When compared to the No Action Alternative, changes in source water fractions would be similar in
13 season, geographic extent, and magnitude to those discussed for Existing Conditions with exception
14 to Buckley Cove. At Buckley Cove, modeled drought period San Joaquin River fractions would
15 increase 15% in July and 26% in August when compared to No Action Alternative (Appendix 8D,
16 Source Water Fingerprinting). These increases would primarily balance through decreases in
17 Sacramento River water and eastside tributary waters. Nevertheless, the San Joaquin River would
18 only account for 37% of the total source water volume at Buckley Cove in July and August during the
19 modeled drought period. As such, these modeled changes in the source water fractions of
20 Sacramento, San Joaquin and Delta agriculture water are not of sufficient magnitude to substantially
21 alter the long-term risk of pesticide-related toxicity to aquatic life, nor adversely affect other
22 beneficial uses of the Delta. Unlike the comparison to Existing Conditions, the comparison to the No
23 Action Alternative reflects changes in Delta source water fractions due only to Alternative 1A
24 operations.

25 ***SWP/CVP Export Service Areas***

26 Assessment of effects in SWP/CVP Export Service Areas is based on effects seen in the Plan Area at
27 the Banks and Jones pumping plants. Under Alternative 1A, Sacramento River source water fractions
28 would increase substantially at both Banks and Jones pumping plants relative to Existing Conditions
29 and the No Action Alternative (Appendix 8D, Source Water Fingerprinting). Source water fractions
30 would generally increase from 13–53% for the period of December through June for the modeled
31 16-year hydrologic period and 13–40% from the period of March through May for the modeled
32 drought period. These increases in Sacramento source water fraction would primarily balance
33 through equivalent decreases in San Joaquin River fraction. Based on the general observation that
34 San Joaquin River, in comparison to the Sacramento River, is a greater contributor of OP insecticides
35 in terms of greater frequency of incidence and presence at concentrations exceeding water quality
36 benchmarks, modeled increases in Sacramento River fraction at Banks and Jones would generally
37 represent an improvement in export water quality respective to pesticides.

38 ***NEPA Effects:*** In summary, the changes in long-term average flows on the Sacramento, Feather,
39 American, and San Joaquin Rivers, under Alternative 1A relative to the No Action Alternative, are of
40 insufficient magnitude to substantially increase the long-term risk of pesticide-related water quality
41 degradation and related toxicity to aquatic life in these water bodies upstream of the Delta.
42 Similarly, modeled changes in source water fractions to the Delta are of insufficient magnitude to
43 substantially alter the long-term risk of pesticide-related water quality degradation and related
44 toxicity to aquatic life in the Delta or CVP/SWP export service areas. The effects on pesticides from
45 operations and maintenance (CM1) are determined not to be adverse.

1 **CEQA Conclusion:** Key findings discussed in the effects assessment relative to Existing Conditions is
2 provided above are summarized here, and are then compared to the CEQA thresholds of significance
3 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this
4 constituent. For additional details on the effects assessment findings that support this CEQA impact
5 determination, see the effects assessment discussion that immediately precedes this conclusion.

6 Sources of pesticides upstream of the Delta include direct input of pesticide containing surface
7 runoff from agriculture and urbanized areas. Flows in rivers receiving these discharges dilute these
8 pesticide inputs. Relative to Existing Conditions, however, modeled changes in long-term average
9 flows on the Sacramento, Feather, American, and San Joaquin Rivers are of insufficient magnitude to
10 substantially increase the long-term risk of pesticide-related water quality degradation and related
11 toxicity to aquatic life in these water bodies upstream of the Delta.

12 In the Delta, sources of pesticides include direct input of surface runoff from Delta agriculture and
13 Delta urbanized areas as well as inputs from rivers upstream of the Delta. While facilities operations
14 and maintenance activities would not affect these sources, changes in Delta source water fraction
15 could change the relative risk associated with pesticide related toxicity to aquatic life. Under
16 Alternative 1A, however, modeled changes in source water fractions relative to Existing Conditions
17 are of insufficient magnitude to substantially alter the long-term risk of pesticide-related toxicity to
18 aquatic life within the Delta, nor would such changes result in adverse pesticide-related effects on
19 any other beneficial uses of Delta waters.

20 The assessment of Alternative 1A effects on pesticides in the SWP/CVP Export Service Areas is
21 based on assessment of changes predicted at Banks and Jones pumping plants. As just discussed
22 regarding effects to pesticides in the Delta, modeled changes in source water fractions at the Banks
23 and Jones pumping plants are of insufficient magnitude to substantially alter the long-term risk of
24 pesticide-related toxicity to aquatic life beneficial uses, or any other beneficial uses, in water bodies
25 of the SWP and CVP export service area.

26 Based on the above, Alternative 1A would not result in any substantial change in long-term average
27 pesticide concentration or result in substantial increase in the anticipated frequency with which
28 long-term average pesticide concentrations would exceed aquatic life toxicity thresholds or other
29 beneficial use effect thresholds upstream of the Delta, at the 11 assessment locations analyzed for
30 the Delta, or the SWP/CVP service area. Numerous pesticides are currently used throughout the
31 affected environment, and while some of these pesticides may be bioaccumulative, those present-
32 use pesticides for which there is sufficient evidence for their presence in waters affected by SWP
33 and CVP operations (i.e., diazinon, chlorpyrifos, diuron, and pyrethroids) are not considered
34 bioaccumulative, and thus changes in their concentrations would not directly cause bioaccumulative
35 problems in aquatic life or humans. Furthermore, while there are numerous 303(d) listings
36 throughout the affected environment that name pesticides as the cause for beneficial use
37 impairment, the modeled changes in upstream river flows and Delta source water fractions would
38 not be expected to make any of these beneficial use impairments measurably worse. Because long-
39 term average pesticide concentrations are not expected to increase substantially, no long-term
40 water quality degradation with respect to pesticides is expected to occur and, thus, no adverse
41 effects on beneficial uses would occur. This impact is considered to be less than significant. No
42 mitigation is required.

1 **Impact WQ-22: Effects on Pesticide Concentrations Resulting from Implementation of CM2-**
 2 **CM22**

3 With the exception of CM13, the mostly non-land disturbing CM12–CM22 present no new sources of
 4 pesticides to the affected environment, including areas Upstream of the Delta, within the Plan Area,
 5 and the SWP/CVP Export Service Area. Implementation of urban stormwater treatment measures
 6 (CM19) may result in beneficial effects, to the extent that control measures treat or reduce pesticide
 7 loading from urban land uses. However, control of nonnative aquatic vegetation (CM13) associated
 8 with tidal habitat restoration efforts would include killing invasive and nuisance aquatic vegetation
 9 through direct application of herbicides or through alternative mechanical means. Use and selection
 10 of type of herbicides would largely be circumstance specific, but would follow existing control
 11 methods used by the California Department of Boating and Waterways (CDBW). The CDBW's use of
 12 herbicides is regulated by permits and regulatory agreements with the Central Valley Water Board,
 13 US Fish and Wildlife Service, and National Marine Fisheries Service and is guided by research
 14 conducted on the efficacy of vegetation control in the Delta through herbicide use. Through a
 15 program of adaptive management and assessment, the CDBW has employed a program of herbicide
 16 use that reduces potential environmental impacts, nevertheless, the CDBW found that impacts on
 17 water quality and associated aquatic beneficial uses would continue to occur and could not be
 18 avoided, including non-target impacts on aquatic invertebrates and beneficial aquatic plants
 19 (California Department of Boating and Waterways 2006).

20 In addition to the potential beneficial and adverse effects of CM19 and CM13, respectively, the
 21 various restoration efforts of CM2–CM11 could involve the conversion of active or fallow
 22 agricultural lands to natural landscapes, such as wetlands, grasslands, floodplains, and vernal pools.
 23 In the long-term, conversion of agricultural land to natural landscapes could possibly result in a
 24 limited reduction in pesticide use throughout the Delta. In the short-term, tidal and non-tidal
 25 wetland restoration, as well as seasonal floodplain restoration (i.e., CM4, CM5, and CM10) over
 26 former agricultural lands may include the contamination of water with pesticide residues contained
 27 in the soils. Present use pesticides typically degrade fairly rapidly, and in such cases where pesticide
 28 containing soils are flooded, dissipation of those pesticides would be expected to occur rapidly.
 29 Moreover, seasonal floodplain restoration (CM5) and Yolo Bypass enhancements (CM2) may be
 30 managed alongside continuing agriculture, where pesticides may be used on a seasonal basis and
 31 where water during flood events may come in contact with residues of these pesticides. Similarly,
 32 however, rapid dissipation would be expected, particularly in the large volumes of water involved in
 33 flooding. During these flooding events, pesticides potentially suspended in water would not be
 34 expected to cause toxicity to aquatic life or cause substantial adverse effects on any other beneficial
 35 uses of these water bodies.

36 **NEPA Effects:** In summary, CM13 of Alternative 1A proposes the use of herbicides to control
 37 invasive aquatic vegetation around habitat restoration sites. Herbicides directly applied to water
 38 could adversely affect non-target aquatic life, such as aquatic invertebrates and beneficial aquatic
 39 plants. Use of herbicides could potentially exceed aquatic life toxicity objectives with sufficient
 40 frequency and magnitude such that beneficial uses would be adversely affected, thus constituting an
 41 adverse effect on water quality. Mitigation Measure WQ-22 would be available to reduce this effect.

42 **CEQA Conclusion:** With the exception of CM13, implementation of CM2–CM22 would not present
 43 new or substantially increased sources of pesticides in the Plan Area. In the long-term,
 44 implementation of conservation measures could possibly result in a limited reduction in pesticide
 45 use throughout the Delta through the potential repurposing of active or fallow agricultural land for

1 natural habitat purposes. In the short-term, the repurposing of agricultural land associated with
 2 CM4, CM5, and CM10 may expose water used for habitat restoration to pesticide residues. Moreover,
 3 CM2 and CM5 may be managed alongside continuing agriculture, where pesticides may be used on a
 4 seasonal basis and where water during flood events may come in contact with residues of these
 5 pesticides. However, rapid dissipation would be expected, particularly in the large volumes of water
 6 involved in flooding, such that aquatic life toxicity objectives would not be exceeded by frequency,
 7 magnitude, and geographic extent whereby adverse effects on beneficial uses would be expected.
 8 Conservation Measures 2–22 do not include the use of pesticides known to be bioaccumulative in
 9 animals or humans, nor do the conservation measures propose the use of any pesticide currently
 10 named in a Section 303(d) listing of the affected environment. CM13 proposes the use of herbicides
 11 to control invasive aquatic vegetation around habitat restoration sites. Herbicides directly applied to
 12 water could include adverse effects on non-target aquatic life, such as aquatic invertebrates and
 13 beneficial aquatic plants. As such, aquatic life toxicity objectives could be exceeded with sufficient
 14 frequency and magnitude such that beneficial uses would be impacted. Potential environmental
 15 effects related only to CM13 are considered significant and unavoidable. Mitigation Measure WQ-22
 16 is available to partially reduce this impact of pesticides on water quality; however, no feasible
 17 mitigation is available that would reduce it to a level that would be less than significant. This impact
 18 is therefore considered significant and unavoidable.

19 **Mitigation Measure WQ-22: Implement Principals of Integrated Pest Management**

20 Implement the principals of integrated pest management (IPM) in the management of invasive
 21 aquatic vegetation under CM13, including the selective use of pesticides applied in a manner
 22 that minimizes risks to human health, nontarget organisms and the aquatic ecosystem. In doing
 23 so, the BDCP proponents will consult with the Central Valley Water Board, USFWS, NMFS, and
 24 CDBW to obtain effective IPM strategies such as selective application of pesticides, timing of
 25 applications in order to minimize tidal dispersion, and timing to target the invasive plant species
 26 at the most vulnerable times such that less herbicide can be used or the need for repeat
 27 applications can be reduced.

28 **Impact WQ-23: Effects on Phosphorus Concentrations Resulting from Facilities Operations** 29 **and Maintenance (CM1)**

30 ***Upstream of the Delta***

31 The conveyance facilities operations and maintenance (CM1) for Alternative 1A will not contribute
 32 additional sources of phosphorus to the water bodies upstream of the Delta. Because phosphorus
 33 loading to waters upstream of the Delta is not anticipated to change under Alternative 1A, and
 34 because changes in flows do not necessarily result in changes in concentrations or loading of
 35 phosphorus to these water bodies, as discussed for the No Action Alternative, substantial changes in
 36 phosphorus concentration are not anticipated in any of the water bodies of the affected
 37 environment located upstream of the Delta under Alternative 1A, relative to Existing Conditions or
 38 the No Action Alternative. Any negligible changes in phosphorus concentrations that may occur in
 39 these water bodies would not be of frequency, magnitude and geographic extent that would exceed
 40 adopted phosphorus objectives/criteria (because there are none), adversely affect any beneficial
 41 uses, or substantially degrade the quality of these water bodies, with regards to phosphorus.

Delta

As discussed for the No Action Alternative, because phosphorus concentrations in the major source waters to the Delta are similar for much of the year, phosphorus concentrations in the Delta are not anticipated to change substantially on a long term-average basis. Additionally, activities associated with CM1 will not contribute additional sources of phosphorus to the Delta. Phosphorus concentrations may increase during January through March at locations where the source fraction of San Joaquin River water increases, due to the higher concentration of phosphorus in the San Joaquin River during these months compared to Sacramento River water or San Francisco Bay water. Based on the DSM2 fingerprinting results (see Appendix 8D), together with source water concentrations show in Figure 8-56, the magnitude of increase during these months may range from negligible up to approximately 0.05 mg/L. However, there are no state or federal objectives for phosphorus, and because algal growth rates are limited by availability of light in the Delta, and thus increases or decreases in nutrient levels are, in general, expected to have little effect on productivity, any changes in phosphorus concentrations that may occur at certain locations within the Delta are not anticipated to be of frequency, magnitude and geographic extent that would adversely affect any beneficial uses or substantially degrade the water quality at these locations, with regards to phosphorus.

SWP/CVP Export Service Areas

Assessment of effects of phosphorus in the SWP and CVP Export Service Areas is based on effects on phosphorus at the Banks and Jones pumping plants.

Based on the DSM2 fingerprinting results (see Appendix 8D), together with source water concentrations show in Figure 8-56, long-term average monthly and annual phosphorus concentrations at Banks and Jones pumping plants are anticipated to decrease as a result of Sacramento River water replacing San Joaquin River water in exports. During drought conditions, phosphorus concentrations may increase during certain months, but these increases are expected to be negligible (<0.01 mg/L). There are no state or federal objectives for phosphorus. Moreover, given the many factors that contribute to potential algal blooms in the SWP and CVP canals within the Export Service Area, and the lack of studies that have shown a direct relationship between nutrient concentrations in the canals and reservoirs and problematic algal blooms in these water bodies, there is no basis to conclude that any seasonal increases in phosphorus concentrations at the levels expected under this alternative, should they occur, would increase the potential for problem algal blooms in the SWP and CVP Export Service Area.

Any increases in phosphorus concentrations that may occur in water exported via Banks and Jones pumping plants are not expected to result in adverse effects to beneficial uses of exported water or substantially degrade the quality of exported water, with regards to phosphorus.

NEPA Effects: The effects on phosphorus from implementing CM1 are determined to not be adverse.

CEQA Conclusion: Key findings discussed in the effects assessment relative to Existing Conditions is provided above are summarized here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this constituent. For additional details on the effects assessment findings that support this CEQA impact determination, see the effects assessment discussion that immediately precedes this conclusion.

Because phosphorus loading to waters upstream of the Delta is not anticipated to change, and because changes in flows do not necessarily result in changes in concentrations or loading of

1 phosphorus to these water bodies, substantial changes in phosphorus concentration upstream of the
2 Delta are not anticipated for Alternative 1A, relative to Existing Conditions.

3 Because phosphorus concentrations in the major source waters to the Delta are similar for much of
4 the year, phosphorus concentrations in the Delta are not anticipated to change substantially on a
5 long term-average basis under Alternative 1A, relative to Existing Conditions. Algal growth rates are
6 limited by availability of light in the Delta, and therefore any minor increases in phosphorus levels
7 that may occur at some locations and times within the Delta would be expected to have little effect
8 on primary productivity in the Delta.

9 The assessment of effects of phosphorus under Alternative 1A in the SWP and CVP Export Service
10 Areas is based on effects on phosphorus at the Banks and Jones pumping plants. As noted above,
11 phosphorus concentrations in the Delta (including Banks and Jones pumping plants) are not
12 anticipated to change substantially on a long term-average basis.

13 Based on the above, there would be no substantial, long-term increase in phosphorus concentrations
14 in the rivers and reservoirs upstream of the Delta, in the Delta Region, or the waters exported to the
15 CVP and SWP service areas under the Alternative 1A relative to Existing Conditions. As such, this
16 alternative is not expected to cause additional exceedance of applicable water quality objectives/
17 criteria by frequency, magnitude, and geographic extent that would cause adverse effects on any
18 beneficial uses of waters in the affected environment. Because phosphorus concentrations are not
19 expected to increase substantially, no long-term water quality degradation is expected to occur and,
20 thus, no adverse effects to beneficial uses would occur. Phosphorus is not 303(d) listed within the
21 affected environment and thus any minor increases that may occur in some areas would not make
22 any existing phosphorus-related impairment measurably worse because no such impairments
23 currently exist. Because phosphorus is not bioaccumulative, minor increases that may occur in some
24 areas would not bioaccumulate to greater levels in aquatic organisms that would, in turn, pose
25 substantial health risks to fish, wildlife, or humans. This impact is considered to be less than
26 significant. No mitigation is required.

27 **Impact WQ-24: Effects on Phosphorus Concentrations Resulting from Implementation of** 28 **CM2–CM22**

29 **NEPA Effects:** CM2–CM11 include activities that create additional aquatic habitat within the affected
30 environment, and therefore may increase the total amount of algae and plant-life within the Delta.
31 These activities would not affect phosphorus loading to the affected environment, but may affect
32 phosphorus dynamics and speciation. For example, water column concentrations of total
33 phosphorus may increase or decrease in localized areas as a result of increased or decreased
34 suspended solids, while ortho-phosphate concentrations may be locally altered as a result of
35 changing planktonic and macroinvertebrate species contributing to the cycling of phosphorus
36 within the affected environment. Additionally, depending on age, configuration, location, operation,
37 and season, some of the restoration measures included under these conservation measures may
38 function to remove or sequester phosphorus, but since presently, the specific design, operational
39 criteria, and location of these activities are not well established, the degree to which this would
40 occur is unknown. Overall, phosphorus concentrations are not expected to change substantially in
41 the affected environment as a result of CM2–CM22. Because increases or decreases in phosphorus
42 levels are, in general, expected to have little effect on productivity, any changes in phosphorus
43 concentrations that may occur at certain locations within the affected environment are not
44 anticipated to be of frequency, magnitude and geographic extent that would adversely affect any

1 beneficial uses or substantially degrade the water quality at these locations, with regards to
2 phosphorus.

3 Because urban stormwater is a source of phosphorus in the affected environment, CM19, Urban
4 Stormwater Treatment, is expected to slightly reduce phosphorus loading to the Delta, thus slightly
5 decreasing phosphorus concentrations relative to the No Action Alternative. Implementation of
6 CM12–CM18 and CM20–CM22 is not expected to substantially alter phosphorus concentrations in
7 the affected environment.

8 The effects on phosphorus from implementing CM2–22 are considered to be not adverse.

9 **CEQA Conclusion:** There would be no substantial, long-term increase in phosphorus concentrations
10 in the rivers and reservoirs upstream of the Delta, in the Delta Region, or the waters exported to the
11 CVP and SWP service areas due to implementation of CM2–CM22 under Alternative 1A relative to
12 Existing Conditions. Because urban stormwater is a source of phosphorus in the affected
13 environment, CM19, Urban Stormwater Treatment, is expected to slightly reduce phosphorus
14 loading to the Delta. As such, implementation of these conservation measures is not expected to
15 cause adverse effects on any beneficial uses of waters in the affected environment. Because
16 phosphorus concentrations are not expected to increase substantially due to these conservation
17 measures, no long-term water quality degradation is expected to occur and, thus, no adverse effects
18 to beneficial uses would occur. Phosphorus is not 303(d) listed within the affected environment and
19 thus any minor increases that may occur in some areas would not make any existing phosphorus-
20 related impairment measurably worse because no such impairments currently exist. Because
21 phosphorus is not bioaccumulative, minor increases that may occur in some areas would not
22 bioaccumulate to greater levels in aquatic organisms that would, in turn, pose substantial health
23 risks to fish, wildlife, or humans. This impact is considered to be less than significant. No mitigation
24 is required.

25 **Impact WQ-25: Effects on Selenium Concentrations Resulting from Facilities Operations and** 26 **Maintenance (CM1)**

27 ***Upstream of the Delta***

28 For the same reasons stated for the No Action Alternative, Alternative 1A would have negligible, if
29 any, effect on selenium concentrations in the rivers and reservoirs upstream of the Delta relative to
30 Existing Conditions and the No Action Alternative. Any negligible increases in selenium
31 concentrations that could occur in the water bodies of the affected environment in the Upstream of
32 the Delta Region would not be of frequency, magnitude, and geographic extent that would adversely
33 affect any beneficial uses or substantially degrade the quality of these water bodies, with regard to
34 selenium.

35 ***Delta***

36 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
37 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
38 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
39 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
40 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
41 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

1 As presented in Section 8.3.3.1, selenium concentrations would be similar among Existing
2 Conditions and the No Action Alternative; Alternative 1A would result in small changes in average
3 selenium concentrations in water at all modeled Delta assessment locations relative to Existing
4 Conditions and the No Action Alternative (Appendix 8M, Table M-10A). These small changes in
5 selenium concentrations in water are reflected in small percent changes (10% or less) in available
6 assimilative capacity for selenium (based on 2 µg/L ecological risk benchmark) for all years. Relative
7 to Existing Conditions, Alternative 1A would result in the largest modeled increase in available
8 assimilative capacity at Buckley Cove (5%) and the largest decrease at Contra Costa PP (2%) (Figure
9 8-59). Relative to the No Action Alternative, the largest modeled increase in available assimilative
10 capacity would be at Mokelumne River (South Fork) at Staten Island (Staten Island) (1%) and the
11 largest decrease would be at Franks Tract (2%) (Figure 8-60). Although there are some small
12 negative changes in selenium concentrations in water, the effect of Alternative 1A is generally
13 minimal for the Delta locations. Furthermore, the modeled selenium concentrations in water
14 (Appendix 8M, Table M-11) for Alternative 1A (range 0.21–0.70 µg/L) are similar to those for
15 Existing Conditions (range 0.21–0.76 µg/L), and the No Action Alternative (range 0.21–0.69 µg/L),
16 and all would be below the ecological risk benchmark (2 µg/L).

17 Relative to Existing Conditions and the No Action Alternative, Alternative 1A would result in small
18 changes in estimated selenium concentrations in biota (whole-body fish, bird eggs [invertebrate
19 diet], bird eggs [fish diet], and fish fillets) (Appendix 8M, Table M-12 and Addendum M.A to
20 Appendix 8M, Table M.A-2). Relative to Existing Conditions, the largest increase of selenium
21 concentrations in biota would be at Contra Costa PP for all years and for sturgeon at the two
22 western Delta locations in all years, and the largest decrease would be at Buckley Cove for drought
23 years. Relative to the No Action Alternative, the largest increase would be at Buckley Cove for
24 drought years (except for bird eggs [assuming a fish diet] at Franks Tract for all years) and for
25 sturgeon at the two western Delta locations in all years; the largest decrease would be at Staten
26 Island for all years (except for bird eggs [assuming a fish diet] at Buckley Cove for drought years).
27 Except for sturgeon in the western Delta, concentrations of selenium in whole-body fish and bird
28 eggs (invertebrate and fish diets) would exceed only the lower benchmarks (4 and 6 mg/kg dry
29 weight, respectively, indicating a low potential for effects), under drought conditions, at Buckley
30 Cove for Existing Conditions and the No Action Alternative, and Alternative 1A (Figures 8-61
31 through 8-63). However, Exceedance Quotients for these exceedances of the lower benchmarks for
32 Alternative 1A are between 1.0 and 1.5 (similar to Existing Conditions and the No Action
33 Alternative), indicating a low risk to biota in the Delta and no substantial difference from Existing
34 Conditions and the No Action Alternative. Selenium concentrations in fish fillets would not exceed
35 the screening value for protection of human health (Figure 8-64). For sturgeon in the western Delta,
36 whole-body selenium concentrations would increase from 12.3 mg/kg under Existing Conditions
37 and the No Action Alternative to 13.1 mg/kg under Alternative 1A, a 7% increase (Table M.A-2).
38 Although all of these values exceed both the low and high toxicity benchmarks, it is unlikely that the
39 modeled increases in whole-body selenium for sturgeon would be measurable in the environment
40 (see also the discussion of results provided in Addendum M.A to Appendix 8M).

41 Relative to Existing Conditions and the No Action Alternative, Alternative 1A would result in
42 essentially no change in selenium concentrations throughout the Delta. Alternative 1A would not be
43 expected to substantially increase the frequency with which applicable benchmarks would be
44 exceeded in the Delta or substantially degrade the quality of water in the Delta, with regard to
45 selenium.

1 **SWP/CVP Export Service Areas**

2 As presented in Section 8.3.3.1, effects on selenium concentrations in water would vary little among
3 Existing Conditions the and No Action Alternative, and Alternative 1A would result in only small
4 changes in average selenium concentrations in water at the two modeled Export Service Area
5 assessment locations relative to Existing Conditions and the No Action Alternative (Appendix 8M,
6 Table M-10A). These small changes in selenium concentrations in water are reflected in small
7 percent changes (10% or less) in available assimilative capacity for selenium (based on 2 µg/L
8 ecological risk benchmark) for all years. Relative to Existing Conditions and the No Action
9 Alternative, Alternative 1A would result in small increases in available assimilative capacity at Jones
10 PP (6% and 7%, respectively) and at Banks PP (6% and 5%, respectively), and have a small positive
11 effect on the Export Service Area locations (Figures 8-59 and 8-60). Furthermore, the modeled
12 selenium concentrations in water (Table 8.3-E-Se) for Alternative 1A (range 0.37–0.50 µg/L) are
13 similar to those for Existing Conditions (range 0.37–0.58 µg/L) and the No Action Alternative (range
14 0.37–0.59 µg/L), and all would be well below the ecological risk benchmark (2 µg/L).

15 Relative to Existing Conditions and the No Action Alternative, Alternative 1A would result in small
16 changes in estimated selenium concentrations in biota (whole-body fish, bird eggs [invertebrate
17 diet], bird eggs [fish diet], and fish fillets) (Appendix 8M, Table M-12). Relative to Existing
18 Conditions and the No Action Alternative, the largest increase of selenium concentrations in biota
19 under Alternative 1A would be at Banks PP for drought years, and the largest decrease would be at
20 Jones PP for all years (except for bird eggs [assuming a fish diet] at Jones PP for drought years).
21 Relative to the No Action Alternative, the largest increase under Alternative 1A would be at Banks
22 PP for drought years (except for bird eggs [assuming a fish diet] at Banks PP for all years), and the
23 largest decrease would be at Jones PP for all years (except for bird eggs [assuming a fish diet] at
24 Jones PP for drought years). However, concentrations in biota would not exceed any benchmarks for
25 Alternative 1A (Figures 8-61 through 8-64).

26 Thus, relative to Existing Conditions and the No Action Alternative, Alternative 1A would result in
27 minimal changes in selenium concentrations at the Export Service Area locations. Selenium
28 concentrations in water and biota would generally decrease under Alternative 1A and would not
29 exceed ecological benchmarks at either location, whereas the lower benchmark for bird eggs (fish
30 diet) would be exceeded under Existing Conditions and the No Action Alternative at Jones PP for
31 drought years. This small positive change in selenium concentrations under Alternative 1A would be
32 expected to slightly decrease the frequency with which applicable benchmarks would be exceeded
33 or slightly improve the quality of water at the Export Service Area locations, with regard to
34 selenium.

35 **NEPA Effects:** Based on the discussion above, the effects on selenium (both as waterborne and as
36 bioaccumulated in biota) from Alternative 1A are not considered to be adverse.

37 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
38 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
39 purpose of making the CEQA impact determination for selenium. For additional details on the effects
40 assessment findings that support this CEQA impact determination, see the effects assessment
41 discussion that immediately precedes this conclusion.

42 There are no substantial point sources of selenium in watersheds upstream of the Delta, and no
43 substantial nonpoint sources of selenium in the watersheds of the Sacramento River and the eastern
44 tributaries. Nonpoint sources in the San Joaquin Valley that contribute selenium to the Delta will be

1 controlled through a TMDL developed by the Central Valley Water Board (2001) for the lower San
2 Joaquin River, established limits for the Grassland Bypass Project, and Basin Plan objectives (Central
3 Valley Water Board 2010c) and State Water Board (2010d, 2010e) that are expected to result in
4 decreasing discharges of selenium from the San Joaquin River to the Delta. Consequently, any
5 modified reservoir operations and subsequent changes in river flows under Alternative 1A, relative
6 to Existing Conditions, are expected to cause negligible changes in selenium concentrations in water.
7 Any negligible changes in selenium concentrations that may occur in the water bodies of the affected
8 environment located upstream of the Delta would not be of frequency, magnitude, and geographic
9 extent that would adversely affect any beneficial uses or substantially degrade the quality of these
10 water bodies as related to selenium.

11 Relative to Existing Conditions, modeling estimates indicate that Alternative 1A would result in
12 essentially no change in selenium concentrations in water or biota throughout the Delta.

13 Assessment of effects of selenium in the SWP and CVP Export Service Areas is based on effects on
14 selenium concentrations at the Banks and Jones pumping plants. Relative to Existing Conditions,
15 Alternative 1A would slightly decrease the frequency with which applicable benchmarks would be
16 exceeded or slightly improve the quality of water in selenium concentrations at the Banks and Jones
17 pumping plants locations.

18 Based on the above, selenium concentrations that would occur in water under Alternative 1A would
19 not cause additional exceedances of applicable state or federal numeric or narrative water quality
20 objectives/criteria, or other relevant water quality effects thresholds identified for this assessment
21 (Appendix 8M, Table 8-54), by frequency, magnitude, and geographic extent that would result in
22 adverse effects to one or more beneficial uses within affected water bodies. In comparison to
23 Existing Conditions, water quality conditions under this alternative would not increase levels of
24 selenium by frequency, magnitude, and geographic extent such that the affected environment would
25 be expected to have measurably higher body burdens of selenium in aquatic organisms, thereby
26 substantially increasing the health risks to wildlife (including fish) or humans consuming those
27 organisms. Water quality conditions under this alternative with respect to selenium would not cause
28 long-term degradation of water quality in the affected environment, and therefore would not result
29 in use of available assimilative capacity such that exceedances of water quality objectives/criteria
30 would be likely and would result in substantially increased risk for adverse effects to one or more
31 beneficial uses. This alternative would not further degrade water quality by measurable levels, on a
32 long-term basis, for selenium and, thus, cause the 303(d)-listed impairment of beneficial use to be
33 made discernibly worse. This impact is considered to be less than significant. No mitigation is
34 required.

35 **Impact WQ-26: Effects on Selenium Concentrations Resulting from Implementation of CM2-** 36 **CM22**

37 **NEPA Effects:** In general, with the possible exception of changes in Delta hydrodynamics resulting
38 from habitat restoration, CM2–CM11 would not substantially increase selenium concentrations in
39 the water bodies of the affected environment. Modeling scenarios included assumptions regarding
40 how certain habitat restoration activities (CM2 and CM4) would affect Delta hydrodynamics, and
41 thus such effects of these restoration measures were included in the assessment of CM1 facilities
42 operations and maintenance (see Impact WQ-25).

43 However, implementation of these conservation measures may increase water residence time
44 within the restoration areas. Increased restoration area water residence times could potentially

1 increase the bioaccumulation of selenium in biota, thereby potentially increasing fish tissue and bird
2 egg concentrations of selenium, but models are not available to quantitatively estimate the level of
3 changes in residence time and the associated selenium bioavailability. If increases in fish tissue or
4 bird egg selenium were to occur, the increases would likely be of concern only where fish tissues or
5 bird eggs are already elevated in selenium to near or above thresholds of concern. That is, where
6 biota concentrations are currently low and not approaching thresholds of concern, changes in
7 residence time alone would not be expected to cause them to then approach or exceed thresholds of
8 concern. In consideration of this factor, although the Delta as a whole is a 303(d)-listed water body
9 for selenium, and although monitoring data of fish tissue or bird eggs in the Delta are sparse, the
10 most likely areas in which biota tissues would be at levels high enough that additional
11 bioaccumulation due to increased residence time from restoration areas would be a concern are the
12 western Delta and Suisun Bay, and the South Delta in areas that receive San Joaquin River water.

13 The western Delta and Suisun Bay receive elevated selenium loads from North San Francisco Bay
14 (including San Pablo Bay, Carquinez Strait, and Suisun Bay) and from the San Joaquin River. Point
15 sources of selenium in North San Francisco Bay (i.e., refineries) that contribute selenium to Suisun
16 Bay are expected to be reduced through a TMDL under development by the San Francisco Bay Water
17 Board (San Francisco Bay Water Board 2012) that is expected to result in decreasing discharges of
18 selenium. Nonpoint sources of selenium in the San Joaquin Valley that contribute selenium to the
19 San Joaquin River, and thus the Delta and Suisun Bay, will be controlled through a TMDL developed
20 by the Central Valley Water Board (2001) for the lower San Joaquin River, established limits for the
21 Grassland Bypass Project, and Basin Plan objectives (Central Valley Water Board 2010c, d) that are
22 expected to result in decreasing discharges of selenium from the San Joaquin River to the Delta. If
23 selenium levels are not sufficiently reduced via these efforts, it is expected that the State Water
24 Board and the San Francisco Bay and Central Valley Water Boards would initiate additional actions
25 to further control sources of selenium.

26 The South Delta receives elevated selenium loads from the San Joaquin River. In contrast to Suisun
27 Bay and possibly the western Delta in the future, the South Delta lacks the overbite clam (*Corbula*
28 [*Potamocorbula*] *amurensis*), which is considered a key driver of selenium bioaccumulation in
29 Suisun Bay, due to its high bioaccumulation of selenium and its role in the benthic food web that
30 includes long-lived sturgeon. The South Delta does have *Corbicula fluminea*, another bivalve that
31 bioaccumulates selenium, but it is not as invasive as the overbite clam and thus likely makes up a
32 smaller fraction of sturgeon diet. Also, as mentioned above, nonpoint sources of selenium in the San
33 Joaquin Valley that contribute selenium to the Delta will be controlled through a TMDL developed by
34 the Central Valley Water Board (2001) for the lower San Joaquin River, established limits for the
35 Grassland Bypass Project, and Basin Plan objectives (Central Valley Water Board 2010c, d) that are
36 expected to result in decreasing discharges of selenium from the San Joaquin River to the Delta.
37 Further, if selenium levels in the San Joaquin River are not sufficiently reduced via these efforts, it is
38 expected that the State Water Board and Central Valley Water Board would initiate additional
39 TMDLs to further control nonpoint sources of selenium.

40 Wetland restoration areas will not be designed such that water flows in and does not flow out.
41 Exchange of water between the restoration areas and existing Delta channels is an important design
42 factor, since one goal of the restoration areas is to export food produced in these areas to the rest of
43 the Delta (see BDCP Chapter 3, *Conservation Strategy*, Section 3.3, Biological Goals and Objectives).
44 Thus, these areas can be thought of as “flow-through” systems. Consequently, although water
45 residence times associated with BDCP restoration could increase, they are not expected to increase

1 without bound. and selenium concentrations in the water column would not continue to build up
2 and be recycled in sediments and organisms as may be the case within a closed system.

3 However, because increases in bioavailable selenium in the habitat restoration areas are uncertain,
4 proposed avoidance and minimization measures would require evaluating risks of selenium
5 exposure at a project level for each restoration area, minimizing to the extent practicable potential
6 risk of additional bioaccumulation, and monitoring selenium levels in fish and/or wildlife to
7 establish whether, or to what extent, additional bioaccumulation is occurring. See Appendix 3B,
8 *Environmental Commitments* for a description of the environmental commitment BDCP proponents
9 are making with respect to Selenium Management; and Appendix 3.C. of the BDCP for additional
10 detail on this avoidance and minimization measure (AMM27). Data generated as part of the
11 avoidance and minimization measures will assist the State and Regional Water Boards in
12 determining whether beneficial uses are being impacted by selenium, and thus will provide the data
13 necessary to support regulatory actions (including additional TMDL development), should such
14 actions be warranted.

15 Given the factors discussed in the assessment above, any increases in bioaccumulation rates from
16 water-borne selenium that could occur in some areas as a result of increased water residence time
17 would not be of sufficient magnitude and geographic extent that any portion of the Delta would be
18 expected to have measurably higher body burdens of selenium in aquatic organisms and, therefore,
19 would not substantially increase risk for adverse effects to beneficial uses. Furthermore, although
20 the Delta is a 303(d)-listed water body for selenium, given the discussion in the assessment above, it
21 is unlikely that restoration areas would result in measurable increases in selenium in fish tissues or
22 bird eggs such that the beneficial use impairment would be made discernibly worse.

23 Because it is unlikely that substantial increases in selenium in fish tissues or bird eggs would occur
24 such that effects on aquatic life beneficial uses would be anticipated, and because of the avoidance
25 and minimization measures that are designed to further minimize and evaluate the risk of such
26 increases, the effects of WQ-26 are considered not adverse.

27 **CEQA Conclusion:** There would be no substantial, long-term increase in selenium concentrations in
28 water in the rivers and reservoirs upstream of the Delta, water in the Delta, or the waters exported
29 to the CVP and SWP service areas due to implementation of CM2–CM22 relative to Existing
30 Conditions. Waterborne selenium concentrations under this alternative would not exceed applicable
31 water quality objectives/criteria.

32 Given the factors discussed in the assessment above, any increases in bioaccumulation rates from
33 water-borne selenium that could occur in some areas as a result of increased water residence times
34 would not be of sufficient magnitude and geographic extent that any portion of the Delta would be
35 expected to have measurably higher body burdens of selenium in aquatic organisms, and therefore
36 would not substantially increase risk for adverse effects to beneficial uses. CM2-22 would not cause
37 long-term degradation of water quality resulting in sufficient use of available assimilative capacity
38 such that occasionally exceeding water quality objectives/criteria would be likely. Also, CM2-22
39 would not result in substantially increased risk for adverse effects to any beneficial uses.
40 Furthermore, although the Delta is a 303(d)-listed water body for selenium, given the discussion in
41 the assessment above, it is unlikely that restoration areas would result in measurable increases in
42 selenium in fish tissues or bird eggs such that the beneficial use impairment would be made
43 discernibly worse.

1 Since it is unlikely that substantial increases in selenium in fish tissues or bird eggs would occur
2 such that effects on aquatic life beneficial uses would be anticipated, and because of the avoidance
3 and minimization measures that are designed to further minimize and evaluate the risk of such
4 increases (see Appendix 3.C. of the BDCP for more detail on AMM27) also described as the Selenium
5 Management environmental commitment (see Appendix 3B, *Environmental Commitments*), this
6 impact is considered less than significant. No mitigation is required.

7 **Impact WQ-27: Effects on Trace Metal Concentrations Resulting from Facilities Operations** 8 **and Maintenance (CM1)**

9 ***Upstream of the Delta***

10 For the same reasons stated for the No Action Alternative, Alternative 1A would result in negligible,
11 and likely immeasurable, increases in trace metal concentrations in the rivers and reservoirs
12 upstream of the Delta, relative to Existing Conditions and the No Action Alternative. Effects due to
13 the operation and maintenance of the conveyance facilities are expected to be immeasurable, on an
14 annual and long-term average basis. As such, Alternative 1A would not be expected to substantially
15 increase the frequency with which applicable Basin Plan objectives or CTR criteria would be
16 exceeded in water bodies of the affected environment located upstream of the Delta or substantially
17 degrade the quality of these water bodies, with regard to trace metals.

18 ***Delta***

19 For the same reasons stated for the No Action Alternative, Alternative 1A would not result in
20 substantial increases in trace metal concentrations in the Delta relative to Existing Conditions and
21 the No Action Alternative. Effects due to the operation and maintenance of the conveyance facilities
22 are expected to be negligible, on a long-term average basis. As such, Alternative 1A would not be
23 expected to substantially increase the frequency with which applicable Basin Plan objectives or CTR
24 criteria would be exceeded in the Delta or substantially degrade the quality of Delta waters, with
25 regard to trace metals.

26 ***SWP/CVP Export Service Areas***

27 For the same reasons stated for the No Action Alternative, Alternative 1A would not result in
28 substantial increases in trace metal concentrations in the water exported from the Delta or diverted
29 from the Sacramento River through the proposed conveyance facilities. As such, there is not
30 expected to be substantial changes in trace metal concentrations in the SWP/CVP export service
31 area waters under Alternative 1A, relative to Existing Conditions and the No Action Alternative. As
32 such, Alternative 1A would not be expected to substantially increase the frequency with which
33 applicable Basin Plan objectives or CTR criteria would be exceeded in the water bodies of the
34 affected environment in the SWP and CVP Service Area or substantially degrade the quality of these
35 water bodies, with regard to trace metals.

36 ***NEPA Effects:*** In summary, Alternative 1A, relative to the No Action Alternative, would not cause a
37 substantial increase in long-term average trace metals concentrations within the affected
38 environment, nor would it cause an increased frequency of water quality objective/criteria
39 exceedances within the affected environment. The effect on trace metals is determined not to be
40 adverse.

1 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
2 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
3 purpose of making the CEQA impact determination for this constituent. For additional details on the
4 effects assessment findings that support this CEQA impact determination, see the effects assessment
5 discussion that immediately precedes this conclusion.

6 While greater water demands under the Alternative 1A would alter the magnitude and timing of
7 reservoir releases north, south and east of the Delta, these activities would have no substantial effect
8 on the various watershed sources of trace metals. Moreover, long-term average flow and trace
9 metals at Sacramento River at Hood and San Joaquin River at Vernalis are poorly correlated;
10 therefore, changes in river flows would not be expected to cause a substantial long-term change in
11 trace metal concentrations upstream of the Delta.

12 Average and 95th percentile trace metal concentrations are very similar across the primary source
13 waters to the Delta. Given this similarity, very large changes in source water fraction would be
14 necessary to effect a relatively small change in trace metal concentration at a particular Delta
15 location. Moreover, average and 95th percentile trace metal concentrations for these primary source
16 waters are all below their respective water quality criteria, including those that are hardness-based
17 without a WER adjustment. No mixing of these three source waters could result in a metal
18 concentration greater than the highest source water concentration, and given that trace metals do
19 not already exceed water quality criteria, more frequent exceedances of criteria in the Delta would
20 not be expected to occur under the Alternative 1A.

21 The assessment of the Alternative 1A effects on trace metals in the SWP/CVP Export Service Areas is
22 based on assessment of changes in trace metal concentrations at Banks and Jones pumping plants.
23 As just discussed regarding similarities in Delta source water trace metal concentrations, the
24 Alternative 1A is not expected to result in substantial changes in trace metal concentrations in Delta
25 waters, including Banks and Jones pumping plants, therefore effects on trace metal concentrations
26 in the SWP/CVP Export Service Area are expected to be negligible.

27 Based on the above, there would be no substantial long-term increase in trace metal concentrations
28 in the rivers and reservoirs upstream of the Delta, in the Delta Region, or the SWP/CVP export
29 service area waters under Alternative 1A relative to Existing Conditions. As such, this alternative is
30 not expected to cause additional exceedance of applicable water quality objectives by frequency,
31 magnitude, and geographic extent that would cause adverse effects on any beneficial uses of waters
32 in the affected environment. Because trace metal concentrations are not expected to increase
33 substantially, no long-term water quality degradation for trace metals is expected to occur and, thus,
34 no adverse effects to beneficial uses would occur. Furthermore, any negligible changes in long-term
35 trace metal concentrations that may occur in water bodies of the affected environment would not be
36 expected to make any existing beneficial use impairments measurably worse. The trace metals
37 discussed in this assessment are not considered bioaccumulative, and thus would not directly cause
38 bioaccumulative problems in aquatic life or humans. This impact is considered to be less than
39 significant. No mitigation is required.

40 **Impact WQ-28: Effects on Trace Metal Concentrations Resulting from Implementation of** 41 **CM2–CM22**

42 **NEPA Effects:** Implementation of CM2–CM22 present no new sources of trace metals to the affected
43 environment, including areas upstream of the Delta, within the Delta, or in the SWP and CVP service
44 areas. However, CM19, which would fund projects to contribute to reducing pollutant discharges in

1 stormwater, would be expected to reduce trace metal loading to surface waters of the affected
 2 environment. The remaining conservation measures would not be expected to affect trace metal
 3 levels, because they are actions that do not affect the presence of trace metal sources. As they
 4 pertain to trace metals, implementation of these conservation measures would not be expected to
 5 adversely affect beneficial uses of the affected environment or substantially degrade water quality
 6 with respect to trace metals.

7 In summary, implementation of CM2–CM22 under Alternative 1A, relative to the No Action
 8 Alternative, would have negligible, if any, effect on trace metals concentrations. The effect on trace
 9 metals from implementing CM2–CM22 is determined not to be adverse.

10 **CEQA Conclusion:** Implementation of CM2–CM22 under Alternative 1A would not cause substantial
 11 long-term increase in trace metal concentrations in the rivers and reservoirs upstream of the Delta,
 12 in the Delta Region, or the SWP/CVP export service area. As such, this alternative is not expected to
 13 cause additional exceedance of applicable water quality objectives by frequency, magnitude, and
 14 geographic extent that would cause adverse effects on any beneficial uses of waters in the affected
 15 environment. Because trace metal concentrations are not expected to increase substantially, no
 16 long-term water quality degradation for trace metals is expected to occur and, thus, no adverse
 17 effects to beneficial uses would occur. Furthermore, any negligible changes in long-term trace metal
 18 concentrations that may occur throughout the affected environment would not be expected to make
 19 any existing beneficial use impairments measurably worse. The trace metals discussed in this
 20 assessment are not considered bioaccumulative, and thus would not directly cause bioaccumulative
 21 problems in aquatic life or humans. This impact is considered to be less than significant. No
 22 mitigation is required.

23 **Impact WQ-29: Effects on TSS and Turbidity Resulting from Facilities Operations and** 24 **Maintenance (CM1)**

25 ***Upstream of the Delta***

26 For the same reasons stated for the No Action Alternative, Alternative 1A is expected to have
 27 minimal effect on TSS concentrations and turbidity levels (highs, lows, typical conditions) in
 28 reservoirs and rivers upstream of the Delta relative to Existing Conditions and the No Action
 29 Alternative. Any minor increases in TSS concentrations and turbidity levels that may occur under
 30 Alternative 1A would not be of sufficient frequency, magnitude, and geographic extent that would
 31 result in adverse effects on beneficial uses within the Upstream of the Delta Region, or substantially
 32 degrade the quality of these water bodies, with regard to TSS and turbidity.

33 ***Delta***

34 The TSS concentrations and turbidity levels of Delta inflows under operational and maintenance
 35 conditions of Alternative 1A are not expected to be substantially different from those occurring
 36 under Existing Conditions or would occur under the No Action Alternative. However, the
 37 implementation of this alternative would change the quantity of Delta inflows, which would affect
 38 Delta hydrodynamics and, thus, erosion and deposition potential in certain Delta channels. Localized
 39 changes in TSS concentrations and turbidity levels could occur, depending on how rapidly the Delta
 40 hydrodynamics are altered and the channels equilibrate with the new tidal flux regime, after
 41 implementation of this alternative. The magnitude of increases in TSS concentrations and turbidity
 42 levels in the affected channels due to higher potential of erosion cannot be readily quantified.
 43 However, geomorphic changes associated with sediment transport and deposition are usually

1 gradual, occurring over years. Because the diversions would not substantially affect flows in high
2 storm events, it is expected that the TSS concentrations and turbidity levels in the affected channels
3 would not be substantially different from the levels under Existing Conditions or the No Action
4 Alternative. Consequently, any notable increases in TSS concentrations and turbidity levels that may
5 occur under Alternative 1A would likely be short-term in nature and long-term changes under this
6 alternative would not be of sufficient frequency, magnitude and geographic extent that would result
7 in adverse effects on beneficial uses in the Delta region, or substantially degrade the quality of these
8 water bodies, with regard to TSS and turbidity.

9 ***SWP/CVP Export Service Areas***

10 The water delivered to the SWP/CVP Export Service Areas would differ from that under Existing
11 Conditions and the No Action Alternative, as it would consist of water diverted directly from the
12 Sacramento River at Hood in addition to water withdrawn from the Delta at the current export
13 pumps. Historical median turbidity levels in the Sacramento River at Hood (11 NTU) and in the Delta
14 waters at the Harvey O. Banks Pumping Plant Headworks (11 NTU) are similar (Figure 8-47) and
15 mean turbidity levels differ by 5 NTU (13 NTU at Banks pumping plant and 18 NTU in the
16 Sacramento River at Hood). Thus, it is expected that the TSS concentrations and turbidity levels in
17 the vicinity of the south Delta export pumps would not be substantially different from the levels
18 under the Existing Conditions or the No Action Alternative. Consequently, the increases in TSS
19 concentrations and turbidity levels that may occur under Alternative 1A would not be of sufficient
20 frequency, magnitude, and geographic extent that would result in adverse effects on beneficial uses
21 within the SWP/CVP Export Service Areas or substantially degrade the quality of these water bodies,
22 with regard to TSS and turbidity.

23 ***NEPA Effects:*** The effects on TSS and turbidity from implementing CM1 is determined to not be
24 adverse.

25 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
26 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
27 purpose of making the CEQA impact determination for this constituent. For additional details on the
28 effects assessment findings that support this CEQA impact determination, see the effects assessment
29 discussion that immediately precedes this conclusion.

30 Changes river flow rate and reservoir storage that would occur under Alternative 1A, relative to
31 Existing Conditions, would not be expected to result in a substantial adverse change in TSS
32 concentrations and turbidity levels in the reservoirs and rivers upstream of the Delta, given that
33 suspended sediment concentrations are more affected by season than flow. Site-specific and
34 temporal exceptions may occur due to localized temporary construction activities, dredging
35 activities, development, or other land use changes would be site-specific and temporal, which would
36 be regulated to limit both their short-term and long-term effects on TSS and turbidity levels to less
37 than substantial levels.

38 Within the Delta, geomorphic changes associated with sediment transport and deposition are
39 usually gradual, occurring over years, and high storm event inflows would not be substantially
40 affected. Thus, it is expected that the TSS concentrations and turbidity levels in the affected channels
41 would not be substantially different from the levels under Existing Conditions. Consequently, this
42 alternative is expected to have minimal effect on TSS concentrations and turbidity levels in the Delta
43 region, relative to Existing Conditions.

1 There is not expected to be substantial, if even measurable, changes in TSS concentrations and
2 turbidity levels in the SWP/CVP Export Service Areas waters under Alternative 1A, relative to
3 Existing Conditions, because this alternative is not expected to result in substantial changes in TSS
4 concentrations and turbidity levels at the south Delta export pumps, relative to Existing Conditions.

5 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
6 objectives where such objectives are not exceeded under Existing Conditions. Because TSS
7 concentrations and turbidity levels are not expected to be substantially different, long-term water
8 quality degradation is not expected, and, thus, beneficial uses are not expected to be adversely
9 affected. Finally, TSS and turbidity are neither bioaccumulative nor Clean Water Act section 303(d)
10 listed constituents. This impact is considered to be less than significant. No mitigation is required.

11 **Impact WQ-30: Effects on TSS and Turbidity Resulting from Implementation of CM2–CM22**

12 **NEPA Effects:** Creation of habitat and open water through implementation of CM2–CM11 could
13 affect Delta hydrodynamics and, thus, erosion and deposition potential in certain Delta channels.
14 The magnitude of increases in TSS concentrations and turbidity levels in the affected channels due
15 to higher potential of erosion cannot be readily quantified. The increases in TSS concentrations and
16 turbidity levels in the affected channels could be substantial in localized areas, depending on how
17 rapidly the Delta hydrodynamics are altered and the channels equilibrate with the new tidal flux
18 regime, after implementation of this alternative. However, geomorphic changes associated with
19 sediment transport and deposition are usually gradual, occurring over years. Within the
20 reconfigured channels there could be localized increases in TSS concentrations and turbidity levels,
21 but within the greater Plan Area it is expected that the TSS concentrations and turbidity levels
22 would not be substantially different from the levels under the No Action Alternative.

23 CM19, which would fund projects to contribute to reducing pollutant discharges in stormwater,
24 would be expected to reduce TSS and turbidity in urban discharges relative to the No Action
25 Alternative. The remaining conservation measures (i.e., CM12-CM18, CM20-CM22) would not be
26 expected to affect TSS concentrations and turbidity levels, because they are actions that do not affect
27 the presence of TSS and turbidity sources.

28 The effects on TSS and turbidity from implementing CM2–CM22 is determined to not be adverse.

29 **CEQA Conclusion:** It is expected that the TSS concentrations and turbidity levels Upstream of the
30 Delta, in the Plan Area, and the SWP/CVP Export Service Areas due to implementation of CM2–CM22
31 under Alternative 1A would not be substantially different relative to Existing Conditions, except
32 within localized areas of the Delta modified through creation of habitat and open water. Therefore,
33 this alternative is not expected to cause additional exceedance of applicable water quality objectives
34 where such objectives are not exceeded under Existing Conditions. Because TSS concentrations and
35 turbidity levels Upstream of the Delta, in the greater Plan Area, and in the SWP/CVP Export Service
36 Areas are not expected to be substantially different, long-term water quality degradation is not
37 expected relative to TSS and turbidity, and, thus, beneficial uses are not expected to be adversely
38 affected. Finally, TSS and turbidity are neither bioaccumulative nor Clean Water Act section 303(d)
39 listed constituents. This impact is considered to be less than significant. No mitigation is required.

1 **Impact WQ-31: Water Quality Effects Resulting from Construction-Related Activities (CM1–**
2 **CM22)**

3 This section addresses construction-related water quality effects to constituents of concern other
4 than effects caused by changes in the operations and maintenance of CM1–CM22, which are
5 addressed in terms of constituent-specific impact assessments elsewhere in this chapter. Under
6 Alternative 1A, the majority of construction-related activities for CM1–CM22 would occur within the
7 Delta. Few, if any, of the CM1–CM22 actions involve construction work in the SWP and CVP Service
8 Area or areas upstream of the Delta. The conservation measures, or components of measures, that
9 are anticipated to be constructed in areas upstream of the Delta would be limited to: (1) the Yolo
10 Bypass Fishery Enhancement (CM2) (i.e., the Fremont Weir component of the action), (2)
11 Conservation Hatcheries (CM18) (i.e., the new hatchery facility), and (3) Urban Stormwater
12 Treatment (CM19).

13 Within the Delta, the construction-related activities for Alternative 1A would be most extensive for
14 CM1 involving the new water conveyance facilities. Construction of water conveyance facilities
15 would involve vegetation removal, material storage and handling, excavation, overexcavation for
16 facility foundations, surface grading, trenching, road construction, levee construction, construction
17 site dewatering, soil stockpiling, reusable tunnel material (RTM) dewatering basin construction and
18 storage operations, and other general facility construction activities (i.e., concrete, steel, carpentry,
19 and other building trades) over approximately 7,500 acres during the course of constructing the
20 facilities. Vegetation would be removed (via grubbing and clearing) and grading and other
21 earthwork would be conducted at the intakes, pumping plants, the intermediate forebay, the Byron
22 Tract Forebay, canal and gates between the Byron Tract Forebay tunnel shafts and the approach
23 canal to the Banks Pumping Plant, borrow areas, RTM and spoil storage areas, setback and
24 transition levees, sedimentation basins, solids handling facilities, transition structures, surge shafts
25 and towers, substations, transmission line footings, access roads, concrete batch plants, fuel stations,
26 bridge abutments, barge unloading facilities, and laydown areas. Construction of each intake would
27 take nearly 4 years to complete.

28 Habitat restoration activities in the Delta (i.e., CM4–CM10), including restored tidal wetlands,
29 floodplain, and related channel margin and off-channel habitats, also would involve substantial in-
30 water construction-related activities across widespread areas of the Delta. Construction activities
31 also would occur for CM2 in the Yolo Bypass to implement fish enhancement features. Anticipated
32 construction activities that may occur under CM11–CM22, if any, would involve relatively minor
33 disturbances, and thus would not be anticipated to result in substantial discharges of any
34 constituents of concern.

35 **NEPA Effects:** The types of potential construction-related materials used, soil and vegetation
36 disturbance activities, potential contaminants associated with implementation of CM1–CM22 under
37 Alternative 1A would result in similar potential contaminant discharges to water bodies and
38 associated water quality effects to those discussed above for the No Action Alternative. Construction
39 activities also may result in temporary or permanent changes in stormwater drainage and runoff
40 patterns (i.e., velocity, volume, and direction) that may cause or contribute to soil erosion and offsite
41 sedimentation. However, relative to Existing Conditions and the No Action Alternative conditions,
42 these additional major land and in-water disturbances and related site development activities would
43 be more widespread than non-BDCP projects, and therefore would increase the potential to cause
44 direct discharges and stormwater runoff of contaminants to adjacent water bodies, particularly
45 during the rainy season (generally October to April in California).

1 Land surface grading and excavation activities, or exposure of disturbed sites immediately following
2 construction and prior to stabilization, could result in rainfall- and stormwater-related soil erosion,
3 runoff, and offsite sedimentation in surface water bodies. The initial runoff following construction,
4 or return of seasonal rains to previously disturbed sites, can result in runoff with peak pollutant
5 levels and is referred to as “first flush” storm events. Soil erosion and runoff can also result in
6 increased concentrations and loading of organic matter, nutrients (nitrogen and phosphorus), and
7 other contaminants contained in the soil such as trace metals, pesticides, or animal-related
8 pathogens. Graded and exposed soils also can be compacted by heavy machinery, resulting in
9 reduced infiltration of rainfall and runoff, thus increasing the rate of runoff (and hence
10 contaminants) to downstream water bodies. Construction activities necessary to develop the new
11 habitat restoration areas for CM2 and CM4–CM10 would likely involve a variety of extensive
12 conventional clearing and grading activities on relatively dry sites that are currently separated from
13 the Delta channels by levees, construction of extensive new setback levees, excavation and soil
14 placement for new wetland and other habitat feature development, and a variety of potential in-
15 water construction activities such as excavation, sediment dredging, levee breaching, and hauling
16 and placement or disposal of excavated sediment or dredge material. Construction activities for the
17 proposed restoration sites, due to the direct connectivity with Delta channels, have the potential to
18 result in direct discharge of eroded soil and construction-related contaminants, or indirectly
19 through erosion and site inundation during the weeks or months following construction prior to
20 stabilization of newly contoured and restored landforms and colonization by vegetation.

21 Construction activities also would be anticipated to involve the transport, handling, and use of a
22 variety of hazardous substances and non-hazardous materials that may adversely affect water
23 quality if discharged inadvertently to construction sites or directly to water bodies. Typical
24 construction-related contaminants include petroleum products for refueling and maintenance of
25 machinery (e.g., fuel, oils, solvents), concrete, paints and other coatings, cleaning agents, debris and
26 trash, and human wastes. Construction activities also would involve large material storage and
27 laydown areas, and occasional accidental spills of hazardous materials stored and used for
28 construction may occur. Contaminants released or spilled on bare soil also may result in
29 groundwater contamination. Construction would involve extensive excavation/trenching and other
30 subsurface construction activities, trenching, or work in or near Delta channels requiring site-
31 dewatering operations to isolate the construction site from surface and groundwater. Dewatering
32 operations may contain elevated levels of suspended sediment or other constituents that may cause
33 water quality degradation.

34 The intensity of construction activity along with the fate and transport characteristics of the
35 chemicals used, would largely determine the magnitude, duration, and frequency of construction-
36 related discharges and resulting concentrations and degradation associated with the specific
37 constituents of concern. The potential water quality concerns associated with the major categories
38 of contaminants that might be discharged as a result of construction activity include the following.

- 39 • Suspended sediment: May increase turbidity (i.e., reduce water clarity) that can affect aquatic
40 organisms and increase the costs and effort of removal in municipal/industrial water supplies.
41 Downstream sedimentation can affect aquatic habitat, or cause a nuisance if it affects functions
42 of agricultural or municipal intakes, or boat navigation.
- 43 • Organic matter: May contribute turbidity and oxygen demanding substances (i.e., reduce
44 dissolved oxygen levels) that can affect aquatic organisms. Organic carbon may increase the
45 potential for disinfection byproduct formation in municipal drinking water supplies.

- 1 • Nutrients: May contribute nitrogen, phosphorus, and other key nutrients that can contribute to
2 nuisance biostimulation of algae and vascular aquatic plants, which may affect municipal water
3 supplies, recreation, aquatic life, and aesthetics.
- 4 • Petroleum hydrocarbons: May contribute toxic compounds to aquatic life, and oily sheens may
5 reduce oxygen/gas transfer in water, foul aquatic habitats, and reduce water quality for
6 municipal supplies, recreation, and aesthetics.
- 7 • Trace constituents (metals, pesticides, synthetic organic compounds): Compounds in eroded soil
8 or construction-related materials (e.g., paints, coatings, cleaning agents) may be toxic to aquatic
9 life.
- 10 • Pathogens: Bacteria, viruses, and protozoans may affect aquatic life and increase human health
11 risks via municipal water supplies, reduced recreational water quality, or contaminated shellfish
12 beds.
- 13 • Other inorganic compounds: Construction-related materials can contain inorganic compounds
14 such as acidic/basic materials which can change pH and may adversely affect aquatic life and
15 habitats. Concrete contains lime which can increase pH levels, and drilling fluids may alter pH.

16 Construction-related activities may contribute to the discharge of contaminants such as PAHs which
17 may be bioaccumulative in aquatic organisms, and construction-related disturbances may
18 contribute to discharge of contaminants in soils and sediments in the Delta that are associated with
19 existing impairments identified for Delta water bodies on the state's Section 303(d) list.

20 For the purposes of this assessment, it is assumed that construction activities conducted for
21 Alternative 1A would be conducted in conformance to applicable federal and state regulations
22 pertaining to grading and erosion control, and contaminant spill control and response measures.
23 The construction-related environmental commitments for water quality protection, as identified in
24 Appendix 3B, *Environmental Commitments*, would be implemented by the BDCP proponents. The
25 environmental commitments for construction-related water quality protection would be specifically
26 designed as a part of the final design, included in construction contracts as a required element, and
27 would be implemented for Alternative 1A to avoid, prevent, and minimize the potential discharges
28 of constituents of concern to water bodies and associated adverse water quality effects and comply
29 with state water quality regulations. Additionally, temporary and permanent changes in stormwater
30 drainage and runoff would be minimized and avoided through construction of new or modified
31 drainage facilities, as described in the Chapter 3, *Description of Alternatives*. Alternative 1A would
32 include installation of temporary drainage bypass facilities, long-term cross drainage, and
33 replacement of existing drainage facilities that would be disrupted due to construction of new
34 facilities.

35 In particular, construction-related activities under Alternative 1A would be conducted in accordance
36 with the environmental commitment to develop and implement BMPs for all activities that may
37 result in discharge of soil, sediment, or other construction-related contaminants from facilities
38 related to construction to surface water bodies, and obtain authorization for the construction
39 activities under the State Water Board's NPDES Stormwater General Permit for Stormwater
40 Discharges Associated with Construction and Land Disturbance Activities (Order No. 2009-0009-
41 DWQ/NPDES Permit No. CAS000002). This General Construction NPDES Permit requires the
42 preparation and implementation of SWPPPs, which are the principal plans within the required
43 Permit Registration Documents (PRDs) that identify the proposed erosion control and pollution
44 prevention BMPs that would be used to avoid and minimize construction-related erosion and

1 contaminant discharges. The development of the SWPPPs, and applicability of other provisions of
2 this General Construction Permit depends on the “risk” classification for the construction which is
3 determined based on the potential for erosion to occur as well as the susceptibility of the receiving
4 water to potential adverse effects of construction. While the determination of project risk level, and
5 planning and development of the SWPPPs and BMPs to be implemented, would be completed as a
6 part of final design and contracting for the work, the responsibility for compliance with the
7 provisions of the General Construction Permit necessitates that BMPs are applied to all disturbance
8 activities. In addition to the BMPs, the SWPPPs would include BMP inspection and monitoring
9 activities, and identify responsibilities of all parties, contingency measures, agency contacts, and
10 training requirements and documentation for those personnel responsible for installation,
11 inspection, maintenance, and repair of BMPs. The General Construction Permit contains Numeric
12 Action Levels (NALs) for pH and turbidity, and specifies storm event water quality monitoring to
13 determine if construction is resulting in elevated discharges of these constituents, and monitoring
14 for any non-visible contaminants determined to have been potentially released. If an NAL is
15 determined to have been exceeded, the General Construction Permit requires the discharger to
16 conduct a construction site and run-on evaluation to determine whether contaminant sources
17 associated with the site’s construction activity may have caused or contributed to the exceedance
18 and immediately implement corrective actions if they are needed.

19 The BMPs that are routinely implemented in the construction industry and have proven successful
20 at reducing adverse water quality effects include, but are not limited to, the following broad
21 categories of actions (letters refer to categories of specific BMPs identified in Appendix 3B,
22 *Environmental Commitments*), for which Appendix 3B identifies specific BMPs within these
23 categories (See commitments to Develop and Implement Stormwater Pollution Prevention Plans
24 and Develop and Implement Erosion and Sediment Control Plans):

- 25 ● Waste Management and Spill Prevention and Response (BMP categories A.2 and A.3): Waste
26 management BMPs are designed to minimize exposure of waste materials at all construction
27 sites and staging areas such as waste collection and disposal practices, containment and
28 protection of wastes from wind and rain, and equipment cleaning measures. Spill prevention
29 and response BMPs involve planning, equipment, and training for personnel for emergency
30 event response.
- 31 ● Erosion and Sedimentation Control (BMP categories A.4 and A.5): Erosion control BMPs are
32 designed to prevent erosion processes or events including scheduling work to avoid rain events,
33 stabilizing exposed soils; minimize offsite sediment runoff; remove sediment from onsite runoff
34 before it leaves the site; and slow runoff rates across construction sites. Identification of
35 appropriate temporary and long-term seeding, mulching, and other erosion control measures as
36 necessary. Sedimentation BMPs are designed to minimize offsite sediment runoff once erosion
37 has occurred involving drainage controls, perimeter controls, detention/sedimentation basins,
38 or other containment features.
- 39 ● Good Housekeeping and Non-Stormwater Discharge Management (BMP category A.6 and A.7):
40 Good housekeeping BMPs are designed to reduce exposure of construction sites and materials
41 storage to stormwater runoff including truck tire tracking control facilities; equipment washing;
42 litter and construction debris; and designated refueling and equipment inspection/maintenance
43 practices Non-stormwater discharge management BMPs involve runoff measures for
44 contaminants not directly associated with rain or wind including vehicle washing and street
45 cleaning operations.

- 1 • Construction Site Dewatering and Pipeline Testing (BMP category A.8). Dewatering BMPs
2 involve actions to prevent discharge of contaminants present in dewatering of groundwater
3 during construction, discharges of water from testing of pipelines or other facilities, or the
4 indirect erosion that may be caused by dewatering discharges.
- 5 • BMP Inspection and Monitoring (BMP category A.9): Identification of clear objectives for
6 evaluating compliance with SWPPP provisions, and specific BMP inspection and monitoring
7 procedures, environmental awareness training, contractor and agency roles and responsibilities,
8 reporting procedures, and communication protocols.

9 In addition to the Category “A” BMPs for surface land disturbances identified in the environmental
10 commitments (Appendix 3B, *Environmental Commitments*), BMPs implemented for Alternative 1A
11 also would include the Category “B” BMPs for tunnel/pipeline construction that involves actions
12 primarily to avoid and minimize sediment and contaminant discharges associated with RTM
13 excavation, hauling, and RTM dewatering operations. Additionally, habitat restoration activities
14 under CM2 and CM4–CM10 would be subject to implementation of the Category “C” BMPs (In-Water
15 Construction BMPs) and Category “D” BMPs (Tidal and Wetland Restoration) designed to minimize
16 disturbance and direct discharge of turbidity/suspended solids to the water during in-water
17 construction activities. Category “E” BMPs identify general permanent post-construction actions that
18 would be implemented for all terrestrial, in-water, and habitat restoration activities and would
19 involve planning, design, and development of final site stabilization, revegetation, and drainage
20 control features.

21 Finally, acquisition of applicable environmental permits may be required for specific conservation
22 measures, which as described for the No Action Alternative, may include specific WDRs or CWA
23 Section 401 water quality certifications from the appropriate Regional Water Boards, CDFW
24 Streambed Alteration Agreements, and USACE CWA Section 404 dredge and fill permits. These other
25 permit processes may include requirements to implement additional action-specific BMPs that may
26 reduce potential adverse discharge effects of constituents of concern.

27 The potential construction-related contaminant discharges that could result from projects defined
28 under Alternative 1A would not be anticipated to result in adverse water quality effects at a
29 magnitude, frequency, or regional extent that would cause substantial adverse effects to aquatic life.
30 Relative to Existing Conditions, this assessment indicates the following.

- 31 • Projects would be managed under state water quality regulations and project-defined actions to
32 avoid and minimize contaminant discharges.
- 33 • Individual projects would generally be dispersed, and involve infrequent and temporary
34 activities, thus not likely resulting in substantial exceedances of water quality standards or long-
35 term degradation.
- 36 • Potential construction-related contaminant discharges under the Alternative 1A would not
37 cause additional exceedance of applicable water quality objectives where such objectives are not
38 exceeded under Existing Conditions. Long-term water quality degradation is not anticipated,
39 and hence would not be expected to adversely affect beneficial uses.
- 40 • By the intermittent and temporary frequency of construction-related activities and potential
41 contaminant discharges, the constituent-specific effects would not be of substantial magnitude
42 or duration to contribute to long-term bioaccumulation processes, or cause measureable long-
43 term degradation such that existing 303(d) impairments would be made discernibly worse or
44 TMDL actions to reduce loading would be adversely affected.

1 Consequently, because the construction-related activities for the conservation measures would be
 2 conducted with implementation of environmental commitments, including but not limited to those
 3 identified in Appendix 3B, with respect to the Existing Conditions and No Action Alternative
 4 conditions, Alternative 1A would not be expected to cause constituent discharges of sufficient
 5 frequency and magnitude to result in a substantial increase of exceedances of water quality
 6 objectives/criteria, or substantially degrade water quality with respect to the constituents of
 7 concern, and thus would not adversely affect any beneficial uses in the Delta.

8 In summary, with implementation of environmental commitments in Appendix 3B, the potential
 9 construction-related water quality effects are considered to be not adverse.

10 **CEQA Conclusion:** In summary, with implementation of environmental commitments in Appendix
 11 3B, the potential construction-related water quality effects with respect to the Existing Conditions
 12 are considered to be less than significant. No mitigation is required.

13 **8.4.3.3 Alternative 1B—Dual Conveyance with East Alignment and** 14 **Intakes 1–5 (15,000 cfs; Operational Scenario A)**

15 Alternative 1B would be nearly identical to Alternative 1A except that the up to 15,000 cfs of water
 16 routed from the north Delta to the south Delta would be conveyed by gravity through a canal along
 17 the east side of the Delta instead of through pipelines/tunnels. Intakes 1 through 5 would be located
 18 on the east bank of the Sacramento River. An intermediate pumping plant north of the town of Holt
 19 would be constructed as well as a new 600 acre Byron Tract Forebay. Unlike Alternative 1A, there
 20 would be no intermediate forebay. Culvert and tunnel siphons would be utilized to divert canal
 21 water beneath existing water courses. Water supply and conveyance operations would follow the
 22 guidelines described as Scenario A, which does not include fall X2. CM2–CM22 would be
 23 implemented under this alternative, and these conservation measures would be the same as those
 24 under Alternative 1A. See Chapter 3, *Description of Alternatives*, Section 3.5.3, for additional details
 25 on Alternative 1B.

26 **Water Quality Effects Resulting from Facilities Operations and Maintenance (CM1)**

27 Alternative 1B has the same diversion and conveyance operations as Alternative 1A. The primary
 28 difference between the two alternatives is that conveyance under Alternative 1B would be in a lined
 29 or unlined canal, instead of pipeline. Because there would be no difference in conveyance capacity or
 30 operations, there would be no differences between these two alternatives in upstream of the Delta
 31 river flows or reservoir operations, Delta inflow, source fractions to various Delta locations, and
 32 hydrodynamics in the Delta. Conveyance of water in an open channel instead of a pipeline may
 33 result in differing physical properties (e.g., DO, pH, temperature) of the water upon reaching the
 34 south Delta export pumps than if the water was conveyed in a pipeline. However, the physical
 35 properties of water arriving at the south Delta export pumps would continue to change and would
 36 equilibrate to similar levels as Alternative 1A as it is conveyed throughout the SWP/CVP Export
 37 Service Areas. Because no substantial differences in water quality effects are anticipated anywhere
 38 in the affected environment under Alternative 1B compared to those described in detail for
 39 Alternative 1A, the water quality effects described for Alternative 1A also appropriately characterize
 40 effects under Alternative 1B.

1 **Water Quality Effects Resulting from Implementation of CM2–CM22**

2 Alternative 1B has the same conservation measures as Alternative 1A. Because no substantial
3 differences in water quality effects are anticipated anywhere in the affected environment under
4 Alternative 1B compared to those described in detail for Alternative 1A, the water quality effects
5 described for Alternative 1A also appropriately characterize effects under Alternative 1B.

6 **Impact WQ-31: Water Quality Effects Resulting from Construction-Related Activities (CM1–** 7 **CM22)**

8 The primary difference between Alternative 1B and Alternative 1A is that under Alternative 1B, a
9 canal would be constructed for CM1 along the eastern side of the Delta to convey the Sacramento
10 River water south, rather than a tunnel as the primary conveyance feature. As such, construction
11 techniques and locations of major features of the conveyance system within the Delta would be
12 different (see Chapter 3, *Description of Alternatives*, Section 3.5.3). Consequently, Alternative 1B
13 would involve substantial land surface construction disturbance. Construction of the canal
14 conveyance facilities also would involve vegetation grubbing/removal, grading, excavation, soil
15 stockpiling, levee and siphon construction, trenching, temporary access road construction, and soil
16 hauling and storage, and other activities over approximately 21,500 acres during the course of
17 constructing the facilities. Additionally, numerous natural drainages and constructed ditches would
18 be rerouted to pass over, under, or around the canal, thus involving disturbance and potential work
19 in flowing water. The remainder of the facilities constructed under Alternative 1B, including CM2–
20 CM22, would be very similar to, or the same as, those to be constructed for Alternative 1A.

21 **NEPA Effects:** The types of potential construction-related water quality effects associated with
22 implementation of CM1 under Alternative 1B would be similar to the effects discussed for
23 Alternative 1A, and the effects anticipated with implementation of CM2–CM22 would be essentially
24 identical. Given the substantial differences in the conveyance features under CM1 with the
25 construction of a canal, there would be differences in the location, magnitude, duration, and
26 frequency of construction activities and related water quality effects. In particular, relative to the No
27 Action Alternative conditions, construction of the major intakes and canal features for CM1 under
28 Alternative 1B would involve extensive general construction activities, material handling/
29 storage/placement activities, surface soil grading/excavation/disposal and associated exposure of
30 disturbed sites to erosion and runoff, and construction site dewatering operations. Nevertheless, the
31 construction of CM1, and any individual components necessitated by CM2, and CM4–CM10, with the
32 implementation of the BMPs specified in Appendix 3B, *Environmental Commitments*, would result in
33 the potential water quality effects being largely avoided and minimized. The specific environmental
34 commitments that would be implemented under Alternative 1B would be similar to those described
35 for Alternative 1A with the exception that Category “B” BMPs for RTM dewatering basin
36 construction and operations, if necessary at all, would be much reduced. Consequently, relative to
37 the No Action Alternative, Alternative 1B would not be expected to cause exceedance of applicable
38 water quality objectives/criteria or substantial water quality degradation with respect to
39 constituents of concern, and thus would not adversely affect any beneficial uses upstream of the
40 Delta, in the Delta, or in the SWP and CVP service area.

41 In summary, with implementation of environmental commitments in Appendix 3B, the potential
42 construction-related water quality effects are considered to be not adverse.

43 **CEQA Conclusion:** Because environmental commitments would be implemented under Alternative
44 1B for construction-related activities along with agency-issued permits that also contain

1 construction related mitigation requirements to protect water quality, the construction-related
 2 effects, relative to Existing Conditions, would not be expected to cause or contribute to substantial
 3 alteration of existing drainage patterns which would result in substantial erosion or siltation on- or
 4 off-site, substantial increased frequency of exceedances of water quality objectives/criteria, or
 5 substantially degrade water quality with respect to the constituents of concern on a long-term
 6 average basis, and thus would not adversely affect any beneficial uses in water bodies upstream of
 7 the Delta, within the Delta, or in the SWP and CVP service area. Moreover, because the construction-
 8 related activities would be temporary and intermittent in nature, the construction would involve
 9 negligible discharges, if any, of bioaccumulative or 303(d) listed constituents to water bodies of the
 10 affected environment. As such, construction activities would not contribute measurably to
 11 bioaccumulation of contaminants in organisms or humans or cause 303(d) impairments to be
 12 discernibly worse. Based on these findings, this impact is determined to be less than significant. No
 13 mitigation is required.

14 **8.4.3.4 Alternative 1C—Dual Conveyance with West Alignment and** 15 **Intakes W1–W5 (15,000 cfs; Operational Scenario A)**

16 Alternative 1C would be nearly identical to Alternative 1A except that the up to 15,000 cfs of water
 17 routed from the north Delta to the south Delta would be conveyed through a canal/tunnel along the
 18 west side of the Delta instead of through pipelines/tunnels. Intakes 1 through 5 would be located on
 19 the west bank of the Sacramento River and diverted water would be carried by canals and tunnels to
 20 a new 600 acre forebay at Byron Tract. An intermediate pumping plant would be constructed, but
 21 there would be no intermediate forebay. Culvert and tunnel siphons would be utilized to divert
 22 canal water beneath existing water courses. Water supply and conveyance operations would follow
 23 the guidelines described as Scenario A, which does not include fall X2. CM2–CM22 would be
 24 implemented under this alternative, and these conservation measures would be the same as those
 25 under Alternative 1A. See Chapter 3, *Description of Alternatives*, Section 3.5.4, for additional details
 26 on Alternative 1C.

27 **Water Quality Effects Resulting from Facilities Operations and Maintenance (CM1)**

28 Alternative 1C has the same diversion and conveyance operations as Alternative 1A. The primary
 29 differences between the two alternatives are that conveyance under Alternative 1C would be in a
 30 lined or unlined canal, instead of pipeline, and the alignment of the canal would be along the
 31 western side of the Delta, rather than the eastern side. Because there would be no difference in
 32 conveyance capacity or operations, there would be no differences between these two alternatives in
 33 upstream of the Delta river flows or reservoir operations, Delta inflow, source fractions to various
 34 Delta locations, and hydrodynamics in the Delta. Conveyance of water in an open channel instead of
 35 a pipeline may result in differing physical properties (e.g., DO, pH, temperature) of the water upon
 36 reaching the south Delta export pumps than if the water was conveyed in a pipeline. However, the
 37 physical properties of water arriving at the south Delta export pumps would continue to change and
 38 would equilibrate to similar levels as Alternative 1A as it is conveyed throughout the SWP/CVP
 39 Export Service Areas. Because no substantial differences in water quality effects are anticipated
 40 anywhere in the affected environment under Alternative 1C compared to those described in detail
 41 for Alternative 1A, the water quality effects described for Alternative 1A also appropriately
 42 characterize effects under Alternative 1C.

1 Water Quality Effects Resulting from Implementation of CM2–CM22

2 Alternative 1C has the same conservation measures as Alternative 1A. Because no substantial
3 differences in water quality effects are anticipated anywhere in the affected environment under
4 Alternative 1C compared to those described in detail for Alternative 1A, the water quality effects
5 described for Alternative 1A also appropriately characterize effects under Alternative 1C.

6 Impact WQ-31: Water Quality Effects Resulting from Construction-Related Activities (CM1– 7 CM22)

8 The primary difference between Alternative 1C and Alternative 1A is that under Alternative 1C, a
9 canal would be constructed for CM1 along the western side of the Delta to convey the Sacramento
10 River water south, in addition to similar but shorter tunnel/pipeline features. Construction of water
11 conveyance facilities would involve vegetation removal; constructing building pads, levees, canals,
12 and a tunnel; excavation; overexcavation for facility foundations; surface grading; trenching; road
13 construction; spoil storage; soil stockpiling; and other activities over approximately 17,400 acres
14 during the course of constructing the facilities. Excavation of a large volume of borrow material
15 would be required to construct the canals. As such, construction techniques and locations of major
16 features of the conveyance system within the Delta would be different (see Chapter 3, *Description of*
17 *Alternatives*, Section 3.5.4). The remainder of the facilities constructed under Alternative 1C,
18 including CM2–CM22, would be very similar to, or the same as, those to be constructed for
19 Alternative 1A.

20 **NEPA Effects:** The types of potential construction-related water quality effects associated with
21 implementation of CM1 under Alternative 1C would be very similar to the effects discussed for
22 Alternative 1A, and the effects anticipated with implementation of CM2–CM22 would be essentially
23 identical. However, given the addition of extensive canal conveyance segments under CM1 in
24 addition to the tunnel/pipeline features, there would be differences in the location, magnitude,
25 duration, and frequency of construction activities and related water quality effects. In particular,
26 relative to the No Action Alternative conditions, construction of the major canal features for CM1
27 under Alternative 1C would involve extensive general construction activities, material
28 handling/storage/placement activities, surface soil grading/excavation/disposal and associated
29 exposure of disturbed sites to erosion and runoff, and construction site dewatering operations.
30 Nevertheless, the construction of CM1, and any individual components necessitated by CM2, and
31 CM4–CM10, with the implementation of the BMPs specified in Appendix 3B, *Environmental*
32 *Commitments*, and other agency permitted construction requirements would result in the potential
33 water quality effects being largely avoided and minimized. The specific environmental commitments
34 that would be implemented under Alternative 1C would be similar to those described for Alternative
35 1A (refer to Chapter 3, *Description of Alternatives* and Appendix 3B, *Environmental Commitments*, for
36 additional information regarding the environmental commitments and environmental permits).
37 However, this alternative would involve environmental commitments associated with both
38 tunnel/pipeline and canal construction activities. Consequently, relative to No Action Alternative
39 conditions, Alternative 1C would not be expected to cause exceedance of applicable water quality
40 objectives/criteria or substantial water quality degradation with respect to constituents of concern,
41 and thus would not adversely affect any beneficial uses upstream of the Delta, in the Delta, or in the
42 SWP and CVP service area.

43 In summary, with implementation of environmental commitments in Appendix 3B, the potential
44 construction-related water quality effects are considered to be not adverse.

1 **CEQA Conclusion:** Because environmental commitments would be implemented under Alternative
 2 1C for construction-related activities, the construction-related effects, relative to Existing
 3 Conditions, would not be expected to cause or contribute to substantial alteration of existing
 4 drainage patterns which would result in substantial erosion or siltation on- or off-site, substantial
 5 increased frequency of exceedances of water quality objectives/criteria, or substantially degrade
 6 water quality with respect to the constituents of concern on a long-term average basis, and thus
 7 would not adversely affect any beneficial uses in water bodies upstream of the Delta, within the
 8 Delta, or in the SWP and CVP service area. Moreover, because the construction-related activities
 9 would be temporary and intermittent in nature, the construction would involve negligible
 10 discharges, if any, of bioaccumulative or 303(d) listed constituents to water bodies of the affected
 11 environment. As such, construction activities would not contribute measurably to bioaccumulation
 12 of contaminants in organisms or humans or cause 303(d) impairments to be discernibly worse.
 13 Based on these findings, this impact is determined to be less than significant. No mitigation is
 14 required.

15 **8.4.3.5 Alternative 2A—Dual Conveyance with Pipeline/Tunnel and Five** 16 **Intakes (15,000 cfs; Operational Scenario B)**

17 Alternative 2A would convey up to 15,000 cfs of water from the north Delta to the south Delta
 18 through pipelines/tunnels from five screened intakes on the east bank of the Sacramento River
 19 between Clarksburg and Walnut Grove i.e., (Intakes 1 through 5). A new 600 acre Byron Tract
 20 Forebay, adjacent to and south of Clifton Court Forebay, would be constructed which would provide
 21 water to the south Delta pumping plants. In addition to the same physical/structural components
 22 described for Alternative 1A, Alternative 2A would include an operable barrier at the head of Old
 23 River and could potentially include two alternative intake and intake pumping plant locations
 24 located downstream of Steamboat and Sutter Sloughs (i.e., Intakes 6 and 7). Water supply and
 25 conveyance operations would follow the guidelines described as Scenario B, which includes fall X2.
 26 CM2–CM22 would be implemented under this alternative, and would be the same as those under
 27 Alternative 1A. See Chapter 3, *Description of Alternatives*, Section 3.5.5, for additional details on
 28 Alternative 2A.

29 **Effects of the Alternative on Delta Hydrodynamics**

30 Under the No Action Alternative and Alternatives 1–9, the following two primary factors can
 31 substantially affect water quality within the Delta:

- 32 • Within the south, west, and interior Delta, a decrease in the percentage of Sacramento River-
 33 sourced water and a concurrent increase in San Joaquin River-sourced water can increase the
 34 concentrations of numerous constituents (e.g., boron, bromide, chloride, electrical conductivity,
 35 nitrate, organic carbon, some pesticides, selenium). This source water replacement is caused by
 36 decreased exports of San Joaquin River water (due to increased Sacramento River water
 37 exports), or effects of climate change on timing of flows in the rivers. Changes in channel flows
 38 also can affect water residence time and many related physical, chemical, and biological
 39 variables.
- 40 • Particularly in the west Delta, sea water intrusion as a result of sea level rise or decreased Delta
 41 outflow can increase the concentration of salts (bromide, chloride) and levels of electrical
 42 conductivity. Conversely, increased Delta outflow (e.g., as a result of Fall X2 operations in wet

1 and above normal water years) will decrease levels of these constituents, particularly in the
2 west Delta.

3 Under Alternative 2A, over the long term, average annual delta exports are anticipated to decrease
4 by 76 TAF relative to Existing Conditions, and increase by 628 TAF relative to the No Action
5 Alternative. Since, over the long-term, approximately 58% of the exported water will be from the
6 new North Delta intakes, average monthly diversions at the south Delta intakes would be decreased
7 because of the shift in diversions to the north Delta intakes (see Chapter 5, *Water Supply*, for more
8 information). The result of this is increased San Joaquin River water influence throughout the south,
9 west, and interior Delta, and a corresponding decrease in Sacramento River water influence. This
10 can be seen, for example, in Appendix 8D, ALT 2–Old River at Rock Slough for ALL years (1976–
11 1991), which shows increased SJR percentage and decreased SAC percentage under the alternative,
12 relative to Existing Conditions and the No Action Alternative.

13 Under Alternative 2A, long-term average annual Delta outflow is anticipated to increase 105 TAF
14 relative to Existing Conditions, due to both changes in operations (including north Delta intake
15 capacity of 15,000 cfs, Fall X2, and numerous other operational components of Scenario B) and
16 climate change/sea level rise (see Chapter 5, *Water Supply*, for more information). The increase
17 relative to Existing Conditions is partially because Alternative 2A includes operations to meet Fall
18 X2, while Existing Conditions does not. Long-term average annual Delta outflow is anticipated to
19 decrease under Alternative 2A by 645 TAF relative to the No Action Alternative, due only to changes
20 in operations. The result of this is increased sea water intrusion in the west Delta. The increase in
21 sea water intrusion (represented by an increase in BAY percentage) can be seen, for example, in
22 Appendix 8D, ALT 2A–Sacramento River at Mallard Island for ALL years (1976–1991).

23 **Impact WQ-1: Effects on Ammonia Concentrations Resulting from Facilities Operations and** 24 **Maintenance (CM1)**

25 *Upstream of the Delta*

26 For the same reasons stated for the No Action Alternative, Alternative 2A would have negligible, if
27 any, effect on ammonia concentrations in the rivers and reservoirs upstream of the Delta relative to
28 Existing Conditions and the No Action Alternative. Any negligible increases in ammonia-N
29 concentrations that could occur in the water bodies of the affected environment upstream of the
30 Delta would not be of frequency, magnitude, and geographic extent that would adversely affect any
31 beneficial uses or substantially degrade the quality of these water bodies, with regard to ammonia.

32 *Delta*

33 Assessment of the effects of ammonia under Alternative 2A is the same as discussed under
34 Alternative 1A, Impact WQ-1, except that because flows in the Sacramento River at Freeport would
35 be different between the two alternatives, estimated monthly average and long term annual average
36 predicted ammonia-N concentrations in the Sacramento River downstream of Freeport are
37 different.

38 As Table 8-65 shows, estimated ammonia-N concentrations in the Sacramento River downstream of
39 Freeport (upon full mixing of the SRWTP discharge with river water) under Alternative 2A and the
40 No Action Alternative are expected to be similar. Minor increases in ammonia-N concentrations
41 would occur during July through September, November, and January through March, and remaining
42 months would be unchanged or have a minor decrease. A minor increase in the annual average

1 concentration would occur under Alternative 2A, compared to the No Action Alternative. Moreover,
 2 the estimated concentrations downstream of Freeport under Alternative 2A would be similar to
 3 existing source water concentrations for the San Francisco Bay and San Joaquin River. Consequently,
 4 changes in source water fraction anticipated under Alternative 2A, relative to the No Action
 5 Alternative, would not be expected to substantially increase ammonia concentrations at any Delta
 6 locations.

7 Any negligible increases in ammonia-N concentrations that could occur at certain locations in the
 8 Delta would not be of frequency, magnitude, and geographic extent that would adversely affect any
 9 beneficial uses or substantially degrade the water quality at these locations, with regards to
 10 ammonia.

11 **Table 8-65. Estimated Ammonia-N (mg-L as N) Concentrations in the Sacramento River Downstream of**
 12 **the Sacramento Regional Wastewater Treatment Plant for the No Action Alternative and Alternative**
 13 **2A**

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual Average
No Action Alternative	0.074	0.084	0.069	0.060	0.057	0.060	0.058	0.064	0.067	0.060	0.067	0.064	0.065
Alternative 2A	0.073	0.088	0.069	0.061	0.058	0.061	0.058	0.062	0.062	0.063	0.071	0.065	0.066

14
 15 ***SWP/CVP Export Service Areas***

16 The assessment of effects on ammonia in the SWP/CVP Export Service Area is based on assessment
 17 of ammonia-N concentrations at Banks and Jones pumping plants. Similar to the discussion for
 18 Alternative 1A, under Alternative 2A for areas of the Delta that are influenced by Sacramento River
 19 water, including Banks and Jones pumping plants, ammonia-N concentrations would be expected to
 20 decrease, relative to Existing Conditions (in association with less diversion of water influenced by
 21 the SRWTP). This decrease in ammonia-N concentrations for water exported via the south Delta
 22 pumps would not be expected to result in an adverse effect on beneficial uses or substantially
 23 degrade water quality of exported water, with regards to ammonia.

24 Furthermore, as discussed above for the Plan Area, for all areas of the Delta, including Banks and
 25 Jones pumping plants, ammonia-N concentrations would not be expected to substantially differ
 26 under Alternative 2A, relative to the No Action Alternative. Any negligible increases in ammonia-N
 27 concentrations that could occur at Banks and Jones pumping plants would not be of frequency,
 28 magnitude, and geographic extent that would adversely affect any beneficial uses or substantially
 29 degrade the water quality at these locations, with regards to ammonia.

30 ***NEPA Effects:*** In summary, based on the discussion above, effects on ammonia from implementation
 31 of CM1 are considered to be not adverse.

32 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
 33 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
 34 purpose of making the CEQA impact determination for this constituent. For additional details on the
 35 effects assessment findings that support this CEQA impact determination, see the effects assessment
 36 discussion that immediately precedes this conclusion.

1 Ammonia-N concentrations are generally low in the reservoirs and rivers of the watersheds, owing
2 to the lack of substantial point and nonpoint sources of ammonia-N upstream of the SRWTP in the
3 Sacramento River watershed, in the watersheds of the eastern tributaries (Cosumnes, Mokelumne,
4 and Calaveras Rivers), or upstream of the Delta in the San Joaquin River watershed. Consequently,
5 any modified reservoir operations and subsequent changes in river flows under Alternative 2A,
6 relative to Existing Conditions, are expected to have negligible, if any, effects on reservoir and river
7 ammonia-N concentrations upstream of Freeport in the Sacramento River watershed and upstream
8 of the Delta in the San Joaquin River watershed.

9 Ammonia-N concentrations in the Sacramento River downstream of the SRWTP would be
10 substantially lower under Alternative 2A, relative to Existing Conditions, due to upgrades to the
11 SRWTP that are assumed to be in place, and thus, ammonia concentrations for all areas of the Delta
12 that are influenced by Sacramento River water are expected to decrease. At locations which are not
13 influenced notably by Sacramento River water, concentrations are expected to remain relatively
14 unchanged, due to the similarity in SJR and BAY concentrations and the lack of expected changes in
15 either of these concentrations.

16 The assessment of effects on ammonia in the SWP/CVP Export Service Areas is based on assessment
17 of ammonia-N concentrations at Banks and Jones pumping plants. As discussed above for the Plan
18 Area, for areas of the Delta that are influenced by Sacramento River water, including Banks and
19 Jones pumping plants, ammonia-N concentrations are expected to decrease under Alternative 2A,
20 relative to Existing Conditions.

21 Based on the above, there would be no substantial, long-term increase in ammonia-N concentrations
22 in the rivers and reservoirs upstream of the Delta, in the Plan Area, or the waters exported to the
23 CVP and SWP service areas under Alternative 2A relative to Existing Conditions. As such, this
24 alternative would not be expected to cause additional exceedance of applicable water quality
25 objectives/criteria by frequency, magnitude, and geographic extent that would cause significant
26 impacts on any beneficial uses of waters in the affected environment. Because ammonia
27 concentrations would not be expected to increase substantially, no long-term water quality
28 degradation would be expected to occur and, thus, no significant impact on beneficial uses would
29 occur. Ammonia is not 303(d) listed within the affected environment and thus any minor increases
30 that could occur in some areas would not make any existing ammonia-related impairment
31 measurably worse because no such impairments currently exist. Because ammonia-N is not
32 bioaccumulative, minor increases that could occur in some areas would not bioaccumulate to
33 greater levels in aquatic organisms that would, in turn, pose substantial health risks to fish, wildlife,
34 or humans. This impact would be considered less than significant. No mitigation is required.

35 **Impact WQ-2: Effects on Ammonia Concentrations Resulting from Implementation of CM2-** 36 **CM22**

37 **NEPA Effects:** Effects of CM2-22 on ammonia under Alternative 2A are the same as those discussed
38 for Alternative 1A and are considered to be not adverse.

39 **CEQA Conclusion:** Conservation Measures 2-22 proposed under Alternative 2A would be similar to
40 those proposed under Alternative 1A. As such, effects on ammonia resulting from the
41 implementation of CM2-CM22 would be similar to that previously discussed for Alternative 1A. This
42 impact is considered to be less than significant. No mitigation is required.

1 **Impact WQ-3: Effects on Boron Concentrations Resulting from Facilities Operations and** 2 **Maintenance (CM1)**

3 ***Upstream of the Delta***

4 Effects of CM1 on boron under Alternative 2A in areas upstream of the Delta would be very similar
5 to the effects discussed for Alternative 1A. There would be no expected change to the sources of
6 boron in the Sacramento and east-side tributary watersheds, and resultant changes in flows from
7 altered system-wide operations would have negligible, if any, effects on the concentration of boron
8 in the rivers and reservoirs of these watersheds. The modeled long-term annual average lower San
9 Joaquin River flow at Vernalis would decrease slightly compared to Existing Conditions (in
10 association with project operations, climate change, and increased water demands), and would be
11 similar compared to the No Action Alternative considering only changes due to Alternative 2A
12 operations. The reduced flow would result in possible increases in long-term average boron
13 concentrations of up to about 3% relative to the Existing Conditions (Appendix 8F, Table 24). The
14 increased boron concentrations would not increase the frequency of exceedances of any applicable
15 objectives or criteria and would not be expected to cause further degradation at measurable levels
16 in the lower San Joaquin River, and thus would not cause the existing impairment there to be
17 discernibly worse. Consequently, Alternative 2A would not be expected to cause exceedance of
18 boron objectives/criteria or substantially degrade water quality with respect to boron, and thus
19 would not adversely affect any beneficial uses of the Sacramento River, the east-side tributaries,
20 associated reservoirs upstream of the Delta, or the San Joaquin River.

21 ***Delta***

22 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
23 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
24 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
25 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
26 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
27 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

28 Effects of CM1 on boron under Alternative 2A in the Delta would be very similar to the effects
29 discussed for Alternative 1A. Relative to the Existing Conditions and No Action Alternative,
30 Alternative 2A would generally result in unchanged or reduced long-term average boron
31 concentrations for the 16-year period modeled at northern and eastern Delta locations. However,
32 the average boron concentration at the eastern SJR at Buckley Cove location would increase relative
33 to Existing Conditions (8%) but decrease relative to the No Action Alternative. Concentrations
34 would increase at interior and western Delta locations (by as much as 3% at the SF Mokelumne
35 River at Staten Island, 18% at Franks Tract, and 118% at Old River at Rock Slough) (Appendix 8F,
36 Table Bo-8). The comparison to Existing Conditions reflects changes due to both Alternative 2A
37 operations (including north Delta intake capacity of 15,000 cfs, Fall X2, and numerous other
38 operational components of Scenario B) and climate change/sea level rise. The comparison to the No
39 Action Alternative reflects changes due only to operations.

40 Implementation of tidal habitat restoration under CM4 also may contribute to increased boron
41 concentrations at western Delta assessment locations (more discussion of this phenomenon is
42 included in Section 8.3.1.3), and thus would not be anticipated to substantially affect agricultural
43 diversions which occur primarily at interior Delta locations. The long-term annual average and
44 monthly average boron concentrations, for either the 16-year period or drought period modeled,

1 would never exceed the 2,000 µg/L human health advisory objective (i.e., for children) or 500 µg/L
2 agricultural objective at any of the eleven Delta assessment locations, which represents no change
3 from the Existing Conditions and No Action Alternative (Appendix 8F, Table Bo-3A). Reductions in
4 long-term average assimilative capacity of up to 11% at interior Delta locations (i.e., Franks Tract
5 and Old River at Rock Slough) and up to 12% at the SJR at Buckley Cove location relative to No
6 Action Alternative, would occur with respect to the 500 µg/L agricultural objective (Appendix 8F,
7 Table Bo-9). However, because the absolute boron concentrations would still be well below the
8 lowest 500 µg/L objective for the protection of the agricultural beneficial use under Alternative 2A,
9 the levels of boron degradation would not be of sufficient magnitude to substantially increase the
10 risk of exceeding objectives or cause adverse effects to municipal and agricultural water supply
11 beneficial uses, or any other beneficial uses, in the Delta (Appendix 8F, Figure Bo-2).

12 ***SWP/CVP Export Service Areas***

13 Effects of CM1 on boron under Alternative 2A in the Delta would be very similar to the effects
14 discussed for Alternative 1A. Under Alternative 2A, long-term average boron concentrations would
15 decrease by as much as 25% at the Banks Pumping Plant and by as much as 27% at Jones Pumping
16 Plant relative to Existing Conditions and No Action Alternative (Appendix 8F, Table Bo-8) as a result
17 of export of a greater proportion of low-boron Sacramento River water. Commensurate with the
18 decrease in exported boron concentrations, boron concentrations in the lower San Joaquin River
19 may be reduced and would likely alleviate or lessen any expected increase in boron concentrations
20 at Vernalis associated with flow reductions (see discussion of Upstream of the Delta), as well as
21 locations in the Delta receiving a large fraction of San Joaquin River water. Reduced export boron
22 concentrations also may contribute to reducing the existing 303(d) impairment in the lower San
23 Joaquin River and associated TMDL actions for reducing boron loading.

24 Maintenance of SWP and CVP facilities under Alternative 2A would not be expected to create new
25 sources of boron or contribute towards a substantial change in existing sources of boron in the
26 affected environment. Maintenance activities would not be expected to cause any substantial
27 increases in boron concentrations or degradation with respect to boron such that objectives would
28 be exceeded more frequently, or any beneficial uses would be adversely affected anywhere in the
29 affected environment.

30 ***NEPA Effects:*** In summary, relative to the No Action Alternative conditions, Alternative 2A would
31 result in relatively small increases in long-term average boron concentrations in the Delta and not
32 appreciably change boron levels in the lower San Joaquin River. However, the predicted changes
33 would not be expected to cause exceedances of applicable objectives or further measurable water
34 quality degradation, and thus would not constitute an adverse effect on water quality.

35 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
36 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
37 purpose of making the CEQA impact determination for this constituent. For additional details on the
38 effects assessment findings that support this CEQA impact determination, see the effects assessment
39 discussion that immediately precedes this conclusion.

40 Boron is not a constituent of concern in the Sacramento River watershed upstream of the Delta, thus
41 river flow rate and reservoir storage reductions that would occur under the Alternative 2A, relative
42 to Existing Conditions, would not be expected to result in a substantial adverse change in boron
43 levels. Additionally, relative to Existing Conditions, Alternative 2A would not result in reductions in
44 river flow rates (i.e., less dilution) or increased boron loading such that there would be any

1 substantial increases in boron concentration upstream of the Delta in the San Joaquin River
2 watershed.

3 Small increased boron levels predicted for interior and western Delta locations in response to a shift
4 in the Delta source water percentages and tidal habitat restoration under this alternative would not
5 be expected to cause exceedances of objectives, or substantial degradation of these water bodies.
6 Alternative 2A maintenance also would not result in any substantial increases in boron
7 concentrations in the affected environment. Boron concentrations would be reduced in water
8 exported from the Delta to the CVP/SWP Export Service Areas, thus reflecting a potential
9 improvement to boron loading in the lower San Joaquin River.

10 Boron is not a bioaccumulative constituent, thus any increased concentrations under Alternative 2A
11 would not result in adverse boron bioaccumulation effects to aquatic life or humans. Relative to
12 Existing Conditions, Alternative 2A would not result in substantially increased boron concentrations
13 such that frequency of exceedances of municipal and agricultural water supply objectives would
14 increase. The levels of boron degradation that may occur under Alternative 2A would not be of
15 sufficient magnitude to cause substantially increased risk for adverse effects to municipal or
16 agricultural beneficial uses within the affected environment. Long-term average boron
17 concentrations would decrease in Delta water exports to the SWP and CVP service area, which may
18 contribute to reducing the existing 303(d) impairment of agricultural beneficial uses in the lower
19 San Joaquin River. Based on these findings, this impact is determined to be less than significant. No
20 mitigation is required.

21 **Impact WQ-4: Effects on Boron Concentrations Resulting from Implementation of CM2–CM22**

22 **NEPA Effects:** Effects of CM2–CM22 on boron under Alternative 2A are the same as those discussed
23 for Alternative 1A and are determined to be not adverse.

24 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 2A would be similar to
25 those proposed under Alternative 1A. As such, effects on boron resulting from the implementation
26 of CM2–CM22 would be similar to that previously discussed for Alternative 1A. This impact is
27 considered to be less than significant. No mitigation is required.

28 **Impact WQ-5: Effects on Bromide Concentrations Resulting from Facilities Operations and** 29 **Maintenance (CM1)**

30 ***Upstream of the Delta***

31 Under Alternative 2A there would be no expected change to the sources of bromide in the
32 Sacramento and eastside tributary watersheds. Bromide loading in these watersheds would remain
33 unchanged and resultant changes in flows from altered system-wide operations under Alternative
34 2A would have negligible, if any, effects on the concentration of bromide in the rivers and reservoirs
35 of these watersheds. Consequently, Alternative 2A would not be expected to adversely affect the
36 MUN beneficial use, or any other beneficial uses, of the Sacramento River, the eastside tributaries, or
37 their associated reservoirs upstream of the Delta.

38 Under Alternative 2A, modeling indicates that long-term annual average flows on the San Joaquin
39 River would decrease by 6%, relative to Existing Conditions and would remain virtually the same
40 relative to the No Action Alternative (Appendix 5A). These decreases in flow would result in
41 possible increases in long-term average bromide concentrations of about 3%, relative to Existing

1 Conditions, and less than <1% relative to the No Action Alternative (Appendix 8E, Bromide Table
2 22). The small increases in lower San Joaquin River bromide levels that could occur under
3 Alternative 2A, relative to existing and the No Action Alternative conditions would not be expected
4 to adversely affect the MUN beneficial use, or any other beneficial uses, of the lower San Joaquin
5 River.

6 **Delta**

7 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
8 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
9 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
10 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
11 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
12 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

13 Under Alternative 2A, the geographic extent of effects pertaining to long-term average bromide
14 concentrations in the Delta would be similar to that previously described for Alternative 1A,
15 although the magnitude of predicted long-term change and relative frequency of concentration
16 threshold exceedances would be different. Using the mass-balance modeling approach for bromide
17 (see Section 8.3.1.3), relative to Existing Conditions, modeled long-term average bromide
18 concentrations would increase at Staten Island, Emmaton (during the drought period only), and
19 Barker Slough, while modeled long-term average bromide concentrations would decrease at all
20 other assessment locations (Appendix 8E, Bromide Table 6). Overall effects would be greatest at
21 Barker Slough, where predicted long-term average bromide concentrations would increase from 51
22 µg/L to 63 µg/L (22% relative increase) for the modeled 16-year hydrologic period and would
23 increase from 54 µg/L to 94 µg/L (75% relative increase) for the modeled drought period. At Barker
24 Slough, the predicted 50 µg/L exceedance frequency would decrease from 49% under Existing
25 Conditions to 38% under Alternative 2A, but would increase from 55% to 63% during the drought
26 period. At Barker Slough, the predicted 100 µg/L exceedance frequency would increase from 0%
27 under Existing Conditions to 17% under Alternative 2A, and would increase from 0% to 38% during
28 the drought period. Relative increases in long-term average bromide concentrations at Staten Island
29 would be of similar magnitude to that described for Barker Slough, although modeled 100 µg/L
30 exceedance frequency increases would be much less considerable. At Staten Island, the predicted
31 100 µg/L exceedance frequency would increase from 1% under Existing Conditions to 4% under
32 Alternative 2A (0% to 2% during the drought period). Modeled long-term average concentration at
33 Staten Island would be about 62 µg/L (about 63 µg/L in drought years). Changes in exceedance
34 frequency of the 50 µg/L and 100 µg/L concentration thresholds, as well as relative change in long-
35 term average concentration, at other assessment locations would be less substantial. The
36 comparison to Existing Conditions reflects changes in bromide due to both Alternative 2A
37 operations (including north Delta intake capacity of 15,000 cfs, Fall X2, and numerous other
38 operational components of Scenario B) and climate change/sea level rise.

39 Due to the relatively small differences between modeled Existing Conditions and No Action baseline,
40 changes in long-term average bromide concentrations and changes in exceedance frequencies
41 relative to the No Action Alternative are generally of similar magnitude to those previously
42 described for the existing condition comparison (Appendix 8E, *Bromide*, Table 6). Modeled long-
43 term average bromide concentration increases would similarly be greatest at Barker Slough, where
44 long-term average concentrations are predicted to increase by about 26% (about 75% in drought
45 years) relative to the No Action Alternative. However, unlike the Existing Conditions comparison,

1 long-term average bromide concentrations at Buckley Cove under Alternative 2A would increase
2 relative to the No Action Alternative, although the increases would be relatively small ($\leq 4\%$). Unlike
3 the comparison to Existing Conditions, the comparison to the No Action Alternative reflects bromide
4 changes due only to operations.

5 At Barker Slough, modeled long-term average bromide concentrations for the two baseline
6 conditions are very similar (Appendix 8E, *Bromide*, Table 6). Such similarity demonstrates that the
7 modeled Alternative 2A change in bromide is almost entirely due to Alternative 2A operations, and
8 not climate change/sea level rise. Therefore, operations are the primary driver of effects on bromide
9 at Barker Slough, regardless whether Alternative 2A is compared to Existing Conditions, or
10 compared to the No Action Alternative.

11 Results of the modeling approach which used relationships between EC and chloride and between
12 chloride and bromide (see Section 8.3.1.3) differed somewhat from what is presented above for the
13 mass-balance approach (see Appendix 8E, Table 7). For most locations, the frequency of exceedance
14 of the 50 $\mu\text{g/L}$ and 100 $\mu\text{g/L}$ were similar. The greatest difference between the methods was
15 predicted for Barker Slough. The increases in frequency of exceedance of the 100 $\mu\text{g/L}$ threshold,
16 relative to Existing Conditions and the No Action Alternative, were not as great using this alternative
17 EC to chloride and chloride to bromide relationship modeling approach as compared to that
18 presented above from the mass-balance modeling approach. However, there were still substantial
19 increases, resulting in 10% exceedance over the modeled period under Alternative 2A, as compared
20 to 1% under Existing Conditions and 2% under the No Action Alternative. For the drought period,
21 exceedance frequency increased from 0% under Existing Conditions and the No Action Alternative,
22 to 20% under Alternative 2A. Because the mass-balance approach predicts a greater level of impact
23 at Barker Slough, determination of impacts was based on the mass-balance results.

24 The increase in long-term average bromide concentrations predicted at Barker Slough, principally
25 the relative increase in 100 $\mu\text{g/L}$ exceedance frequency, would result in a substantial change in
26 source water quality for existing drinking water treatment plants drawing water from the North Bay
27 Aqueduct. As discussed for Alternative 1A, drinking water treatment plants obtaining water via the
28 North Bay Aqueduct utilize a variety of conventional and enhanced treatment technologies in order
29 to achieve DBP drinking water criteria. While the implications of such a modeled change in bromide
30 at Barker Slough are difficult to predict, the substantial modeled increases could lead to adverse
31 changes in the formation of disinfection byproducts such that considerable treatment plant
32 upgrades may be necessary in order to achieve equivalent levels of health protection. Because many
33 of the other modeled locations already frequently exceed the 100 $\mu\text{g/L}$ threshold under Existing
34 Conditions and the No Action Alternative, these locations likely already require treatment plant
35 technologies to achieve equivalent levels of health protection, and thus no additional treatment
36 technologies would be triggered by the small increases in the frequency of exceeding the 100 $\mu\text{g/L}$
37 threshold. Hence, no further impact on the drinking water beneficial use would be expected at these
38 locations.

39 The seasonal intakes at Mallard Slough and City of Antioch are infrequently used due to water
40 quality constraints related to sea water intrusion. On a long-term average basis, bromide at these
41 locations is in excess of 3,000 $\mu\text{g/L}$, but during seasonal periods of high Delta outflow can be < 300
42 $\mu\text{g/L}$. Based on modeling using the mass-balance approach, use of the seasonal intakes at Mallard
43 Slough and City of Antioch under Alternative 2A would experience a period average increase in
44 bromide during the months when these intakes would most likely be utilized. For those wet and
45 above normal water year types where mass balance modeling would predict water quality typically

1 suitable for diversion, predicted long-term average bromide would increase from 103 µg/L to 165
2 µg/L (61% increase) at City of Antioch and would increase from 150 µg/L to 211 µg/L (41%
3 increase) at Mallard Slough relative to Existing Conditions (Appendix 8E, *Bromide*, Table 23).
4 Increases would be similar for the No Action Alternative comparison. Modeling results using the EC
5 to chloride and chloride to bromide relationships show increases during these months, but the
6 relative magnitude of the increases is much lower (Appendix 8E, *Bromide*, Table 24). Regardless of
7 the differences in the data between the two modeling approaches, the decisions surrounding the use
8 of these seasonal intakes is largely driven by acceptable water quality, and thus have historically
9 been opportunistic. Opportunity to use these intakes would remain, and the predicted increases in
10 bromide concentrations at the City of Antioch and Mallard Slough intake would not be expected to
11 adversely affect MUN beneficial uses, or any other beneficial use, at these locations.

12 ***SWP/CVP Export Service Areas***

13 Under Alternative 2A, improvement in long-term average bromide concentrations would occur at
14 the Banks and Jones pumping plants. Long-term average bromide concentrations for the modeled
15 16-year hydrologic period at these locations would decrease by as much as 46% relative to Existing
16 Conditions and 39% relative to the No Action Alternative. Relative change in long-term average
17 bromide concentration would be less during drought conditions ($\leq 34\%$), but would still represent
18 considerable improvement (Appendix 8E, *Bromide*, Table 6). As a result, less frequent bromide
19 concentration exceedances of the 50 µg/L and 100 µg/L assessment thresholds would be predicted
20 and an overall improvement in Export Service Areas water quality would be experienced respective
21 to bromide. Commensurate with the decrease in exported bromide, an improvement in lower San
22 Joaquin River bromide would also be observed since bromide in the lower San Joaquin River is
23 principally related to irrigation water deliveries from the Delta. While the magnitude of this
24 expected lower San Joaquin River improvement in bromide is difficult to predict, the relative
25 decrease in overall loading of bromide to the Export Service Areas would likely alleviate or lessen
26 any expected increase in bromide concentrations at Vernalis (see discussion of Upstream of the
27 Delta) as well as locations in the Delta receiving a large fraction of San Joaquin River water, such as
28 much of the south Delta.

29 ***NEPA Effects:*** The discussion above is based on results of the mass-balance modeling approach.
30 Results of the modeling approach which used relationships between EC and chloride and between
31 chloride and bromide (see Section 8.3.1.3) were consistent with the discussion above, and
32 assessment of bromide using these data results in the same conclusions as are presented above for
33 the mass-balance approach (see Appendix 8E, *Bromide*, Table 7).

34 Similar to the discussion pertaining to the No Action Alternative, maintenance of SWP and CVP
35 facilities under Alternative 2A would not be expected to create new sources of bromide or
36 contribute towards a substantial change in existing sources of bromide in the affected environment.
37 Maintenance activities would not be expected to cause any substantial change in bromide such that
38 MUN beneficial uses, or any other beneficial use, would be adversely affected anywhere in the
39 affected environment.

40 In summary, Alternative 2A operations and maintenance, relative to the No Action Alternative,
41 would result in small increases (i.e., $<1\%$) in long-term average bromide concentrations at Vernalis
42 related to relatively small declines in long-term average flow on the San Joaquin River. However,
43 Alternative 2A operation and maintenance activities would cause substantial degradation to water
44 quality with respect to bromide at Barker Slough, source of the North Bay Aqueduct. Resultant

1 substantial change in long-term average bromide at Barker Slough could necessitate changes in
2 water treatment plant operations or require treatment plant upgrades in order to maintain DBP
3 compliance, and thus would constitute an adverse effect on water quality. Mitigation Measure WQ-5
4 is available to reduce these effects (implementation of this measure along with a separate, non-
5 environmental commitment as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*,
6 relating to the potential increased treatment costs associated with bromide-related changes would
7 reduce these effects).

8 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
9 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
10 purpose of making the CEQA impact determination for this constituent. For additional details on the
11 effects assessment findings that support this CEQA impact determination, see the effects assessment
12 discussion that immediately precedes this conclusion.

13 Under Alternative 2A there would be no expected change to the sources of bromide in the
14 Sacramento and eastside tributary watersheds. Bromide loading in these watersheds would remain
15 unchanged and resultant changes in flows from altered system-wide operations under Alternative
16 2A would have negligible, if any, effects on the concentration of bromide in the rivers and reservoirs
17 of these watersheds. However, south of the Delta, the San Joaquin River is a substantial source of
18 bromide, primarily due to the use of irrigation water imported from the southern Delta.
19 Concentrations of bromide at Vernalis are inversely correlated to net river flow. Under Alternative
20 2A, long-term average flows at Vernalis would decrease only slightly, resulting in less than
21 substantial predicted increases in long-term average bromide of about 3% relative to Existing
22 Conditions.

23 Relative to Existing Conditions, Alternative 2A would result in small decreases in long-term average
24 bromide concentration at most Delta assessment locations, with principal exceptions being the
25 North Bay Aqueduct at Barker Slough, Staten Island, and Emmaton on the Sacramento River. Overall
26 effects would be greatest at Barker Slough, where substantial increases in long-term average
27 bromide concentrations would be predicted. The increase in long-term average bromide
28 concentrations predicted for Barker Slough would result in a substantial change in source water
29 quality to existing drinking water treatment plants drawing water from the North Bay Aqueduct.
30 These modeled increases in bromide at Barker Slough could lead to adverse changes in the
31 formation of disinfection byproducts at drinking water treatment plants such that considerable
32 water treatment plant upgrades would be necessary in order to achieve equivalent levels of drinking
33 water health protection.

34 The assessment of effects on bromide in the SWP/CVP Export Service Areas is based on assessment
35 of changes in bromide concentrations at Banks and Jones pumping plants. Under Alternative 2A,
36 substantial improvement would occur at the Banks and Jones pumping plants, where predicted
37 long-term average bromide concentrations are predicted to decrease by as much as 46% relative to
38 Existing Conditions. An overall improvement in bromide-related water quality would be predicted
39 in the SWP/CVP Export Service Areas.

40 Based on the above, Alternative 2A operation and maintenance would not result in any substantial
41 change in long-term average bromide concentration upstream of the Delta. Furthermore, under
42 Alternative 2A, water exported from the Delta to the SWP/CVP service area would be substantially
43 improved relative to bromide. Bromide is not bioaccumulative, therefore change in long-term
44 average bromide concentrations would not directly cause bioaccumulative problems in aquatic life

1 or humans. Additionally, bromide is not a constituent related to any 303(d) listings. Alternative 2A
 2 operation and maintenance activities would not cause substantial long-term degradation to water
 3 quality respective to bromide with the exception of water quality at Barker Slough, source of the
 4 North Bay Aqueduct. At Barker Slough, modeled long-term annual average concentrations of
 5 bromide would increase by 22%, and 75% during the modeled drought period. For the modeled 16-
 6 year hydrologic period the frequency of predicted bromide concentrations exceeding 100 µg/L
 7 would increase from 0% under Existing Conditions to 17% under Alternative 2A, while for the
 8 modeled drought period, the frequency would increase from 0% to 38%. Substantial changes in
 9 long-term average bromide could necessitate changes in treatment plant operation or require
 10 treatment plant upgrades in order to maintain DBP compliance. The model predicted change at
 11 Barker Slough is substantial and, therefore, would represent a substantially increased risk for
 12 adverse effects on existing MUN beneficial uses should treatment upgrades not be undertaken. The
 13 impact is considered significant.

14 Implementation of Mitigation Measure WQ-5 along with a separate, non-environmental
 15 commitment relating to the potential increased treatment costs associated with bromide-related
 16 changes would reduce these effects. While mitigation measures to reduce these water quality effects
 17 in affected water bodies to less than significant levels are not available, implementation of
 18 Mitigation Measure WQ-5 is recommended to attempt to reduce the effect that increased bromide
 19 concentrations may have on Delta beneficial uses. However, because the effectiveness of this
 20 mitigation measure to result in feasible measures for reducing water quality effects is uncertain, this
 21 impact is considered to remain significant and unavoidable. Please see Mitigation Measure WQ-5
 22 under Impact WQ-5 in the discussion of Alternative 1A.

23 In addition to and to supplement Mitigation Measure WQ-5, the BDCP proponents have incorporated
 24 into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*, a separate, non-
 25 environmental commitment to address the potential increased water treatment costs that could
 26 result from bromide-related concentration effects on municipal water purveyor operations.
 27 Potential options for making use of this financial commitment include funding or providing other
 28 assistance towards implementation of the North Bay Aqueduct AIP, acquiring alternative water
 29 supplies, or other actions to indirectly reduce the effects of elevated bromide and DOC in existing
 30 water supply diversion facilities. Please refer to Appendix 3B, *Environmental Commitments*, for the
 31 full list of potential actions that could be taken pursuant to this commitment in order to reduce the
 32 water quality treatment costs associated with water quality effects relating to chloride, electrical
 33 conductivity, and bromide.

34 **Mitigation Measure WQ-5: Avoid, Minimize, or Offset, as Feasible, Adverse Water Quality**
 35 **Conditions**

36 Please see Mitigation Measure WQ-5 under Impact WQ-5 in the discussion of Alternative 1A.

37 **Impact WQ-6: Effects on Bromide Concentrations Resulting from Implementation of CM2-**
 38 **CM22**

39 **NEPA Effects:** Conservation Measures 2-22 proposed under Alternative 2A would be the same as
 40 those proposed under Alternative 1A. As discussed for Alternative 1A, implementation of CM2-
 41 CM22 would not present new or substantially changed sources of bromide to the study area. Some
 42 conservation measures may replace or substitute for existing irrigated agriculture in the Delta. This
 43 replacement or substitution is not expected to substantially increase or present new sources of

1 bromide. CM2–CM22 would not be expected to cause any substantial change in bromide such that
 2 MUN beneficial uses, or any other beneficial use, would be adversely affected anywhere in the
 3 affected environment.

4 In summary, implementation of CM2–CM22 under Alternative 2A, relative to the No Action
 5 Alternative, would have negligible, if any, effects on bromide concentrations. The effects on bromide
 6 from implementing CM2–CM22 are determined to not be adverse.

7 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 2A would be similar to
 8 those proposed under Alternative 1A. As such, effects on bromide resulting from the
 9 implementation of CM2–CM22 would be similar to that previously discussed for Alternative 1A. This
 10 impact is considered to be less than significant. No mitigation is required.

11 **Impact WQ-7: Effects on Chloride Concentrations Resulting from Facilities Operations and** 12 **Maintenance (CM1)**

13 ***Upstream of the Delta***

14 Under Alternative 2A there would be no expected change to the sources of chloride in the
 15 Sacramento and eastside tributary watersheds. Chloride loading in these watersheds would remain
 16 unchanged and resultant changes in flows from altered system-wide operations would have
 17 negligible, if any, effects on the concentration of chloride in the rivers and reservoirs of these
 18 watersheds. The modeled long-term annual average flows on the lower San Joaquin River at Vernalis
 19 would decrease slightly compared to Existing Conditions and be similar compared to the No Action
 20 Alternative (as a result of climate change). The reduced flow would result in possible increases in
 21 long-term average chloride concentrations of up to about 3%, relative to the Existing Conditions and
 22 no change relative to No Action Alternative (Appendix 8G, Table Cl-62). The increased chloride
 23 concentrations would not increase the frequency of exceedances of any applicable objectives or
 24 criteria. Consequently, Alternative 2A would not be expected to cause exceedance of chloride
 25 objectives/criteria or substantially degrade water quality with respect to chloride, and thus would
 26 not adversely affect any beneficial uses of the Sacramento River, the eastside tributaries, associated
 27 reservoirs upstream of the Delta, or the San Joaquin River.

28 ***Delta***

29 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 30 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 31 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 32 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 33 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
 34 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

35 Relative to Existing Conditions, modeling predicts that Alternative 2A would result in similar or
 36 reduced long-term average chloride concentrations for the 16-year period modeled at most
 37 assessment locations, and, depending on modeling approach (see Section 8.3.1.3), and would result
 38 in increased concentrations at the North Bay Aqueduct at Barker Slough (i.e., ≤23%) and San Joaquin
 39 River at Staten Island (i.e., ≤18%) (Appendix 8G, *Chloride*, Table Cl-13 and Table Cl-14). Additionally,
 40 implementation of tidal habitat restoration under CM4 would increase the tidal exchange volume in
 41 the Delta, and thus may contribute to increased chloride concentrations in the Bay source water as a
 42 result of increased salinity intrusion. More discussion of this phenomenon is included in Section

1 8.3.1.3. Consequently, while uncertain, the magnitude of chloride increases may be greater than
2 indicated herein and would affect the western Delta assessment locations the most which are
3 influenced to the greatest extent by the Bay source water. The comparison to Existing Conditions
4 reflects changes in chloride due to both Alternative 2A operations (including north Delta intake
5 capacity of 15,000 cfs, Fall X2, and numerous other operational components of Scenario B) and
6 climate change/sea level rise.

7 Relative to the No Action Alternative conditions, the mass balance analysis of modeling results
8 indicated that Alternative 2A would result in similar or reduced long-term average chloride
9 concentrations for the 16-year period modeled at nine of the assessment locations and increased
10 concentrations at the SF Mokelumne River at Staten Island (up to 26%), San Joaquin River at
11 Buckley Cove (up to 3%), and the North Bay Aqueduct at Barker Slough (up to 21%) (Appendix 8G,
12 Table Cl-13). The comparison to the No Action Alternative reflects chloride changes due only to
13 operations.

14 The following outlines the modeled chloride changes relative to the applicable objectives and
15 beneficial uses of Delta waters.

16 *Municipal Beneficial Uses—Relative to Existing Conditions*

17 Estimates of chloride concentrations generated using EC-chloride relationships and DSM2 EC output
18 (see Section 8.3.1.3) were used to evaluate the 150 mg/L Bay-Delta WQCP objective for municipal
19 and industrial beneficial uses on a basis of the percent of years the chloride objective is exceeded for
20 the modeled 16-year period. The objective is exceeded if chloride concentrations exceed 150 mg/L
21 for a specified number of days in a given water year at both the Antioch and Contra Costa Pumping
22 Plant #1 locations. For Alternative 2A, the modeled frequency of objective exceedance would
23 approximately triple from 6% of years under Existing Conditions, to 19% of years under Alternative
24 2A (Appendix 8G, Table Cl-64).

25 Similarly, estimates of chloride concentrations generated using EC-chloride relationships and DSM2
26 EC output (see Section 8.3.1.3) were also used to evaluate the 250 mg/L Bay-Delta WQCP objective
27 for chloride at Contra Costa Pumping Plant #1 where daily average objectives apply. The basis for
28 the evaluation was the predicted number of days the objective was exceeded for the modeled 16-
29 year period. For Alternative 2A, the modeled frequency of objective exceedance would decrease by
30 approximately one half, from 6% of modeled days under Existing Conditions, to 3% of modeled days
31 under Alternative 2A (Appendix 8G, Table Cl-63).

32 Given the limitations inherent to estimating future chloride concentrations (see Section 8.3.1.3),
33 estimation of chloride concentrations through both a mass balance approach and an EC-chloride
34 relationship approach was used to evaluate the 250 mg/L Bay-Delta WQCP objectives in terms of
35 both frequency of exceedance and use of assimilative capacity. When utilizing the mass balance
36 approach to model monthly average chloride concentrations for the 16-year period, the predicted
37 frequency of exceeding the 250 mg/L objective would decrease at the Contra Costa Canal at
38 Pumping Plant #1 (Appendix 8G, Table Cl-15). The frequency of exceedances would increase for the
39 16-year period modeled at the San Joaquin River at Antioch (i.e., from 66% under Existing
40 Conditions to 70%) and Sacramento River at Mallard Island (i.e., from 85% under Existing
41 Conditions to 88%) (Appendix 8G, Table Cl-15), and would cause further degradation at Antioch in
42 March and April (i.e., maximum reduction of 54% of available assimilative capacity for the 16-year
43 period modeled, and 100% reduction, or elimination of assimilative capacity, during the drought
44 period modeled) (Appendix 8G, Table Cl-17).

1 In comparison, when utilizing the chloride-EC relationship to model monthly average chloride
2 concentrations for the 16-year period, trends in frequency of exceedance and use of assimilative
3 capacity would be similar to that discussed when utilizing the mass balance modeling approach
4 (Appendix 8G, Table CI-16 and Table CI-18). However, as with Alternative 1A the modeling approach
5 utilizing the chloride-EC relationships predicted changes of lesser magnitude, where predictions of
6 change utilizing the mass balance approach were generally of greater magnitude, and thus more
7 conservative. As discussed in Section 8.3.1.3, in cases of such disagreement, the approach that
8 yielded the more conservative predictions was used as the basis for determining adverse impacts.

9 Based on the additional predicted seasonal and annual exceedances of one or both Bay Delta WQCP
10 objectives for chloride, and the magnitude of associated long-term average water quality
11 degradation in the western Delta, the potential exists for substantial adverse effects on the
12 municipal and industrial beneficial uses through reduced opportunity for diversion of water of
13 acceptable chloride levels.

14 *303(d) Listed Water Bodies—Relative to Existing Conditions*

15 With respect to the 303(d) listing for chloride in Tom Paine Slough, the monthly average chloride
16 concentrations for the 16-year period modeled at Old River at Tracy Road would generally be
17 similar compared to Existing Conditions, and thus, would not be further degraded on a long-term
18 basis (Appendix 8G, Figure CI-2). With respect to Suisun Marsh, the monthly average chloride
19 concentrations for the 16-year period modeled would generally increase compared to Existing
20 Conditions in some months during October through May at the Sacramento River at Collinsville
21 (Appendix 8G, Figure CI-3) and Mallard Island (Appendix 8G, Figure CI-1), and would increase
22 substantially at Montezuma Slough at Beldon's Landing (i.e., over a doubling of concentration in
23 December through February) (Appendix 8G, Figure CI-4), thereby contributing to additional,
24 measureable long-term degradation that potentially would adversely affect the necessary actions to
25 reduce chloride loading for any TMDL that is developed.

26 *Municipal Beneficial Uses—Relative to No Action Alternative*

27 Similar to the assessment conducted for Existing Conditions, estimates of chloride concentrations
28 generated using EC-chloride relationships and DSM2 EC output (see Section 8.3.1.3) were used to
29 evaluate the 150 mg/L Bay-Delta WQCP objective for municipal and industrial beneficial uses. For
30 Alternative 2A, the modeled frequency of objective exceedance would increase from 6% under the
31 No Action Alternative to 19% of years under Alternative 2A (Appendix 8G, Table CI-64).

32 Similarly, estimates of chloride concentrations generated using EC-chloride relationships and DSM2
33 EC output (see Section 8.3.1.3) were also used to evaluate the 250 mg/L Bay-Delta WQCP objective
34 for chloride at Contra Costa Pumping Plant #1 where daily average objectives apply. For Alternative
35 2A, the modeled frequency of objective exceedance would decrease from 5% of modeled days under
36 the No Action Alternative to 3% of modeled days under Alternative 2A (Appendix 8G, Table CI-63).

37 Similar to Existing Conditions, a comparative assessment of modeling approaches was utilized to
38 evaluate the 250 mg/L Bay-Delta WQCP objectives in terms of both frequency of exceedance and use
39 of assimilative capacity on a monthly average basis. When utilizing the mass balance approach to
40 model monthly average chloride concentrations for the 16-year period, the exceedance frequency
41 would be predicted to decrease slightly at the San Joaquin River at Antioch (i.e., from 73% for the No
42 Action Alternative to 70%), decrease slightly at the Contra Costa Canal at Pumping Plant #1 (i.e.,
43 from 14% to 12%), and increase slightly at the Sacramento River at Mallard Island (i.e., from 86% to

1 88%) (Appendix 8G, Table Cl-15). The available assimilative capacity would be reduced at the
2 Antioch location compared to the No Action Alternative (i.e., reduction of 25% in April, and 100% in
3 April [i.e., eliminated] during the drought period modeled) (Appendix 8G, Table Cl-17). Available
4 assimilative capacity also would be reduced at the Contra Costa Canal at Pumping Plant #1 by up to
5 17% and 12% in September and October of the 16-year modeled period, respectively, and up to
6 100% in the drought period) (Appendix 8G, Table Cl-17), reflecting substantial degradation at these
7 locations during months when average concentrations would be near, or exceed, the objective.

8 In comparison, when utilizing the chloride-EC relationship to model monthly average chloride
9 concentrations for the 16-year period, trends in frequency of exceedance and use of assimilative
10 capacity would be similar to that discussed when utilizing the mass balance modeling approach
11 (Appendix 8G, Table Cl-16 and Table Cl 18). However, as with Alternative 1A the modeling approach
12 utilizing the chloride-EC relationships predicted changes of lesser magnitude, where predictions of
13 change utilizing the mass balance approach were generally of greater magnitude, and thus more
14 conservative. As discussed in Section 8.3.1.3, in cases of such disagreement, the approach that
15 yielded the more conservative predictions was used as the basis for determining adverse impacts.

16 Based on the additional seasonal and annual exceedances of the municipal objectives as well as the
17 magnitude of long-term average water quality degradation with respect to chloride at interior and
18 western Delta locations, the potential exists for substantial adverse effects to the municipal and
19 industrial beneficial uses through reduced opportunity for diversion of water with acceptable
20 chloride levels.

21 *303(d) Listed Water Bodies—Relative to No Action Alternative*

22 With respect to the 303(d) listing for chloride, Alternative 1A would generally result in similar
23 changes to those discussed for the comparison to Existing Conditions. Monthly average chloride
24 concentrations at Tom Paine Slough would not be further degraded on a long-term basis (Appendix
25 8G, Figure Cl-2). Monthly average chloride concentrations at source water channel locations for the
26 Suisun Marsh (Appendix 8G, Figures Cl-1, Cl-3 and Cl-4) would increase substantially in some
27 months during October through May compared to the No Action Alternative conditions. Therefore,
28 additional, measureable long-term degradation would occur in Suisun Marsh that potentially would
29 adversely affect the necessary actions to reduce chloride loading for any TMDL that is developed.

30 ***SWP/CVP Export Service Areas***

31 Under Alternative 2A, long-term average chloride concentrations based on the mass balance
32 analysis of modeling results for the 16-year period modeled at the Banks and Jones pumping plants
33 would decrease by as much as 33% relative to Existing Conditions and 29% compared to No Action
34 Alternative (Appendix 8G, *Chloride*, Table Cl-13). The modeled frequency of exceedances of
35 applicable water quality objectives/criteria would decrease relative to the Existing Conditions and
36 No Action Alternative, for both the 16-year period and the drought period modeled (Appendix 8G,
37 *Chloride*, Table Cl-15). Consequently, water exported into the SWP/CVP service area would
38 generally be of similar or better quality with regards to chloride relative to Existing Conditions and
39 the No Action Alternative conditions.

40 Results of the modeling approach which used relationships between EC and chloride (see Section
41 8.3.1.3) were consistent with the discussion above, and assessment of chloride using these data
42 results in the same conclusions as are presented above for the mass-balance approach (Appendix
43 8G, Table Cl-14 and Table Cl-16).

1 Commensurate with the reduced chloride concentrations in water exported to the service area,
2 reduced chloride loading in the lower San Joaquin River would be anticipated which would likely
3 alleviate or lessen any expected increase in chloride at Vernalis related to decreased annual average
4 San Joaquin River flows (see discussion of Upstream of the Delta).

5 Maintenance of SWP and CVP facilities would not be expected to create new sources of chloride or
6 contribute towards a substantial change in existing sources of chloride in the affected environment.
7 Maintenance activities would not be expected to cause any substantial change in chloride such that
8 any long-term water quality degradation would occur, thus, beneficial uses would not be adversely
9 affected anywhere in the affected environment.

10 **NEPA Effects:** In summary, relative to the No Action Alternative conditions, Alternative 2A would
11 result in increased water quality degradation and frequency of exceedance of the 150 mg/L
12 municipal and industrial objective at Contra Costa Pumping Plant #1 and Antioch locations. The
13 frequency of exceedances of the 250 mg/L municipal and industrial objective at interior and
14 western Delta locations would generally decrease, however, further water quality degradation
15 would occur. Measureable water quality degradation also would occur relative to the 303(d)
16 impairment in Suisun Marsh. The predicted chloride increases constitute an adverse effect on water
17 quality (see Mitigation Measure WQ-7 below; implementation of this measure along with a separate,
18 non-environmental commitment relating to the potential increased chloride treatment costs would
19 reduce these effects). Additionally, the predicted changes relative to the No Action Alternative
20 conditions indicate that in addition to the effects of climate change/sea level rise, implementation of
21 CM1 and CM4 under Alternative 2A would contribute substantially to the adverse water quality
22 effects.

23 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
24 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
25 purpose of making the CEQA impact determination for this constituent. For additional details on the
26 effects assessment findings that support this CEQA impact determination, see the effects assessment
27 discussion that immediately precedes this conclusion.

28 Chloride is not a constituent of concern in the Sacramento River watershed upstream of the Delta,
29 thus river flow rate and reservoir storage reductions that would occur under the Alternative 2A,
30 relative to Existing Conditions, would not be expected to result in a substantial adverse change in
31 chloride levels. Additionally, relative to Existing Conditions, the Alternative 2A would not result in
32 reductions in river flow rates (i.e., less dilution) or increased chloride loading such that there would
33 be any substantial increase in chloride concentrations upstream of the Delta in the San Joaquin River
34 watershed.

35 Relative to Existing Conditions, the Alternative 2A would result in substantially increased chloride
36 concentrations in the Delta such that frequency of exceeding the 150 mg/L Bay-Delta WQCP
37 objective would approximately triple. Moreover, the frequency of exceedance of the 250 mg/L Bay-
38 Delta WQCP objective would increase at the San Joaquin River at Antioch and at Mallard Slough (by
39 3% each), and long-term degradation may occur, that may result in adverse effects on the municipal
40 and industrial water supply beneficial use (see Mitigation Measure WQ-7 below; implementation of
41 this measure along with a separate, non-environmental commitment relating to the potential
42 increased chloride treatment costs would reduce these effects). Relative to the Existing Conditions,
43 the modeled increased chloride concentrations and degradation in the western Delta could further

1 contribute, at measurable levels (i.e., over a doubling of concentration), to the existing 303(d) listed
2 impairment due to chloride in Suisun Marsh for the protection of fish and wildlife.

3 Chloride concentrations would be reduced in water exported from the Delta to the CVP/SWP Export
4 Service Areas, thus reflecting a potential improvement to chloride loading in the lower San Joaquin
5 River.

6 Chloride is not a bioaccumulative constituent, thus any increased concentrations under Alternative
7 2A would not result in substantial chloride bioaccumulation impacts on aquatic life or humans.
8 Alternative 2A maintenance would not result in any substantial changes in chloride concentration
9 upstream of the Delta or in the SWP/CVP Export Service Areas. However, this impact is determined
10 to be significant due to increased chloride concentrations and degradation at western Delta
11 locations and its effects on municipal and industrial water supply and fish and wildlife beneficial
12 uses.

13 While mitigation measures to reduce these water quality effects in affected water bodies to less than
14 significant levels are not available, implementation of Mitigation Measure WQ-7 is recommended to
15 attempt to reduce the effect that increased chloride concentrations may have on Delta beneficial
16 uses. However, because the effectiveness of this mitigation measure to result in feasible measures
17 for reducing water quality effects is uncertain, this impact is considered to remain significant and
18 unavoidable. Please see Mitigation Measure WQ-7 under Impact WQ-7 in the discussion of
19 Alternative 1A.

20 In addition to and to supplement Mitigation Measure WQ-7, the BDCP proponents have incorporated
21 into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*, a separate, non-
22 environmental commitment to address the potential increased water treatment costs that could
23 result from chloride concentration effects on municipal, industrial and agricultural water purveyor
24 operations. Potential options for making use of this financial commitment include funding or
25 providing other assistance towards acquiring alternative water supplies or towards modifying
26 existing operations when chloride concentrations at a particular location reduce opportunities to
27 operate existing water supply diversion facilities. Please refer to Appendix 3B, *Environmental*
28 *Commitments*, for the full list of potential actions that could be taken pursuant to this commitment in
29 order to reduce the water quality treatment costs associated with water quality effects relating to
30 chloride, electrical conductivity, and bromide.

31 **Mitigation Measure WQ-7: Conduct Additional Evaluation and Modeling of Increased**
32 **Chloride Levels and Develop and Implement Phased Mitigation Actions**

33 Please see Mitigation Measure WQ-7 under Impact WQ-7 in the discussion of Alternative 1A.

34 **Impact WQ-8: Effects on Chloride Concentrations Resulting from Implementation of CM2–**
35 **CM22**

36 **NEPA Effects:** Under Alternative 2A, the types and geographic extent of effects on chloride
37 concentrations in the Delta as a result of implementation of the other conservation measures (i.e.,
38 CM2–CM22) would be similar to, and undistinguishable from, those effects previously described for
39 Alternative 1A. The conservation measures would present no new direct sources of chloride to the
40 affected environment. Moreover, some habitat restoration conservation measures (CM4–CM10)
41 would occur on lands within the Delta currently used for irrigated agriculture, thus replacing
42 agricultural land uses with restored tidal wetlands, floodplain, and related channel margin and off-

1 channel habitats. The potential reduction in irrigated lands within the Delta may result in reduced
 2 discharges of agricultural field drainage with elevated chloride concentrations, which would be
 3 considered an improvement compared to No Action Alternative conditions. In summary, based on
 4 the discussion above, the effects on chloride from implementing CM2-CM22 are considered to be not
 5 adverse.

6 **CEQA Conclusion:** Implementation of the CM2–CM22 for Alternative 2A would not present new or
 7 substantially changed sources of chloride to the affected environment upstream of the Delta, within
 8 Delta, or in the SWP/CVP service area compared to Existing Conditions. Replacement of irrigated
 9 agricultural land uses in the Delta with habitat restoration conservation measures may result in
 10 some reduction in discharge of agricultural field drainage with elevated chloride concentrations,
 11 thus resulting in improved water quality conditions. Based on these findings, this impact is
 12 considered to be less than significant. No mitigation is required.

13 **Impact WQ-9: Effects on Dissolved Oxygen Resulting from Facilities Operations and** 14 **Maintenance (CM1)**

15 **NEPA Effects:** Effects of CM1 on DO under Alternative 2A are the same as those discussed for
 16 Alternative 1A and are considered to not be adverse.

17 **CEQA Conclusion:** Effects of CM1 on DO under Alternative 2A would be similar to those discussed
 18 for Alternative 1A, and are summarized here, then compared to the CEQA thresholds of significance
 19 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this
 20 constituent. For additional details on the effects assessment findings that support this CEQA impact
 21 determination, see the effects assessment discussion under Alternative 1A.

22 River flow rate and reservoir storage reductions that would occur under Alternative 2A, relative to
 23 Existing Conditions, would not be expected to result in a substantial adverse change in DO levels in
 24 the reservoirs and rivers upstream of the Delta, given that mean monthly flows would remain within
 25 the ranges historically seen under Existing Conditions and the affected river are large and turbulent.
 26 Any reduced DO saturation level that may be caused by increased water temperature would not be
 27 expected to cause DO levels to be outside of the range seen historically. Finally, amounts of oxygen
 28 demanding substances and salinity would not be expected to change sufficiently to affect DO levels.

29 It is expected there would be no substantial change in Delta DO levels in response to a shift in the
 30 Delta source water percentages under this alternative or substantial degradation of these water
 31 bodies, with regard to DO. DO levels would be affected by nutrient loading, which the state has
 32 begun to aggressively regulate the discharges of, and this loading would not be expected to lower DO
 33 levels relative to Existing Conditions based on historical DO levels. Further, the anticipated changes
 34 in salinity would have relatively minor effects on DO levels, and tidal exchange, which contribute to
 35 the reaeration of Delta waters would not be expected to change substantially.

36 There is not expected to be substantial, if even measurable, changes in DO levels in the SWP/CVP
 37 Export Service Areas waters under Alternative 2A, relative to Existing Conditions, because the
 38 biochemical oxygen demand of the exported water would not be expected to substantially differ
 39 from that under Existing Conditions (due to ever increasing water quality regulations), canal
 40 turbulence and exposure of the water to the atmosphere and the algal communities that exist within
 41 the canals would establish an equilibrium for DO levels within the canals. The same would occur in
 42 downstream reservoirs.

1 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
 2 objectives by frequency, magnitude, and geographic extent that would result in significant impacts
 3 on any beneficial uses within affected water bodies. Because no substantial changes in DO levels are
 4 expected, long-term water quality degradation would not be expected to occur, and, thus, beneficial
 5 uses would not be adversely affected. Various Delta waterways are 303(d)-listed for low DO, but
 6 because no substantial decreases in DO levels would be expected, greater degradation and DO-
 7 related impairment of these areas would not be expected. This impact would be less than significant.
 8 No mitigation is required.

9 **Impact WQ-10: Effects on Dissolved Oxygen Resulting from Implementation of CM2–CM22**

10 **NEPA Effects:** Effects of CM2–CM22 on DO under Alternative 2A are the same as those discussed for
 11 Alternative 1A and are considered to not be adverse.

12 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 2A would be similar to
 13 those proposed under Alternative 1A. As such, effects on DO resulting from the implementation of
 14 CM2–CM22 would be similar to that previously discussed for Alternative 1A. This impact is
 15 considered to be less than significant. No mitigation is required.

16 **Impact WQ-11: Effects on Electrical Conductivity Concentrations Resulting from Facilities** 17 **Operations and Maintenance (CM1)**

18 ***Upstream of the Delta***

19 For the same reasons stated for the No Action Alternative, EC levels (highs, lows, typical conditions)
 20 in the Sacramento River and its tributaries, the eastside tributaries, their associated reservoirs, and
 21 the San Joaquin River upstream of the Delta under Alternative 2A are not expected to be outside the
 22 ranges occurring under Existing Conditions or would occur under the No Action Alternative. Any
 23 minor changes in EC levels that could occur under Alternative 2A in water bodies upstream of the
 24 Delta would not be of sufficient magnitude, frequency and geographic extent that would cause
 25 adverse effects on beneficial uses or substantially degrade water quality with regard to EC.

26 ***Delta***

27 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 28 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 29 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 30 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 31 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
 32 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

33 Relative to Existing Conditions, Alternative 2A would result in an increase in the number of days the
 34 Bay-Delta WQCP EC objectives would be exceeded in the Sacramento River at Emmaton, San Joaquin
 35 River at San Andreas Landing and Prisoners Point, and Old River near Middle River and at Tracy
 36 Bridge (Appendix 8H, Table EC-2). The percent of days the Emmaton EC objective would be
 37 exceeded for the entire period modeled (1976–1991) would increase from 6% under Existing
 38 Conditions to 23% under Alternative 2A, and the percent of days out of compliance would increase
 39 from 11% under Existing Conditions to 35% under Alternative 2A. The percent of days the San
 40 Andreas Landing EC objective would be exceeded would increase from 1% under Existing
 41 Conditions to 4% under Alternative 2A, and the percent of days out of compliance with the EC

1 objective would increase from 1% under Existing Conditions to 6% under Alternative 2A. The
2 percent of days the Prisoners Point EC objective would be exceeded for the entire period modeled
3 would increase from 6% under Existing Conditions to 25% under Alternative 2A, and the percent of
4 days out of compliance with the EC objective would increase from 10% under Existing Conditions to
5 27% under Alternative 2A. The increase in percent of days exceeding the EC objectives and days out
6 of compliance at the Old River locations would be 2% at Tracy Bridge and less than 1% at Middle
7 River. Average EC levels at the western and southern Delta compliance locations would decrease
8 from 0–37% for the entire period modeled. During the drought period modeled (1987-1991),
9 average EC would decrease by 0–32%, at western and southern Delta locations, except Emmaton
10 would have an increase in average EC of 9% (Appendix 8H, Table EC-13). At the two interior Delta
11 locations, there would be increases in average EC: the S. Fork Mokelumne River at Terminous
12 average EC would increase 5% for the entire period modeled and 4% during the drought period
13 modeled; and San Joaquin River at San Andreas Landing average EC would increase 1% for the
14 entire period modeled and 10% during the drought period modeled. On average, EC would increase
15 at San Andreas Landing from February through September. Average EC in the S. Fork Mokelumne
16 River at Terminous would increase during all months (Appendix 8H, Table EC-13). The comparison
17 to Existing Conditions reflects changes in EC due to both Alternative 2A operations (including north
18 Delta intake capacity of 15,000 cfs, Fall X2, and numerous other operational components of Scenario
19 B) and climate change/sea level rise.

20 Relative to the No Action Alternative, the percent of days exceeding EC objectives and percent of
21 days out of compliance would increase at: Sacramento River at Emmaton, San Joaquin River at
22 Jersey Point, San Andreas Landing, and Prisoners Point; and Old River near Middle River and at
23 Tracy Bridge (Appendix 8H, Table EC-2). The increase in percent of days exceeding the EC objective
24 would be 24% at Prisoners Point and 11% or less at the remaining locations. The increase in percent
25 of days out of compliance would be 26% at Prisoners Point and 13% or less at the remaining
26 locations. For the entire period modeled, average EC levels would increase at all Delta compliance
27 locations relative to the No Action Alternative, except in Three Mile Slough near the Sacramento
28 River, the Sacramento River at Emmaton, and the San Joaquin River at Jersey Point. The average EC
29 increase would be 6% or less (Appendix 8H, Table EC-13). Similarly, during the drought period
30 modeled, average EC would increase at all locations, except Three Mile Slough, Emmaton, and Jersey
31 Point. The greatest average EC increase during the drought period modeled would occur in the San
32 Joaquin River at San Andreas Landing (10%); the increase at the other locations would be 1–7%
33 (Appendix 8H, Table EC-13). The comparison to the No Action Alternative reflects changes in EC due
34 only to Alternative 2A operations (including north Delta intake capacity of 15,000 cfs, Fall X2, and
35 numerous other operational components of Scenario B).

36 For Suisun Marsh, October–May is the period when Bay-Delta WQCP EC objectives for protection of
37 fish and wildlife apply. Average EC would increase for the entire period modeled under Alternative
38 2A, relative to Existing Conditions, during the months of March through May by 0.3–0.6 mS/cm in
39 the Sacramento River at Collinsville (Appendix 8H, Table EC-21). Long-term average EC would
40 decrease relative to Existing Conditions in Montezuma Slough at National Steel during October–May
41 (Appendix 8H, Table EC-22). The most substantial increase would occur near Beldon Landing, with
42 long-term average EC levels increasing by 1.6–4.6 mS/cm, depending on the month, at least doubling
43 during some months the long-term average EC relative to Existing Conditions (Appendix 8H, Table
44 EC-23). Sunrise Duck Club and Volanti Slough also would have long-term average EC increases
45 during all months of 0.5–2.4 mS/cm (Appendix 8H, Tables EC-24 and EC-25). The degree to which
46 the long-term average EC increases would cause exceedance of Bay-Delta WQCP objectives is

1 unknown, because objectives are expressed as a monthly average of daily high tide EC, which does
2 not have to be met if it can be demonstrated “equivalent or better protection will be provided at the
3 location” (State Water Resources Control Board 2006:14). The described long-term average EC
4 increase may, or may not, contribute to adverse effects on beneficial uses, depending on how and
5 when wetlands are flooded, soil leaching cycles, and how agricultural use of water is managed, and
6 future actions taken with respect to the marsh. However, the EC increases at certain locations would
7 be substantial and it is uncertain the degree to which current management plans for the Suisun
8 Marsh would be able to address these substantially higher EC levels and protect beneficial uses.
9 Thus, these increased EC levels in Suisun Marsh are considered to have a potentially adverse effect
10 on marsh beneficial uses. Long-term average EC increases in Suisun Marsh under Alternative 2A
11 relative to the No Action Alternative would be similar to the increases relative to Existing
12 Conditions.

13 Given that the western and southern Delta are Clean Water Act section 303(d) listed as impaired
14 due to elevated EC, the increase in the incidence of exceedance of EC objectives under Alternative
15 2A, relative to Existing Conditions and the No Action Alternative, has the potential to contribute to
16 additional impairment and potentially adversely affect beneficial uses. Suisun Marsh is CWA section
17 303(d) listed as impaired due to elevated EC, and the potential increases in long-term average EC
18 concentrations could contribute to additional impairment, because the increases would be double
19 that relative to Existing Conditions and the No Action Alternative.

20 ***SWP/CVP Export Service Areas***

21 At the Banks and Jones pumping plants, Alternative 2A would result in no exceedances of the Bay-
22 Delta WQCP’s 1,000 $\mu\text{mhos/cm}$ EC objective for the entire period modeled (Appendix 8H, Table EC-
23 10). Thus, there would be no adverse effect on the beneficial uses in the SWP/CVP Export Service
24 Areas using water pumped at this location under the Alternative 2A.

25 At the Banks pumping plant, relative to Existing Conditions, average EC levels under Alternative 2A
26 would decrease 28% for the entire period modeled and 22% during the drought period modeled.
27 Relative to the No Action Alternative, average EC levels would decrease by 22% for the entire period
28 modeled and 17% during the drought period modeled. (Appendix 8H, Table EC-13)

29 At the Jones pumping plant, relative to Existing Conditions, average EC levels under Alternative 2A
30 would decrease 28% for the entire period modeled and 23% during the drought period modeled.
31 Relative to the No Action Alternative, average EC levels would decrease by 24% for the entire period
32 modeled and 20% during the drought period modeled. (Appendix 8H, Table EC-13)

33 Based on the decreases in long-term average EC levels that would occur at the Banks and Jones
34 pumping plants, Alternative 2A would not cause degradation of water quality with respect to EC in
35 the SWP/CVP Export Service Areas; rather, Alternative 2A would improve long-term average EC
36 conditions in the SWP/CVP Export Service Areas.

37 Commensurate with the EC decrease in exported waters, an improvement in lower San Joaquin
38 River average EC levels would be expected since EC in the lower San Joaquin River is, in part, related
39 to irrigation water deliveries from the Delta. While the magnitude of this expected lower San
40 Joaquin River improvement in EC is difficult to predict, the relative decrease in overall loading of EC-
41 elevating constituents to the Export Service Areas would likely alleviate or lessen any expected
42 increase in EC at Vernalis related to decreased annual average San Joaquin River flows (see EC
43 impact discussion under the No Action Alternative).

1 The export area of the Delta is listed on the state's CWA Section 303(d) list as impaired due to
2 elevated EC. Alternative 2A would result in lower average EC levels relative to Existing Conditions
3 and the No Action Alternative and, thus, would not contribute to additional beneficial use
4 impairment related to elevated EC in the SWP/CVP Export Service Areas waters.

5 **NEPA Effects:** In summary, the increased frequency of exceedance of EC objectives and increased
6 long-term and drought period average EC levels that would occur at western, interior, and southern
7 Delta compliance locations under Alternative 2A, relative to the No Action Alternative, would
8 contribute to adverse effects on the agricultural beneficial uses. In addition, the increased frequency
9 of exceedance of the San Joaquin River at Prisoners Point EC objective and long-term and drought
10 period average EC could contribute to adverse effects on fish and wildlife beneficial uses. Given that
11 the western and southern Delta are Clean Water Act section 303(d) listed as impaired due to
12 elevated EC, the increase in the incidence of exceedance of EC objectives and long-term average and
13 drought period average EC in this portion of the Delta has the potential to contribute to additional
14 beneficial use impairment. The increases in long-term average EC levels that would occur in Suisun
15 Marsh would further degrade existing EC levels and could contribute additional to adverse effects on
16 the fish and wildlife beneficial uses. Suisun Marsh is section 303(d) listed as impaired due to
17 elevated EC, and the potential increases in long-term average EC levels could contribute to
18 additional beneficial use impairment. These increases in EC constitute an adverse effect on water
19 quality. Mitigation Measure WQ-11 would be available to reduce these effects (implementation of
20 this measure along with a separate, non-environmental commitment as set forth in EIR/EIS
21 Appendix 3B, *Environmental Commitments*, relating to the potential EC-related changes would
22 reduce these effects).

23 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
24 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
25 purpose of making the CEQA impact determination for this constituent. For additional details on the
26 effects assessment findings that support this CEQA impact determination, see the effects assessment
27 discussion that immediately precedes this conclusion.

28 River flow rate and reservoir storage reductions that would occur under Alternative 2A, relative to
29 Existing Conditions, would not be expected to result in a substantial adverse change in EC levels in
30 the reservoirs and rivers upstream of the Delta, given that: changes in the quality of watershed
31 runoff and reservoir inflows would not be expected to occur in the future; the state's aggressive
32 regulation of point-source discharge effects on Delta salinity-elevating parameters and the expected
33 further regulation as salt management plans are developed; the salt-related TMDLs adopted and
34 being developed for the San Joaquin River; and the expected improvement in lower San Joaquin
35 River average EC levels commensurate with the lower EC of the irrigation water deliveries from the
36 Delta.

37 Relative to Existing Conditions, Alternative 2A would not result in any substantial increases in long-
38 term average EC levels in the SWP/CVP Export Service Areas. There would be no exceedance of the
39 EC objective at the Jones and Banks pumping plants. Average EC levels for the entire period modeled
40 would decrease at both plants and, thus, this alternative would not contribute to additional
41 beneficial use impairment related to elevated EC in the SWP/CVP Export Service Areas waters.
42 Rather, this alternative would improve long-term EC levels in the SWP/CVP Export Service Areas,
43 relative to Existing Conditions.

1 In the Plan Area, Alternative 2A would result in an increase in the frequency with which Bay-Delta
2 WQCP EC objectives are exceeded for the entire period modeled (1976–1991): in the Sacramento
3 River at Emmaton (agricultural objective; 17% increase), in the San Joaquin River at San Andreas
4 Landing (agricultural objective; 3% increase), and Prisoners Point (fish and wildlife objective; 19%
5 increase), both in the interior Delta; and in Old River near Middle River and at Tracy Bridge
6 (agricultural objectives; up to 2% increase), both in the southern Delta. Average EC levels at San
7 Andreas Landing would increase by 1% during for the entire period modeled and 10% during the
8 drought period modeled. The increases in long-term and drought period average EC levels and
9 increased frequency of exceedance of EC objectives that would occur in the San Joaquin River at San
10 Andreas Landing, and the increased exceedance of EC objectives in the Sacramento River at
11 Emmaton would potentially contribute to adverse effects on the agricultural beneficial uses in the
12 interior and western Delta. Further, the increased frequency of exceedance of the fish and wildlife
13 objective at Prisoners Point could contribute to adverse effects on aquatic life. Because EC is not
14 bioaccumulative, the increases in long-term average EC levels would not directly cause
15 bioaccumulative problems in aquatic life or humans. The western and southern Delta are Clean
16 Water Act section 303(d) listed for elevated EC and the increased frequency of exceedance of EC
17 objectives that would occur in these portions of the Delta could make beneficial use impairment
18 measurably worse. This impact is considered to be significant.

19 Further, relative to Existing Conditions, Alternative 2A would result in substantial increases in long-
20 term average EC during the months of October through May in Suisun Marsh, such that EC levels
21 would be double that relative to Existing Conditions. The increases in long-term average EC levels
22 that would occur in Suisun Marsh could further degrade existing EC levels and thus contribute
23 additionally to adverse effects on the fish and wildlife beneficial uses. Because EC is not
24 bioaccumulative, the increases in long-term average EC levels would not directly cause
25 bioaccumulative problems in fish and wildlife. Suisun Marsh is Clean Water Act section 303(d) listed
26 for elevated EC and the increases in long-term average EC that would occur in the marsh could make
27 beneficial use impairment measurably worse. This impact is considered to be significant.

28 Implementation of Mitigation Measure WQ-11 along with a separate, non-environmental
29 commitment relating to the potential increased costs associated with EC-related changes would
30 reduce these effects. While mitigation measures to reduce these water quality effects in affected
31 water bodies to less than significant levels are not available, implementation of Mitigation Measure
32 WQ-11 is recommended to attempt to reduce the effect that increased EC concentrations may have
33 on Delta beneficial uses. However, because the effectiveness of this mitigation measure to result in
34 feasible measures for reducing water quality effects is uncertain, this impact is considered to remain
35 significant and unavoidable. Please see Mitigation Measure WQ-11 under Impact WQ-11 in the
36 discussion of Alternative 1A.

37 In addition to and to supplement Mitigation Measure WQ-11, the BDCP proponents have
38 incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*, a
39 separate, non-environmental commitment to address the potential increased water treatment costs
40 that could result from EC concentration effects on municipal, industrial and agricultural water
41 purveyor operations. Potential options for making use of this financial commitment include funding
42 or providing other assistance towards acquiring alternative water supplies or towards modifying
43 existing operations when EC concentrations at a particular location reduce opportunities to operate
44 existing water supply diversion facilities. Please refer to Appendix 3B, *Environmental Commitments*,
45 for the full list of potential actions that could be taken pursuant to this commitment in order to

1 reduce the water quality treatment costs associated with water quality effects relating to chloride,
2 electrical conductivity, and bromide.

3 **Mitigation Measure WQ-11: Avoid, Minimize, or Offset, as Feasible, Reduced Water**
4 **Quality Conditions**

5 Please see Mitigation Measure WQ-11 under Impact WQ-11 in the discussion of Alternative 1A.

6 **Impact WQ-12: Effects on Electrical Conductivity Resulting from Implementation of CM2–**
7 **CM22**

8 **NEPA Effects:** Effects of CM2–CM22 on EC under Alternative 2A are the same as those discussed for
9 Alternative 1A and are considered not to be adverse.

10 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 2A would be similar to
11 those proposed under Alternative 1A. As such, effects on EC resulting from the implementation of
12 CM2–CM22 would be similar to that previously discussed for Alternative 1A. This impact is
13 considered to be less than significant. No mitigation is required.

14 **Impact WQ-13: Effects on Mercury Concentrations Resulting from Facilities Operations and**
15 **Maintenance (CM1)**

16 ***Upstream of the Delta***

17 Under Alternative 2A, the magnitude and timing of reservoir releases and river flows upstream of
18 the Delta in the Sacramento River watershed and east-side tributaries would be altered, relative to
19 Existing Conditions and the No Action Alternative.

20 The Sacramento River at Freeport and San Joaquin River at Vernalis (as summarized for water
21 quality average concentrations in Tables 8-48 and 8-49) were examined for flow/concentration
22 relationships for mercury and methylmercury. No significant, predictive regression relationships
23 were discovered for mercury or methylmercury, except for total mercury with flow at Freeport
24 (monthly or annual)(Figures I-10 through I-13, Appendix 8I). Such a positive relationship between
25 total mercury and flow is to be expected based on the association of mercury with suspended
26 sediment and the mobilization of sediments during storm flows. However, the changes in flow in the
27 Sacramento River under Alternative 2A relative to Existing Conditions and the No Action Alternative
28 are not of the magnitude of storm flows, in which substantial sediment-associated mercury is
29 mobilized. Therefore mercury loading should not be substantially different due to changes in flow.
30 In addition, even though it may be flow-affected, total mercury concentrations remain well below
31 criteria at upstream locations. Any negligible changes in mercury concentrations that may occur in
32 the water bodies of the affected environment located upstream of the Delta would not be of
33 frequency, magnitude, and geographic extent that would adversely affect any beneficial uses or
34 substantially degrade the quality of these water bodies as related to mercury. Both waterborne
35 methylmercury concentrations and largemouth bass fillet mercury concentrations are expected to
36 remain above guidance levels at upstream of Delta locations, but will not change substantially
37 relative to Existing Conditions or the No Action Alternative due to changes in flows under
38 Alternative 2A.

39 The upstream of Delta areas in the north will benefit from the implementation of the Cache Creek,
40 Sulfur Creek, Harley Gulch, and Clear Lake Mercury TMDLs and the American River methylmercury
41 TMDL. These projects will target specific sources of mercury and methylation upstream of the Delta

1 and could result in net improvement to Delta mercury loading in the future. The implementation of
2 these projects could help to ensure that upstream of Delta environments will not be substantially
3 degraded for water quality with respect to mercury or methylmercury.

4 ***Delta***

5 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
6 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
7 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
8 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
9 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
10 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

11 The water quality impacts of waterborne concentrations of mercury and methylmercury and fish
12 tissue mercury concentrations were evaluated for 9 Delta locations. The analysis of percentage
13 change in assimilative capacity of waterborne total mercury of Alternative 2A relative to the 25 ng/L
14 ecological risk benchmark showed the greatest decrease to be 2.2% for Old River at Rock Slough as
15 compared to Existing Conditions, and 2.1% for Old River at Rock Slough as compared to the No
16 Action Alternative (Figures 8-53 and 8-54). These changes are not expected to result in adverse
17 effects to beneficial uses. Similarly, changes in methylmercury concentration are expected to be very
18 small. The greatest annual average methylmercury concentration for drought conditions was 0.163
19 ng/L for the San Joaquin River at Buckley Cove which was slightly higher than Existing Conditions
20 (0.161 ng/L) and slightly lower than the No Action Alternative (0.167 ng/L) (Appendix 8I, Table I-
21 6). All modeled input concentrations exceeded the methylmercury TMDL guidance objective of 0.06
22 ng/L, therefore percentage change in assimilative capacity was not evaluated for methylmercury.

23 Fish tissue estimates show only small or no increases in exceedance quotients based on long-term
24 annual average concentrations for mercury at the Delta locations. The greatest increase in
25 exceedance quotients was 13% at Old River at Rock Slough relative to Existing Conditions, and 11 -
26 12% at the Mokelumne River (South Fork) at Staten Island, Franks Tract, and Old River at Rock
27 Slough relative to the No Action Alternative (Figure 8-55; Appendix 8I, Table I-9b).

28 ***SWP/CVP Export Service Areas***

29 The analysis of mercury and methylmercury in the SWP/CVP Export Service Areas was based on
30 concentrations estimated at the Banks and Jones pumping plants. Both waterborne total and
31 methylmercury concentrations for Alternative 2A are projected to be lower than Existing Conditions
32 and the No Action Alternative at the Jones and Banks pumping plants (Appendix 8I, Figures I-2 and
33 I-3). Therefore, mercury shows increased assimilative capacity at these locations (Figures 8-53 and
34 8-54).

35 The largest improvements in bass tissue mercury concentrations and exceedance quotients for
36 Alternative 2A, relative to Existing Conditions and the No Action Alternative at any location within
37 the Delta are expected for the export pump locations (specifically, at Jones Pumping plant, 14%
38 improvement relative to Existing Conditions, 17% relative to the No Action Alternative) (Figure 8-
39 55, Appendix 8I, Table I-9b).

40 ***NEPA Effects:*** Based on the above discussion, the effects of mercury and methylmercury in
41 comparison of Alternative 2A to the No Action Alternative (as waterborne and bioaccumulated
42 forms) are not considered to be adverse.

1 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
2 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
3 purpose of making the CEQA impact determination for this constituent. For additional details on the
4 effects assessment findings that support this CEQA impact determination, see the effects assessment
5 discussion that immediately precedes this conclusion.

6 Under Alternative 2A, greater water demands and climate change would alter the magnitude and
7 timing of reservoir releases and river flows upstream of the Delta in the Sacramento River
8 watershed and east-side tributaries, relative to Existing Conditions. Concentrations of mercury and
9 methylmercury upstream of the Delta will not be substantially different relative to Existing
10 Conditions due to the lack of important relationships between mercury/methylmercury
11 concentrations and flow for the major rivers.

12 Methylmercury concentrations exceed criteria at all locations in the Delta and no assimilative
13 capacity exists. However, monthly average waterborne concentrations of total and methylmercury,
14 over the period of record, are very similar to Existing Conditions. Similarly, estimates of fish tissue
15 mercury concentrations show almost no differences would occur among sites for Alternative 2A as
16 compared to Existing Conditions for Delta sites.

17 Assessment of effects of mercury in the SWP and CVP Export Service Areas were based on effects on
18 mercury concentrations and fish tissue mercury concentrations at the Banks and Jones pumping
19 plants. The Banks and Jones pumping plants are expected to show increased assimilative capacity
20 for waterborne mercury and decreased fish tissue concentrations of mercury for Alternative 2A as
21 compared to Existing Conditions.

22 As such, this alternative is not expected to cause additional exceedance of applicable water quality
23 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
24 on any beneficial uses of waters in the affected environment. Because mercury concentrations are
25 not expected to increase substantially, no long-term water quality degradation is expected to occur
26 and, thus, no adverse effects to beneficial uses would occur. Because any increases in mercury or
27 methylmercury concentrations are not likely to be measurable, changes in mercury concentrations
28 or fish tissue mercury concentrations would not make any existing mercury-related impairment
29 measurably worse. In comparison to Existing Conditions, Alternative 2A would not increase levels of
30 mercury by frequency, magnitude, and geographic extent such that the affected environment would
31 be expected to have measurably higher body burdens of mercury in aquatic organisms, thereby
32 substantially increasing the health risks to wildlife (including fish) or humans consuming those
33 organisms. This impact is considered to be less than significant. No mitigation is required.

34 **Impact WQ-14: Effects on Mercury Concentrations Resulting from Implementation of CM2-** 35 **CM22**

36 **NEPA Effects:** Some habitat restoration activities under Alternative 2A would occur on lands in the
37 Delta formerly used for irrigated agriculture. Tidal and other restoration proposed under
38 Alternative 2A have the potential to increase water residence times and increase accumulation of
39 organic sediments that are known to enhance methylmercury bioaccumulation in biota in the
40 restored habitat. Therefore, increases in mercury methylation in the habitat restoration areas is
41 possible but uncertain depending on the specific restoration design implemented at a particular
42 Delta location. Models to estimate the potential for methylmercury formation in restored areas are
43 not currently available. However, DSM2 modeling for Alternative 2A operations does incorporate
44 assumptions for certain habitat restoration activities proposed under CM2 and CM4 (see Section

1 8.3.1.3) that result in changes to Delta hydrodynamics compared to the No Action Alternative. These
2 modeled restoration assumptions provide some insight into potential hydrodynamic changes that
3 could be expected related to implementing CM2 and CM4 and are considered in the evaluation of the
4 potential for increased mercury and methylmercury concentrations under Alternative 2A.

5 BDCP Conservation Measure 12 (CM12) addresses the potential for methylmercury bioaccumulation
6 associated with restoration activities and acknowledges the uncertainties associated with mitigating
7 or minimizing this potential effect. CM12 proposes project-specific mercury management plans for
8 restoration actions that will incorporate relevant approaches recommended in Phase 1
9 Methylmercury TMDL control studies. Specific approaches recommended under CM12 that are
10 intended to minimize or mitigate for potential increases in methylmercury bioaccumulation at
11 future restoration sites include:

- 12 • Characterizing mercury, methylmercury, organic carbon, iron, and sulfate concentrations to
13 better inform restoration design,
- 14 • Sequestering methylmercury at restoration sites using low intensity chemical dosing
15 techniques,
- 16 • Minimizing microbial methylation associated with anoxic conditions by reducing the amount of
17 organic material at a restoration site,
- 18 • Designing restoration sites to enhance photo degeneration that converts methylmercury into a
19 biologically unavailable, inorganic form of mercury,
- 20 • Remediating restoration site soils with iron to reduce methylation in sulfide rich soils, and
21 • Considering capping mercury laden sediments, where possible to reduce methylation potential
22 at a site.

23 Because of the uncertainties associated with site-specific estimates of methylmercury
24 concentrations and the uncertainties in source modeling and tissue modeling, the effectiveness of
25 methylmercury management proposed under CM12 to reduce methylmercury concentrations would
26 need to be evaluated separately for each restoration effort, as part of design and implementation. In
27 summary, because of this uncertainty and the known potential for methylmercury creation in the
28 Delta this potential effect of implementing CM2–CM22 is considered adverse.

29 **CEQA Conclusion:** There would be no substantial, long-term increase in mercury or methylmercury
30 concentrations or loads in the rivers and reservoirs upstream of the Delta or the waters exported to
31 the CVP and SWP service areas due to implementation of CM2–CM22 relative to Existing Conditions.
32 However, uptake of mercury from water and/or methylation of inorganic mercury may increase to
33 an unquantified degree as part of the creation of new, marshy, shallow, or organic-rich restoration
34 areas. Methylmercury is 303(d)-listed within the affected environment, and therefore any potential
35 measurable increase in methylmercury concentrations would make existing mercury-related
36 impairment measurably worse. Because mercury is bioaccumulative, increases in water-borne
37 mercury or methylmercury that could occur in some areas could bioaccumulate to somewhat
38 greater levels in aquatic organisms and would, in turn, pose health risks to fish, wildlife, or humans.
39 Design of restoration sites under Alternative 2A would be guided by CM12 which requires
40 development of site specific mercury management plans as restoration actions are implemented.
41 The effectiveness of minimization and mitigation actions implemented according to the mercury
42 management plans is not known at this time although the potential to reduce methylmercury
43 concentrations exists based on current research. Although the BDCP will implement CM12 with the

1 goal to reduce this potential effect the uncertainties related to site specific restoration conditions
 2 and the potential for increases in methylmercury concentrations in the Delta result in this potential
 3 impact being considered significant. No mitigation measures would be available until specific
 4 restoration actions are proposed. Therefore this programmatic impact is considered significant and
 5 unavoidable.

6 **Impact WQ-15: Effects on Nitrate Concentrations Resulting from Facilities Operations and** 7 **Maintenance (CM1)**

8 ***Upstream of the Delta***

9 For the same reasons stated for the No Action Alternative, Alternative 2A would have negligible, if
 10 any, impact on nitrate concentrations in the rivers and reservoirs upstream of the Delta in the
 11 Sacramento River watershed relative to Existing Conditions and the No Action Alternative.

12 Under Alternative 2A, modeling indicates that long-term annual average flows on the San Joaquin
 13 River would decrease by an estimated 6%, relative to Existing Conditions, and would remain
 14 virtually the same relative to the No Action Alternative (Appendix 5A). Given these relatively small
 15 decreases in flows and the weak correlation between nitrate and flows in the San Joaquin River (see
 16 Nitrate Appendix 8J, Figure 2), it is expected that nitrate concentrations in the San Joaquin River
 17 would be minimally affected, if at all, by changes in flow rates under Alternative 2A.

18 Any negligible changes in nitrate-N concentrations that may occur in the water bodies of the affected
 19 environment located upstream of the Delta would not be of frequency, magnitude and geographic
 20 extent that would adversely affect any beneficial uses or substantially degrade the quality of these
 21 water bodies, with regards to nitrate.

22 ***Delta***

23 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 24 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 25 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 26 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 27 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
 28 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

29 Results of the mixing calculations indicate that under Alternative 2A, relative to Existing Conditions
 30 and the No Action Alternative, nitrate concentrations throughout the Delta are anticipated to remain
 31 low (<1.4 mg/L-N) relative to adopted objectives (Nitrate Appendix 8J, Table 10 and 11). Although
 32 changes at specific Delta locations and for specific months may be substantial on a relative basis, the
 33 absolute concentration of nitrate in Delta waters would remain low (<1.4 mg/L-N) in relation to the
 34 drinking water MCL of 10 mg/L-N, as well as all other thresholds identified in Table 8-50. Long-term
 35 average nitrate concentrations are anticipated to remain below 1 mg/L-N at all 11 assessment
 36 locations except the San Joaquin River at Buckley Cove, where long-term average concentrations
 37 would be somewhat above 1 mg/L-N. Nevertheless, at this location, long-term average nitrate
 38 concentration would be somewhat reduced under Alternative 2A, relative to Existing Conditions,
 39 and slightly increased relative to the No Action Alternative. No additional exceedances of the MCL
 40 are anticipated at any location (Nitrate Appendix 8J, Table 10). On a monthly average basis and on a
 41 long term annual average basis, for all modeled years and for the drought period (1987–1991) only,
 42 use of assimilative capacity available under Existing Conditions and the No Action Alternative,

1 relative to the drinking water MCL of 10 mg/L-N, was low or negligible (i.e., <5%) for all locations
 2 and months, except San Joaquin River at Buckley Cove in August, which showed a 6.4% use of the
 3 assimilative capacity that was available under the No Action Alternative, for the drought period
 4 (1987–1991) (Nitrate Appendix 8J, Table 12).

5 Nitrate concentrations will likely be higher than the modeling results indicate in certain locations.
 6 This includes in the Sacramento River between Freeport and Mallard Island and other areas in the
 7 Delta downstream of Freeport that are influenced by Sacramento River water. These increases are
 8 associated with ammonia and nitrate that are discharged from the SRWTP, which are not included in
 9 the modeling.

- 10 • Under Existing Conditions, most of the ammonia discharged from the SRWTP is converted to
 11 nitrate downstream of the facility's discharge at Freeport, and thus, nitrate concentrations
 12 under Existing Conditions in these areas are expected to be higher than the modeling
 13 predicts, the increase becoming greater with increasing distance downstream. However, the
 14 increase in nitrate concentrations downstream of the SRWTP is expected to be small—the
 15 existing increase appears to be from approximately 0.1 mg/L-N to approximately 0.4–0.5
 16 mg/L-N over this reach, due to approximately a 1:1 conversion of ammonia-N to nitrate-N
 17 (Central Valley Water Board 2010a:32).
- 18 • Under Alternative 2A, the planned upgrades to the SRWTP, which include
 19 nitrification/partial denitrification, would substantially decrease ammonia concentrations
 20 in the discharge, but would increase nitrate concentrations in the discharge up to 10 mg/L-
 21 N, which is substantially higher than under Existing Conditions.
- 22 • Overall, under Alternative 2A, the nitrogen load from the SRWTP discharge is expected to
 23 decrease (by up to 50%), relative to Existing Conditions, due to nitrification/partial
 24 denitrification upgrades at the SRWTP facility. Thus, while concentrations of nitrate
 25 downstream of the facility are expected to be higher than modeling results indicate for both
 26 Existing Conditions and Alternative 2A, the increase is expected to be greater under Existing
 27 Conditions than for Alternative 2A due to the upgrades that are assumed under Alternative
 28 2A.

29 The other areas in which nitrate concentrations will be higher than the modeling results indicate are
 30 immediately downstream of other wastewater treatment plants that practice nitrification, but not
 31 denitrification (e.g., City of Rio Vista Beach WWTF, Town of Discovery Bay WWTF, City of Stockton
 32 RWCF). For all such facilities in the Delta, the Regional Water Boards have issued NPDES permits
 33 that allow discharge of wastewater containing nitrate into the Delta, and under these permits, the
 34 State has determined that no beneficial uses are adversely affected by the discharge, and that the
 35 discharger's use of available assimilative capacity of the water body is acceptable. When dilution is
 36 necessary in order for the discharge to be in compliance with the Basin Plans (which incorporate the
 37 10 mg/L-N MCL by reference), not all of the assimilative capacity of the receiving water is granted to
 38 the discharger. Thus, limited decreases in flows are not anticipated to result in systemic
 39 exceedances of the MCLs by these POTWs. Furthermore, NPDES permits are renewed on a 5-year
 40 basis, and thus, if under changes in flows, dilution was no longer sufficient to maintain nitrate below
 41 the MCL in the receiving water, the NPDES permit renewal process would address such cases.

42 Therefore, any increases in nitrate-N concentrations that may occur at certain locations within the
 43 Delta would not be of frequency, magnitude and geographic extent that would adversely affect any
 44 beneficial uses or substantially degrade the water quality at these locations, with regards to nitrate.

1 **SWP/CVP Export Service Areas**

2 Assessment of effects of nitrate in the SWP and CVP Export Service Areas is based on effects on
3 nitrate-N at the Banks and Jones pumping plants.

4 Results of the mixing calculations indicate that under Alternative 2A, relative to Existing Conditions
5 and the No Action Alternative, nitrate concentrations at Banks and Jones pumping plants are
6 anticipated to decrease on a long-term average annual basis (Nitrate Appendix 8J, Table 10 and 11).
7 During the late summer, particularly in the drought period assessed, concentrations are expected to
8 increase substantially on a relative basis (i.e., >50%), but the absolute value of these changes (i.e., in
9 mg/L-N) is small. Additionally, given the many factors that contribute to potential algal blooms in
10 the SWP and CVP canals within the Export Service Area, and the lack of studies that have shown a
11 direct relationship between nutrient concentrations in the canals and reservoirs and problematic
12 algal blooms in these water bodies, there is no basis to conclude that these small (i.e., generally <0.3
13 mg/L-N), seasonal increases in nitrate concentrations would increase the potential for problem algal
14 blooms in the SWP and CVP Export Service Area. No additional exceedances of the MCL are
15 anticipated (Nitrate Appendix 8J, Table 10). On a monthly average basis and on a long term annual
16 average basis, for all modeled years and for the drought period (1987–1991) only, use of
17 assimilative capacity available under Existing Conditions and the No Action Alternative, relative to
18 the 10 mg/L-N MCL, was negligible (<4%) for both Banks and Jones pumping plants (Nitrate
19 Appendix 8J, Table 12).

20 Any increases in nitrate-N concentrations that may occur in water exported via Banks and Jones
21 pumping plants are not expected to result in adverse effects to beneficial uses or substantially
22 degrade the quality of exported water, with regards to nitrate.

23 **NEPA Effects:** In summary, based on the discussion above, the effects on nitrate from implementing
24 CM1 are considered to be not adverse.

25 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
26 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
27 purpose of making the CEQA impact determination for this constituent. For additional details on the
28 effects assessment findings that support this CEQA impact determination, see the effects assessment
29 discussion that immediately precedes this conclusion.

30 Nitrate-N concentrations are generally low in the reservoirs and rivers of the watersheds, owing to
31 substantial dilution available for point sources and the lack of substantial nonpoint sources of
32 nitrate-N upstream of the SRWTP in the Sacramento River watershed, and in the watersheds of the
33 eastern tributaries (Cosumnes, Mokelumne, and Calaveras Rivers). Although higher in the San
34 Joaquin River watershed, nitrate-N concentrations are not well-correlated with flow rates.
35 Consequently, any modified reservoir operations and subsequent changes in river flows under
36 Alternative 2A, relative to Existing Conditions, are expected to have negligible, if any, effects on
37 reservoir and river nitrate-N concentrations upstream of Freeport in the Sacramento River
38 watershed and upstream of the Delta in the San Joaquin River watershed.

39 In the Delta, results of the mixing calculations indicate that under Alternative 2A, relative to Existing
40 Conditions, nitrate concentrations throughout the Delta are anticipated to remain low (<1.4 mg/L-
41 N) relative to adopted objectives. No additional exceedances of the MCL are anticipated at any
42 location, and use of assimilative capacity available under Existing Conditions, relative to the

1 drinking water MCL of 10 mg/L-N, was low or negligible (i.e., <5%) for virtually all locations and
2 months.

3 Assessment of effects of nitrate in the SWP and CVP Export Service Areas is based on effects on
4 nitrate-N concentrations at the Banks and Jones pumping plants. Results of the mixing calculations
5 indicate that under Alternative 2A, relative to Existing Conditions, long-term average nitrate
6 concentrations at Banks and Jones pumping plants are anticipated to change negligibly. No
7 additional exceedances of the MCL are anticipated, and use of assimilative capacity available under
8 Existing Conditions, relative to the MCL was negligible (i.e., <4%) for both Banks and Jones pumping
9 plants for all months.

10 Based on the above, there would be no substantial, long-term increase in nitrate-N concentrations in
11 the rivers and reservoirs upstream of the Delta, in the Delta Region, or the waters exported to the
12 CVP and SWP service areas under Alternative 2A relative to Existing Conditions. As such, this
13 alternative is not expected to cause additional exceedance of applicable water quality
14 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
15 on any beneficial uses of waters in the affected environment. Because nitrate concentrations are not
16 expected to increase substantially, no long-term water quality degradation is expected to occur and,
17 thus, no adverse effects to beneficial uses would occur. Nitrate is not 303(d) listed within the
18 affected environment and thus any increases that may occur in some areas and months would not
19 make any existing nitrate-related impairment measurably worse because no such impairments
20 currently exist. Because nitrate is not bioaccumulative, increases that may occur in some areas and
21 months would not bioaccumulate to greater levels in aquatic organisms that would, in turn, pose
22 substantial health risks to fish, wildlife, or humans. This impact is considered to be less than
23 significant. No mitigation is required.

24 **Impact WQ-16: Effects on Nitrate Concentrations Resulting from Implementation of CM2-22**

25 **NEPA Effects:** Effects of CM2-22 on nitrate under Alternative 2A are the same as those discussed for
26 Alternative 1A and are considered not to be adverse.

27 **CEQA Conclusion:** Conservation Measures 2-22 proposed under Alternative 2A would be similar to
28 those proposed under Alternative 1A. As such, effects on nitrate resulting from the implementation
29 of CM2-CM22 would be similar to that previously discussed for Alternative 1A. This impact is
30 considered to be less than significant. No mitigation is required.

31 **Impact WQ-17: Effects on Dissolved Organic Carbon Concentrations Resulting from Facilities 32 Operations and Maintenance (CM1)**

33 ***Upstream of the Delta***

34 Under Alternative 2A, there would be no substantial change to the sources of DOC within the
35 watersheds upstream of the Delta. Moreover, long-term average flow and DOC levels in the
36 Sacramento River at Hood and San Joaquin River at Vernalis are poorly correlated. Thus changes in
37 system operations and resulting reservoir storage levels and river flows would not be expected to
38 cause a substantial long-term change in DOC concentrations in the water bodies upstream of the
39 Delta. Any negligible changes in DOC levels in water bodies upstream of the Delta under Alternative
40 2A, relative to Existing Conditions and the No Action Alternative, would not be of sufficient
41 frequency, magnitude and geographic extent that would adversely affect any beneficial uses or
42 substantially degrade the quality of these water bodies, with regards to DOC.

Delta

Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2 and CM4) would affect Delta hydrodynamics. To the extent that restoration actions alter hydrodynamics within the Delta region, which affects mixing of source waters, these effects are included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

Under Alternative 2A, the geographic extent of effects pertaining to long-term average DOC concentrations in the Delta would be similar to that previously described for Alternative 1A, although the magnitude of predicted long-term change and relative frequency of concentration threshold exceedances would be slightly greater. Modeled effects would be greatest at Franks Tract, Rock Slough, and Contra Costa PP No. 1, where for the 16-year hydrologic period and the modeled drought period, long-term average concentration increases ranging from 0.3–0.4 mg/L would be predicted ($\leq 12\%$ net increase) (Appendix 8K, DOC Table 3). Increases in long-term average concentrations would correspond to more frequent concentration threshold exceedances, with the greatest change occurring at Rock Slough and Contra Costa PP No. 1 locations. For Rock Slough, long-term average DOC concentrations exceeding 3 mg/L would increase from 52% under Existing Conditions to 74% under the Alternative 2A (an increase from 47% to 70% for the drought period), and concentrations exceeding 4 mg/L would increase from 30% to 36% (32% to 38% for the drought period). For Contra Costa PP No. 1, long-term average DOC concentrations exceeding 3 mg/L would increase from 52% under Existing Conditions to 80% under Alternative 2A (45% to 80% for the drought period), and concentrations exceeding 4 mg/L would increase from 32% to 41% (35% to 42% for the drought period). Relative change in frequency of threshold exceedance for other assessment locations would be similar or less. While Alternative 2A would generally lead to slightly higher long-term average DOC concentrations (≤ 0.4 mg/L) at some municipal water intakes and Delta interior locations, the predicted change would not be expected to adversely affect MUN beneficial uses, or any other beneficial use. This comparison to Existing Conditions reflects changes in DOC due to both Alternative 2A operations (including north Delta intake capacity of 15,000 cfs, Fall X2, and numerous other operational components of Scenario B) and climate change/sea level rise.

In comparison, Alternative 2A relative to the No Action Alternative would generally result in a similar magnitude of change to that discussed for the comparison to Existing Conditions. Maximum increases of 0.2–0.3 mg/L DOC (i.e., $\leq 9\%$) would be predicted at Franks Tract, Rock Slough, and Contra Costa PP No. 1 relative to No Action Alternative (Appendix 8K, DOC Table 3). Threshold concentration exceedance frequency trends would also be similar to that discussed for the existing condition comparison, with exception to the predicted 4 mg/L exceedance frequency at Buckley Cove. In comparison to the No Action Alternative, the frequency which long-term average DOC concentrations exceeded 4 mg/L at Buckley Cove would increase slightly from 27% to 28% (42% to 50% for the modeled drought period). While the Alternative 2A would generally lead to slightly higher long-term average DOC concentrations at some Delta assessment locations when compared to No Action Alternative conditions, the predicted change would not be expected to adversely affect MUN beneficial uses, or any other beneficial use, particularly when considering the relatively small change in long-term annual average concentration. Unlike the comparison to Existing Conditions, this comparison to the No Action Alternative reflects changes in DOC due to only Alternative 2A operations.

1 As discussed for Alternative 1A, substantial change in ambient DOC concentrations would need to
2 occur before significant changes in drinking water treatment plant design or operations are
3 triggered. The increases in long-term average DOC concentrations estimated to occur at various
4 Delta locations under Alternative 2A are of sufficiently small magnitude that they would not require
5 existing drinking water treatment plants to substantially upgrade treatment for DOC removal above
6 levels currently employed.

7 Relative to existing and No Action Alternative conditions, Alternative 2A would lead to predicted
8 improvements in long-term average DOC concentrations at Barker Slough, as well as Banks and
9 Jones pumping plants (discussed below). At Barker Slough, long-term average DOC concentrations
10 would be predicted to decrease by as much as 0.1–0.2 mg/L, depending on baseline conditions
11 comparison and modeling period.

12 ***SWP/CVP Export Service Areas***

13 Under Alternative 2A, modeled long-term average DOC concentrations would decrease at Banks and
14 Jones pumping plants for both the modeled 16-year hydrologic period and the modeled drought
15 period. Relative to Existing Conditions, long-term average DOC concentrations at Banks would be
16 predicted to decrease by 0.5 mg/L (0.2 mg/L during drought period) (Appendix 8K, DOC Table 3). At
17 Jones, long-term average DOC concentrations would be predicted to decrease by 0.4 mg/L (<0.1
18 mg/L during drought period). Predicted decreases under relative to the No Action Alternative would
19 be of similar magnitude. Such decreases in long-term average DOC would result in generally lower
20 exceedance frequencies for concentration thresholds, although the frequency of exceedance during
21 the modeled drought period (i.e., 1987–1991) would be predicted to increase. For the Banks
22 pumping plant during the drought period, exceedance of the 3 mg/L threshold would increase from
23 57% under Existing Conditions to 84% under Alternative 2A, while at the Jones pumping plant,
24 exceedance frequency would increase from 72% to 88%. There would be comparatively fewer
25 increases in the frequency of exceeding the 4 mg/L threshold at Banks and Jones. Comparisons to
26 the No Action Alternative yield similar trends, but with slightly smaller magnitude drought period
27 changes. Overall, modeling results for the SWP/CVP Export Service Areas predict an overall
28 improvement in Export Service Areas water quality, although more frequent exports of >3 mg/L
29 DOC water would likely occur for drought periods.

30 Similar to the discussion pertaining to the No Action Alternative, maintenance of SWP and CVP
31 facilities under Alternative 2A would not be expected to create new sources of DOC or contribute
32 towards a substantial change in existing sources of DOC in the affected area. Maintenance activities
33 would not be expected to cause any substantial change in long-term average DOC concentrations
34 such that MUN beneficial uses, or any other beneficial use, would be adversely affected.

35 ***NEPA Effects:*** In summary, Alternative 2A, relative to the No Action Alternative, would not cause a
36 substantial long-term change in DOC concentrations in the water bodies upstream of the Delta.
37 Long-term average DOC concentrations at Banks and Jones pumping plants are predicted to
38 decrease by as much as 0.6 mg/L, while long-term average DOC concentrations for some Delta
39 interior locations, including Contra Costa PP #1, are predicted to increase by as much as 0.3 mg/L.
40 The increase in long-term average DOC concentration that could occur within the Delta interior
41 would not be of sufficient magnitude to adversely affect the MUN beneficial use, or any other
42 beneficial uses, of Delta waters. The effect of Alternative 1A operations and maintenance (CM1) on
43 DOC is determined not to be adverse.

1 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
2 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
3 purpose of making the CEQA impact determination for this constituent. For additional details on the
4 effects assessment findings that support this CEQA impact determination, see the effects assessment
5 discussion that immediately precedes this conclusion.

6 While greater water demands under the Alternative 2A would alter the magnitude and timing of
7 reservoir releases north, south and east of the Delta, these activities would have no substantial effect
8 on the various watershed sources of DOC. Moreover, long-term average flow and DOC at Sacramento
9 River at Hood and San Joaquin River at Vernalis are poorly correlated; therefore, changes in river
10 flows would not be expected to cause a substantial long-term change in DOC concentrations
11 upstream of the Delta.

12 Relative to Existing Conditions, Alternative 2A would result in relatively small increases (i.e., $\leq 12\%$)
13 in long-term average DOC concentrations at some Delta interior locations, including Franks Tract,
14 Rock Slough, and Contra Costa PP No. 1. However, these increases would not substantially increase
15 the frequency with which long-term average DOC concentrations exceeds 2, 3, or 4 mg/L. While
16 Alternative 2A would generally lead to slightly higher long-term average DOC concentrations (≤ 0.4
17 mg/L) within the Delta interior and some municipal water intakes, the predicted change would not
18 be expected to adversely affect MUN beneficial uses, or any other beneficial use.

19 The assessment of Alternative 2A effects on DOC in the SWP/CVP Export Service Areas is based on
20 assessment of changes in DOC concentrations at Banks and Jones pumping plants. Relative to the
21 existing condition, long-term average DOC concentrations would decrease by as much as 0.5 mg/L at
22 Banks and Jones pumping plants, although slightly more frequent export of >3 mg/L DOC water is
23 predicted during periods of drought. Nevertheless, an overall improvement in DOC-related water
24 quality would be predicted in the SWP/CVP Export Service Areas.

25 Based on the above, Alternative 2A operation and maintenance would not result in any substantial
26 change in long-term average DOC concentration upstream of the Delta or result in substantial
27 increase in the frequency with which long-term average DOC concentrations exceeds 2, 3, or 4 mg/L
28 levels at the 11 assessment locations analyzed for the Delta. Modeled long-term average DOC
29 concentrations would increase by no more than 0.4 mg/L at any single Delta assessment location
30 (i.e., $\leq 12\%$ relative increase), with long-term average concentrations estimated to remain at or
31 below 4.0 mg/L at all Delta locations assessed, with the exception of Buckley Cove on the San
32 Joaquin River during the drought period modeled. Nevertheless, long-term average concentrations
33 at Buckley Cove are expected to decrease slightly during the drought period, relative to Existing
34 Conditions. The increases in long-term average DOC concentration that could occur within the Delta
35 would not be of sufficient magnitude to adversely affect the MUN beneficial use, or any other
36 beneficial uses, of Delta waters or waters of the SWP/CVP Service Area. Because DOC is not
37 bioaccumulative, the increases in long-term average DOC concentrations would not directly cause
38 bioaccumulative problems in aquatic life or humans. Finally, DOC is not causing beneficial use
39 impairments and thus is not 303(d) listed for any water body within the affected environment. Thus,
40 the increases in long-term average DOC that could occur at various locations would not make any
41 beneficial use impairment measurably worse. Because long-term average DOC concentrations are
42 not expected to increase substantially, no long-term water quality degradation with respect to DOC
43 is expected to occur and, thus, no adverse effects on beneficial uses would occur. This impact is
44 considered to be less than significant. No mitigation is required.

1 **Impact WQ-18: Effects on Dissolved Organic Carbon Concentrations Resulting from**
 2 **Implementation of CM2–CM22**

3 **NEPA Effects:** Conservation Measures 2–22 proposed under Alternative 2A would be the same as
 4 those proposed under Alternative 1A. As such, effects on DOC resulting from the implementation of
 5 CM2–CM22 would be similar to that previously discussed for Alternative 1A. In summary, CM4–CM7
 6 and CM10 could contribute substantial amounts of DOC to raw drinking water supplies, largely
 7 depending on final design and operational criteria for the related wetland and riparian habitat
 8 restoration activities. Substantially increased long-term average DOC in raw water supplies could
 9 lead to a need for treatment plant upgrades in order to appropriately manage DBP formation in
 10 treated drinking water. This potential for future DOC increases would lead to substantially greater
 11 associated risk of long-term adverse effects on the MUN beneficial use.

12 In summary, the habitat restoration elements of CM4–CM7 and CM10 under Alternative 2A would
 13 present new localized sources of DOC to the study area, and in some circumstances would substitute
 14 for existing sources related to replaced agriculture. Depending on localized hydrodynamics and
 15 proximity to municipal drinking water intakes, such restoration activities could contribute
 16 substantial amounts of DOC to municipal raw water. Substantial increases in municipal raw water
 17 DOC could necessitate changes in water treatment plant operations or require treatment plant
 18 upgrades in order to maintain DBP compliance, and thus would constitute an adverse effect on
 19 water quality. Mitigation Measure WQ-18 is available to reduce these effects.

20 **CEQA Conclusion:** Effects of CM4–7 and CM10 on DOC under Alternative 2A would be similar to
 21 those discussed for Alternative 1A. This impact is considered to be significant and mitigation is
 22 required. It is uncertain whether implementation of Mitigation Measure WQ-18 would reduce
 23 identified impacts to a less-than-significant level. Hence, this impact remains significant and
 24 unavoidable.

25 In addition to and to supplement Mitigation Measure WQ-18, the BDCP proponents have
 26 incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*, a
 27 separate, non-environmental commitment to address the potential increased water treatment costs
 28 that could result from DOC concentration effects on municipal and industrial water purveyor
 29 operations. Potential options for making use of this financial commitment include funding or
 30 providing other assistance towards implementing treatment for DOC and/or DBPs or DOC source
 31 control strategies. Please refer to Appendix 3B, *Environmental Commitments*, for the full list of
 32 potential actions that could be taken pursuant to this commitment in order to reduce the water
 33 quality treatment costs associated with water quality effects relating to DOC.

34 **Mitigation Measure WQ-18: Design Wetland and Riparian Habitat Features to Minimize**
 35 **Effects on Municipal Intakes**

36 Please see Mitigation Measure WQ-18 under Impact WQ-18 in the discussion of Alternative 1A.

37 **Impact WQ-19: Effects on Pathogens Resulting from Facilities Operations and Maintenance**
 38 **(CM1)**

39 **NEPA Effects:** Effects of CM1 on pathogens under Alternative 2A are the same as those discussed for
 40 Alternative 1A and are considered to not be adverse.

41 **CEQA Conclusion:** Effects of CM1 on pathogens under Alternative 2A are the same as those
 42 discussed for Alternative 1A, and are summarized here, then compared to the CEQA thresholds of

1 significance (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for
2 this constituent. For additional details on the effects assessment findings that support this CEQA
3 impact determination, see the effects assessment discussion under Alternative 1A.

4 River flow rate and reservoir storage reductions that would occur due to implementation of CM1
5 (water facilities and operations) under Alternative 2A, relative to Existing Conditions, would not be
6 expected to result in a substantial adverse change in pathogen concentrations in the reservoirs and
7 rivers upstream of the Delta, given the small magnitude of urban runoff contributions relative to the
8 magnitude of river flows, that pathogen concentrations in the rivers have a minimal relationship to
9 river flow rate, and the expected reduced pollutant loadings in response to NPDES stormwater-
10 related regulations.

11 It is expected there would be no substantial change in Delta pathogen concentrations in response to
12 a shift in the Delta source water percentages under this alternative or substantial degradation of
13 these water bodies, with regard to pathogens. This conclusion is based on the Pathogens Conceptual
14 Model, which found that pathogen sources in close proximity to a Delta site appear to have the
15 greatest influence on pathogen levels at the site, rather than the primary source(s) of water to the
16 site. In-Delta potential pathogen sources, including water-based recreation, tidal habitat, wildlife,
17 and livestock-related uses, would continue under this alternative.

18 In the SWP/CVP Export Service Areas waters, relative to Existing Conditions, an increased
19 proportion of water coming from the Sacramento River would not adversely affect beneficial uses in
20 the SWP/CVP Export Service Areas. The pathogen levels in the Sacramento River are similar to or
21 lower than the water diverted at the Delta export pumps. Further, it is localized sources of
22 pathogens that appear to have the greatest influence on concentrations. Thus, an increased
23 proportion of Sacramento River water diverted to the SWP/CVP Export Service Areas would result
24 in minimal changes in pathogen levels in the SWP/CVP Export Service Areas waters.

25 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
26 objectives by frequency, magnitude, and geographic extent that would cause adverse effects on any
27 beneficial uses of waters in the affected environment. Because pathogen concentrations are not
28 expected to increase substantially, no long-term water quality degradation for pathogens is
29 expected to occur and, thus, no adverse effects on beneficial uses would occur. The San Joaquin
30 River in the Stockton Deep Water Ship Channel is Clean Water Act section 303(d) listed for
31 pathogens. Because no measurable increase in Deep Water Ship Channel pathogen concentrations
32 are expected to occur on a long-term basis, further degradation and impairment of this area is not
33 expected to occur. Finally, pathogens are not bioaccumulative constituents. This impact is
34 considered to be less than significant. No mitigation is required.

35 **Impact WQ-20: Effects on Pathogens Resulting from Implementation of CM2–CM22**

36 **NEPA Effects:** Effects of CM2–CM22 on pathogens under Alternative 2A are the same as those
37 discussed for Alternative 1A and are considered to not be adverse.

38 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 2A would be similar to
39 those proposed under Alternative 1A. As such, effects on pathogens resulting from the
40 implementation of CM2–CM22 would be similar to that previously discussed for Alternative 1A. This
41 impact is considered to be less than significant. No mitigation is required.

1 **Impact WQ-21: Effects on Pesticide Concentrations Resulting from Facilities Operations and**
2 **Maintenance (CM1)**

3 ***Upstream of the Delta***

4 For the same reasons stated for the No Action Alternative, under Alternative 2A no specific
5 operations or maintenance activity of the SWP or CVP would substantially drive a change in
6 pesticide use, and thus pesticide sources would remain unaffected upstream of the Delta.
7 Nevertheless, changes in the timing and magnitude of reservoir releases could have an effect on
8 available dilution capacity along river segments such as the Sacramento, Feather, American, and San
9 Joaquin Rivers.

10 Under Alternative 2A, winter (November–March) and summer (April–October) season average flow
11 rates on the Sacramento River at Freeport, American River at Nimbus, Feather River at Thermalito
12 and the San Joaquin River at Vernalis would change. Relative to existing condition and the No Action
13 Alternative, seasonal average flow rates on the Sacramento would decrease no more than 3% during
14 the summer and 4% during the winter (Appendix 8L, Seasonal average flows Table 1-4). On the
15 Feather River, average flow rates would decrease no more than 2% during the summer and winter,
16 while on the American River average flow rates would decrease by as much as 15% in the summer
17 but would increase by as much as 6% in the winter. Seasonal average flow rates on the San Joaquin
18 River would decrease by as much as 12% in the summer, but increase by as much as 1% in the
19 winter. For the same reasons stated for the No Action Alternative, decreased seasonal average flow
20 of $\leq 15\%$ is not considered to be of sufficient magnitude to substantially increase pesticide
21 concentrations or alter the long-term risk of pesticide-related toxicity to aquatic life, nor adversely
22 affect other beneficial uses of water bodies upstream of the Delta.

23 ***Delta***

24 Sources of diuron, OP, and pyrethroid insecticides to the Plan Area include direct input of surface
25 runoff from in-Delta agriculture and Delta urbanized areas as well as inputs from rivers upstream of
26 the Delta. Similar to Upstream of the Delta, CVP/SWP operations would not affect these sources.

27 Under Alternative 2A, the distribution and mixing of Delta source waters would change. Percent
28 change in monthly average source water fraction were evaluated for the modeled 16-year (1976–
29 1991) hydrologic period and a representative drought period (1987–1991), with special attention
30 given to changes in San Joaquin River, Sacramento River and Delta Agriculture sources water
31 fractions. Relative to Existing Conditions, under Alternative 2A modeled San Joaquin River fractions
32 would increase greater than 10% at Buckley Cove (drought period only), Franks Tract, Rock Slough,
33 and Contra Costa PP No. 1 (Appendix 8D, Source Water Fingerprinting). At Buckley Cove, San
34 Joaquin River source water fractions when modeled for the drought period would increase 15% in
35 August. At Franks Tract, source water fractions when modeled for the 16-year hydrologic period
36 would increase 13–17% during October through November and February through April. At Rock
37 Slough, San Joaquin River source water fractions would increase 11–24% during September through
38 March (11–15% during October and November of the modeled drought period). Similarly, San
39 Joaquin River fractions at Contra Costa Pumping Plant No. 1 would increase 10–24% during October
40 through April (11–13% during October and November of the modeled drought period). While the
41 modeled 24% increases of San Joaquin River Fraction at Rock Slough and Contra Costa PP No. 1 in
42 November are considerable, the resultant net fraction would be $\leq 30\%$. Relative to Existing
43 Conditions, there would be no modeled increases in Sacramento River fractions greater than 13%
44 (with exception to Banks and Jones, discussed below) and Delta agricultural fractions greater than

1 8%. These modeled changes in the source water fractions of Sacramento, San Joaquin and Delta
2 agriculture water are not of sufficient magnitude to substantially alter the long-term risk of
3 pesticide-related toxicity to aquatic life, nor adversely affect other beneficial uses of the Delta.

4 When compared to the No Action Alternative, changes in source water fractions would be similar in
5 season, geographic extent, and magnitude to those discussed for Existing Conditions with exception
6 to Buckley Cove. Relative to the No Action Alternative, on a source water basis Buckley Cove is
7 comprised predominantly of water of San Joaquin River origin (i.e., typically >80% San Joaquin
8 River) for all months of the year but July and August. In July and August, the combined operational
9 effects on Delta hydrodynamics of the Delta Cross Channel being open, the absence of a barrier at
10 Head of Old River, and seasonally high exports from south Delta pumps results in substantially
11 lower San Joaquin River source water fraction at Buckley Cove relative to all other months of the
12 year. Under the operational scenarios of Alternative 2A, however, modeled July and August San
13 Joaquin River fractions at Buckley Cove would increase relative to the No Action Alternative, with
14 increases of 16% in July (33% for the modeled drought period) and 25% in August (48% for the
15 modeled drought period) (Appendix 8D, Source Water Fingerprinting). Despite these San Joaquin
16 River increases, the resulting net San Joaquin River source water fraction for July and August would
17 remain less than all other months. As a result, these modeled changes in the source water fractions
18 are not of sufficient magnitude to substantially alter the long-term risk of pesticide-related toxicity
19 to aquatic life, nor adversely affect other beneficial uses of the Delta.

20 ***SWP/CVP Export Service Areas***

21 Assessment of effects in SWP/CVP Export Service Areas is based on effects seen in the Plan Area at
22 the Banks and Jones pumping plants. Under Alternative 2A, Sacramento River source water fractions
23 would increase substantially at both Banks and Jones pumping plants relative to Existing Conditions
24 and the No Action Alternative (Appendix 8D, Source Water Fingerprinting). At Banks pumping plant,
25 Sacramento source water fractions would generally increase from 23–50% for the period of January
26 through June (22–25% for March through April of the modeled drought period) and at Jones
27 pumping plant Sacramento source water fractions would generally increase from 34–59% for the
28 period of January through June (16–51% for February through May of the modeled drought period).
29 These increases in Sacramento source water fraction would primarily balance through equivalent
30 decreases in San Joaquin River water. Based on the general observation that San Joaquin River, in
31 comparison to the Sacramento River, is a greater contributor of OP insecticides in terms of greater
32 frequency of incidence and presence at concentrations exceeding water quality benchmarks,
33 modeled increases in Sacramento River fraction at Banks and Jones would generally represent an
34 improvement in export water quality respective to pesticides.

35 ***NEPA Effects:*** In summary, the changes in long-term average flows on the Sacramento, Feather,
36 American, and San Joaquin Rivers, under Alternative 2A relative to the No Action Alternative, are of
37 insufficient magnitude to substantially increase the long-term risk of pesticide-related water quality
38 degradation and related toxicity to aquatic life in these water bodies upstream of the Delta.
39 Similarly, modeled changes in source water fractions to the Delta are of insufficient magnitude to
40 substantially alter the long-term risk of pesticide-related water quality degradation and related
41 toxicity to aquatic life in the Delta or CVP/SWP export service areas. The effects on pesticides from
42 operations and maintenance (CM1) are determined not to be adverse.

43 ***CEQA Conclusion:*** Key findings discussed in the effects assessment relative to Existing Conditions is
44 provided above are summarized here, and are then compared to the CEQA thresholds of significance

1 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this
2 constituent. For additional details on the effects assessment findings that support this CEQA impact
3 determination, see the effects assessment discussion that immediately precedes this conclusion.

4 Sources of pesticides upstream of the Delta include direct input of pesticide containing surface
5 runoff from agriculture and urbanized areas. Flows in rivers receiving these discharges dilute these
6 pesticide inputs. Relative to Existing Conditions, however, modeled changes in long-term average
7 flows on the Sacramento, Feather, American, and San Joaquin Rivers are of insufficient magnitude to
8 substantially increase the long-term risk of pesticide-related water quality degradation and related
9 toxicity to aquatic life in these water bodies upstream of the Delta.

10 In the Delta, sources of pesticides include direct input of surface runoff from Delta agriculture and
11 Delta urbanized areas as well as inputs from rivers upstream of the Delta. While facilities operations
12 and maintenance activities would not affect these sources, changes in Delta source water fraction
13 could change the relative risk associated with pesticide related toxicity to aquatic life. Under
14 Alternative 2A, however, modeled changes in source water fractions relative to Existing Conditions
15 are of insufficient magnitude to substantially alter the long-term risk of pesticide-related toxicity to
16 aquatic life within the Delta, nor would such changes result in adverse pesticide-related effects on
17 any other beneficial uses of Delta waters.

18 The assessment of Alternative 2A effects on pesticides in the SWP/CVP Export Service Areas is
19 based on assessment of changes predicted at Banks and Jones pumping plants. As just discussed
20 regarding effects to pesticides in the Delta, modeled changes in source water fractions at the Banks
21 and Jones pumping plants are of insufficient magnitude to substantially alter the long-term risk of
22 pesticide-related toxicity to aquatic life beneficial uses, or any other beneficial uses, in water bodies
23 of the SWP and CVP export service area.

24 Based on the above, Alternative 2A would not result in any substantial change in long-term average
25 pesticide concentration or result in substantial increase in the anticipated frequency with which
26 long-term average pesticide concentrations would exceed aquatic life toxicity thresholds or other
27 beneficial use effect thresholds upstream of the Delta, at the 11 assessment locations analyzed for
28 the Delta, or the SWP/CVP service area. Numerous pesticides are currently used throughout the
29 affected environment, and while some of these pesticides may be bioaccumulative, those present-
30 use pesticides for which there is sufficient evidence for their presence in waters affected by SWP
31 and CVP operations (i.e., diazinon, chlorpyrifos, diuron, and pyrethroids) are not considered
32 bioaccumulative, and thus changes in their concentrations would not directly cause bioaccumulative
33 problems in aquatic life or humans. Furthermore, while there are numerous 303(d) listings
34 throughout the affected environment that name pesticides as the cause for beneficial use
35 impairment, the modeled changes in upstream river flows and Delta source water fractions would
36 not be expected to make any of these beneficial use impairments measurably worse. Because long-
37 term average pesticide concentrations are not expected to increase substantially, no long-term
38 water quality degradation with respect to pesticides is expected to occur and, thus, no adverse
39 effects on beneficial uses would occur. This impact is considered to be less than significant. No
40 mitigation is required.

41 **Impact WQ-22: Effects on Pesticide Concentrations Resulting from Implementation of CM2-** 42 **CM22**

43 **NEPA Effects:** Conservation Measures 2-22 proposed under Alternative 2A would be the same as
44 those proposed under Alternative 1A. As such, effects on pesticides resulting from the

1 implementation of CM2–CM22 would be similar to that previously discussed for Alternative 1A. In
 2 summary, CM13 proposes the use of herbicides to control invasive aquatic vegetation around
 3 habitat restoration sites. Herbicides directly applied to water could include adverse effects on non-
 4 target aquatic life, such as aquatic invertebrates and beneficial aquatic plants. As such, aquatic life
 5 toxicity objectives could be exceeded with sufficient frequency and magnitude such that beneficial
 6 uses would be impacted, thus constituting an adverse effect on water quality.

7 In summary, based on the discussion above, the effects on pesticides from implementing CM2-CM22
 8 are considered to be adverse. Mitigation Measure WQ-22 would be available to reduce this adverse
 9 effect.

10 **CEQA Conclusion:** Effects of CM2–CM22 on pesticides under Alternative 2A are similar to those
 11 discussed for Alternative 1A. Potential environmental effects related only to CM13 are considered to
 12 be significant. Mitigation is required. While Mitigation Measure WQ-22 is available to partially
 13 reduce this impact of pesticides, no feasible mitigation is available that would reduce it to a level
 14 that would be less than significant.

15 **Mitigation Measure WQ-22: Implement Least Toxic Integrated Pest Management**
 16 **Strategies**

17 Please see Mitigation Measure WQ-22 under Impact WQ-22 in the discussion of Alternative 1A.

18 **Impact WQ-23: Effects on Phosphorus Concentrations Resulting from Facilities Operations**
 19 **and Maintenance (CM1)**

20 **NEPA Effects:** Effects of water facilities and operations (CM1) on phosphorus levels in water bodies
 21 of the affected environment under Alternative 2A would be very similar (i.e., nearly the same) to
 22 those discussed for Alternative 1A. Consequently, the environmental consequences to phosphorus
 23 levels discussed in detail for Alternative 1A also adequately represent the effects under Alternative
 24 2A, which are considered to be not adverse. Based on this finding, this impact is considered to be not
 25 adverse.

26 **CEQA Conclusion:** Key findings discussed in the effects assessment relative to Existing Conditions is
 27 provided above are summarized here, and are then compared to the CEQA thresholds of significance
 28 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this
 29 constituent. For additional details on the effects assessment findings that support this CEQA impact
 30 determination, see the effects assessment discussion that immediately precedes this conclusion.

31 Because phosphorus loading to waters upstream of the Delta is not anticipated to change, and
 32 because changes in flows do not necessarily result in changes in concentrations or loading of
 33 phosphorus to these water bodies, substantial changes in phosphorus concentration upstream of the
 34 Delta are not anticipated for Alternative 2A, relative to Existing Conditions.

35 Because phosphorus concentrations in the major source waters to the Delta are similar for much of
 36 the year, phosphorus concentrations in the Delta are not anticipated to change substantially on a
 37 long term-average basis under Alternative 2A, relative to Existing Conditions. Algal growth rates are
 38 limited by availability of light in the Delta, and therefore any minor increases in phosphorus levels
 39 that may occur at some locations and times within the Delta would be expected to have little effect
 40 on primary productivity in the Delta.

1 The assessment of effects of phosphorus under Alternative 2A in the SWP and CVP Export Service
2 Areas is based on effects on phosphorus at the Banks and Jones pumping plants. As noted above,
3 phosphorus concentrations in the Delta (including Banks and Jones pumping plants) are not
4 anticipated to change substantially on a long term-average basis.

5 Based on the above, there would be no substantial, long-term increase in phosphorus concentrations
6 in the rivers and reservoirs upstream of the Delta, in the Delta Region, or the waters exported to the
7 CVP and SWP service areas under Alternative 2A relative to Existing Conditions. As such, this
8 alternative is not expected to cause additional exceedance of applicable water quality
9 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
10 on any beneficial uses of waters in the affected environment. Because phosphorus concentrations
11 are not expected to increase substantially, no long-term water quality degradation is expected to
12 occur and, thus, no adverse effects to beneficial uses would occur. Phosphorus is not 303(d) listed
13 within the affected environment and thus any minor increases that may occur in some areas would
14 not make any existing phosphorus-related impairment measurably worse because no such
15 impairments currently exist. Because phosphorus is not bioaccumulative, minor increases that may
16 occur in some areas would not bioaccumulate to greater levels in aquatic organisms that would, in
17 turn, pose substantial health risks to fish, wildlife, or humans. This impact is considered to be less
18 than significant. No mitigation is required.

19 **Impact WQ-24: Effects on Phosphorus Concentrations Resulting from Implementation of** 20 **CM2–CM22**

21 **NEPA Effects:** Effects of CM2–CM22 on phosphorus levels in water bodies of the affected
22 environment under Alternative 2A would be very similar (i.e., nearly the same) to those discussed
23 for Alternative 1A. Consequently, the environmental consequences to phosphorus levels from
24 implementing CM2–CM22 discussed in detail for Alternative 1A also adequately represent the
25 effects of these same actions under Alternative 2A, which are considered to be not adverse.

26 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 2A would be similar to
27 those proposed under Alternative 1A. As such, effects on phosphorus resulting from the
28 implementation of CM2–CM22 would be similar to that previously discussed for Alternative 1A. This
29 impact is considered to be less than significant. No mitigation is required.

30 **Impact WQ-25: Effects on Selenium Concentrations Resulting from Facilities Operations and** 31 **Maintenance (CM1)**

32 ***Upstream of the Delta***

33 For the same reasons stated for the No Action Alternative, Alternative 2A would have negligible, if
34 any, effect on selenium concentrations in the rivers and reservoirs upstream of the Delta relative to
35 Existing Conditions and the No Action Alternative. Any negligible increases in selenium
36 concentrations that could occur in the water bodies of the affected environment upstream of the
37 Delta would not be of frequency, magnitude, and geographic extent that would adversely affect any
38 beneficial uses or substantially degrade the quality of these water bodies, with regard to selenium.

39 ***Delta***

40 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
41 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter

1 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
2 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
3 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
4 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

5 Alternative 2A would result in small changes in average selenium concentrations in water at all
6 modeled Delta assessment locations relative to Existing Conditions and the No Action Alternative
7 (Appendix 8M, Table M-10A). These small changes in selenium concentrations in water are reflected
8 in small percent changes (10% or less) in available assimilative capacity for selenium (based on 2
9 $\mu\text{g}/\text{L}$ ecological risk benchmark) for all years. Relative to Existing Conditions, Alternative 2A would
10 result in the largest modeled increase in available assimilative capacity at Buckley Cove (1%) and
11 the largest decrease at Contra Costa PP (4%) (Figure 8-59). Relative to the No Action Alternative, the
12 largest modeled increase would be at Staten Island (1%) and the largest decrease would be at
13 Buckley Cove (4%) (Figure 8-60). Although some small negative changes (less than 5%) in selenium
14 concentrations in water are expected, the effect of Alternative 2A would generally be minimal for
15 the Delta locations. Furthermore, the modeled selenium concentrations in water (Appendix 8M,
16 Table M-10A) for Alternative 2A (range 0.22–0.74 $\mu\text{g}/\text{L}$) would be very similar to those for Existing
17 Conditions (range 0.21–0.76 $\mu\text{g}/\text{L}$) and the No Action Alternative (range 0.21–0.69 $\mu\text{g}/\text{L}$), and all
18 would be below the ecological risk benchmark (2 $\mu\text{g}/\text{L}$).

19 Relative to Existing Conditions and the No Action Alternative, Alternative 2A would result in small
20 changes in estimated selenium concentrations in biota (whole-body fish, bird eggs [invertebrate
21 diet], bird eggs [fish diet], and fish fillets) (Appendix 8M, Table M-13 and Addendum M.A to
22 Appendix 8M, Table M.A-2). Relative to Existing Conditions, the largest increase of selenium
23 concentrations in biota would be at Contra Costa PP for all years and for the sturgeon at the San
24 Joaquin River at Antioch in all years, and the largest decrease would be at Buckley Cove for drought
25 years. Relative to the No Action Alternative, the largest increase would be at Buckley Cove for
26 drought years (except for bird eggs [assuming a fish diet] at Old River at Rock Slough [hereafter
27 Rock Slough] for all years) and for the sturgeon at the San Joaquin River at Antioch in all years; the
28 largest decrease would be at Staten Island for drought years. Except for sturgeon in the western
29 Delta, concentrations of selenium in whole-body fish and bird eggs (invertebrate and fish diets)
30 would exceed only the lower benchmarks (4 and 6 mg/kg dry weight, respectively, indicating a low
31 potential for effects), under drought conditions, at Buckley Cove for Existing Conditions, the No
32 Action Alternative, and Alternative 2A (Figures 8-61 through 8-63). However, Exceedance Quotients
33 for these exceedances of the lower benchmarks are between 1.0 and 1.5, indicating a low risk to
34 biota in the Delta and no substantial difference from Existing Conditions and the No Action
35 Alternative. Selenium concentrations in fish fillets would not exceed the screening value for
36 protection of human health (Figure 8-64). For sturgeon in the western Delta, whole-body selenium
37 concentrations would increase from 12.3 mg/kg under Existing Conditions and the No Action
38 Alternative to 13.5 mg/kg under Alternative 2A, a 10% increase (Table M.A-2). Although all of these
39 values exceed both the low and high toxicity benchmarks, it is unlikely that the modeled increases in
40 whole-body selenium for sturgeon would be measurable in the environment (see also the discussion
41 of results provided in Addendum M.A to Appendix 8M).

42 Relative to Existing Conditions and the No Action Alternative, Alternative 2A would result in
43 essentially no change in selenium concentrations throughout the Delta. Alternative 2A would not be
44 expected to substantially increase the frequency with which applicable benchmarks would be
45 exceeded in the Delta or substantially degrade the quality of water in the Delta, with regard to
46 selenium.

1 **SWP/CVP Export Service Areas**

2 Alternative 2A would result in small changes in average selenium concentrations in water at both
3 modeled Export Service Area assessment locations relative to Existing Conditions and the No Action
4 Alternative (Appendix 8M, Table M-10A). These small changes in selenium concentrations in water
5 are reflected in small percent changes (10% or less) in available assimilative capacity for selenium
6 (based on 2 µg/L ecological risk benchmark) for all years. Relative to Existing Conditions and the No
7 Action Alternative, Alternative 2A would result in modeled increases in assimilative capacity at
8 Jones PP (9% and 10%, respectively) and at Banks PP (5%) (Figures 8-59 and 8-60), and generally
9 would have a small positive effect on the Export Service Area locations. Furthermore, the ranges of
10 modeled selenium concentrations in water (Appendix 8M, Table M-10A) for Alternative 2A (range
11 0.37–0.45 µg/L) are similar to those for Existing Conditions (range 0.37–0.58 µg/L) and the No
12 Action Alternative (range 0.37–0.59 µg/L), and would be well below the ecological risk benchmark
13 (2 µg/L).

14 Relative to Existing Conditions and the No Action Alternative, Alternative 2A would result in
15 minimal changes in estimated selenium concentrations in biota (whole-body fish, bird eggs
16 [invertebrate diet], bird eggs [fish diet], and fish fillets) (Appendix 8M, Table M-13). The largest
17 increase of selenium concentrations in biota would be at Banks PP for drought years, and the largest
18 decrease would be at Jones PP for all years (except for bird eggs [assuming a fish diet] at Jones PP
19 for drought years). Concentrations of selenium in biota would not exceed any benchmarks for
20 Alternative 2A (Figures 8-61 through 8-64).

21 Thus, relative to Existing Conditions and the No Action Alternative, Alternative 2A would result in
22 minimal changes in selenium concentrations at the Export Service Area locations. Selenium
23 concentrations in water and biota would generally decrease for Alternative 2A and would not
24 exceed ecological benchmarks at either location. Compared to Existing Conditions and the No Action
25 Alternative at Jones PP under drought conditions, there would be a small positive change in
26 selenium concentrations under Alternative 2A in that it would be expected to slightly decrease the
27 frequency with which applicable benchmarks would be exceeded or slightly improve the quality of
28 water at the Export Service Area locations, with regard to selenium.

29 **NEPA Effects:** Based on the discussion above, the effects on selenium (both as waterborne and as
30 bioaccumulated in biota) from Alternative 2A are not considered to be adverse.

31 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
32 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
33 purpose of making the CEQA impact determination for selenium. For additional details on the effects
34 assessment findings that support this CEQA impact determination, see the effects assessment
35 discussion that immediately precedes this conclusion.

36 There are no substantial point sources of selenium in watersheds upstream of the Delta, and no
37 substantial nonpoint sources of selenium in the watersheds of the Sacramento River and the eastern
38 tributaries. Nonpoint sources in the San Joaquin Valley that contribute selenium to the Delta will be
39 controlled through a TMDL developed by the Central Valley Water Board (2001) for the lower San
40 Joaquin River, established limits for the Grassland Bypass Project, and Basin Plan objectives (Central
41 Valley Water Board 2010c) and State Water Board (2010d, 2010e) that are expected to result in
42 decreasing discharges of selenium from the San Joaquin River to the Delta. Consequently, any
43 modified reservoir operations and subsequent changes in river flows under Alternative 2A, relative
44 to Existing Conditions, are expected to cause negligible changes in selenium concentrations in water.

1 Any negligible changes in selenium concentrations that may occur in the water bodies of the affected
2 environment located upstream of the Delta would not be of frequency, magnitude, and geographic
3 extent that would adversely affect any beneficial uses or substantially degrade the quality of these
4 water bodies as related to selenium.

5 Relative to Existing Conditions, modeling estimates indicate that Alternative 2A would result in
6 essentially no change in selenium concentrations throughout the Delta.

7 Assessment of effects of selenium in the SWP and CVP Export Service Areas is based on effects on
8 selenium concentrations at the Banks and Jones pumping plants. Relative to Existing Conditions,
9 Alternative 2A would slightly decrease the frequency with which applicable benchmarks would be
10 exceeded or slightly improve the quality of water in selenium concentrations at the Banks and Jones
11 pumping plants locations.

12 Based on the above, selenium concentrations that would occur in water under Alternative 2A would
13 not cause additional exceedances of applicable state or federal numeric or narrative water quality
14 objectives/criteria, or other relevant water quality effects thresholds identified for this assessment
15 (Appendix 8M, Table M-10A), by frequency, magnitude, and geographic extent that would result in
16 adverse effects to one or more beneficial uses within affected water bodies. In comparison to
17 Existing Conditions, water quality conditions under this alternative would not increase levels of
18 selenium by frequency, magnitude, and geographic extent such that the affected environment would
19 be expected to have measurably higher body burdens of selenium in aquatic organisms, thereby
20 substantially increasing the health risks to wildlife (including fish) or humans consuming those
21 organisms. Water quality conditions under this alternative with respect to selenium would not cause
22 long-term degradation of water quality in the affected environment, and therefore would not result
23 in use of available assimilative capacity such that exceedances of water quality objectives/criteria
24 would be likely and would result in substantially increased risk for adverse effects to one or more
25 beneficial uses. This alternative would not further degrade water quality by measurable levels, on a
26 long-term basis, for selenium and, thus, cause the 303(d)-listed impairment of beneficial use to be
27 made discernibly worse. This alternative is considered to be less than significant. No mitigation is
28 required.

29 **Impact WQ-26: Effects on Selenium Concentrations Resulting from Implementation of CM2–** 30 **CM22**

31 **NEPA Effects:** In general, with the possible exception of changes in Delta hydrodynamics resulting
32 from habitat restoration, CM2–CM11 would not substantially increase selenium concentrations in
33 the water bodies of the affected environment. Modeling scenarios included assumptions regarding
34 how certain habitat restoration activities (CM2 and CM4) would affect Delta hydrodynamics, and
35 thus such effects of these restoration measures were included in the assessment of CM1 facilities
36 operations and maintenance (see Impact WQ-25).

37 However, implementation of these conservation measures may increase water residence time
38 within the restoration areas. Increased restoration area water residence times could potentially
39 increase the bioaccumulation of selenium in biota, thereby potentially increasing fish tissue and bird
40 egg concentrations of selenium, but models are not available to quantitatively estimate the level of
41 changes in residence time and the associated selenium bioavailability. If increases in fish tissue or
42 bird egg selenium were to occur, the increases would likely be of concern only where fish tissues or
43 bird eggs are already elevated in selenium to near or above thresholds of concern. That is, where
44 biota concentrations are currently low and not approaching thresholds of concern, changes in

1 residence time alone would not be expected to cause them to then approach or exceed thresholds of
2 concern. In consideration of this factor, although the Delta as a whole is a 303(d)-listed water body
3 for selenium, and although monitoring data of fish tissue or bird eggs in the Delta are sparse, the
4 most likely areas in which biota tissues would be at levels high enough that additional
5 bioaccumulation due to increased residence time from restoration areas would be a concern are the
6 western Delta and Suisun Bay, and the South Delta in areas that receive San Joaquin River water.

7 The western Delta and Suisun Bay receive elevated selenium loads from North San Francisco Bay
8 (including San Pablo Bay, Carquinez Strait, and Suisun Bay) and from the San Joaquin River. Point
9 sources of selenium in North San Francisco Bay (i.e., refineries) that contribute selenium to Suisun
10 Bay are expected to be reduced through a TMDL under development by the San Francisco Bay Water
11 Board (San Francisco Bay Water Board 2012) that is expected to result in decreasing discharges of
12 selenium. Nonpoint sources of selenium in the San Joaquin Valley that contribute selenium to the
13 San Joaquin River, and thus the Delta and Suisun Bay, will be controlled through a TMDL developed
14 by the Central Valley Water Board (2001) for the lower San Joaquin River, established limits for the
15 Grassland Bypass Project, and Basin Plan objectives (Central Valley Water Board 2010c, d) that are
16 expected to result in decreasing discharges of selenium from the San Joaquin River to the Delta. If
17 selenium levels are not sufficiently reduced via these efforts, it is expected that the State Water
18 Board and the San Francisco Bay and Central Valley Water Boards would initiate additional actions
19 to further control sources of selenium.

20 The South Delta receives elevated selenium loads from the San Joaquin River. In contrast to Suisun
21 Bay and possibly the western Delta in the future, the South Delta lacks the overbite clam (*Corbula*
22 [*Potamocorbula*] *amurensis*), which is considered a key driver of selenium bioaccumulation in
23 Suisun Bay, due to its high bioaccumulation of selenium and its role in the benthic food web that
24 includes long-lived sturgeon. The South Delta does have *Corbicula fluminea*, another bivalve that
25 bioaccumulates selenium, but it is not as invasive as the overbite clam and thus likely makes up a
26 smaller fraction of sturgeon diet. Also, as mentioned above, nonpoint sources of selenium in the San
27 Joaquin Valley that contribute selenium to the Delta will be controlled through a TMDL developed by
28 the Central Valley Water Board (2001) for the lower San Joaquin River, established limits for the
29 Grassland Bypass Project, and Basin Plan objectives (Central Valley Water Board 2010c, d) that are
30 expected to result in decreasing discharges of selenium from the San Joaquin River to the Delta.
31 Further, if selenium levels in the San Joaquin River are not sufficiently reduced via these efforts, it is
32 expected that the State Water Board and Central Valley Water Board would initiate additional
33 TMDLs to further control nonpoint sources of selenium.

34 Wetland restoration areas will not be designed such that water flows in and does not flow out.
35 Exchange of water between the restoration areas and existing Delta channels is an important design
36 factor, since one goal of the restoration areas is to export food produced in these areas to the rest of
37 the Delta (see BDCP Chapter 3, *Conservation Strategy*, Section 3.3, Biological Goals and Objectives).
38 Thus, these areas can be thought of as “flow-through” systems. Consequently, although water
39 residence times associated with BDCP restoration could increase, they are not expected to increase
40 without bound. and selenium concentrations in the water column would not continue to build up
41 and be recycled in sediments and organisms as may be the case within a closed system.

42 However, because increases in bioavailable selenium in the habitat restoration areas are uncertain,
43 proposed avoidance and minimization measures would require evaluating risks of selenium
44 exposure at a project level for each restoration area, minimizing to the extent practicable potential
45 risk of additional bioaccumulation, and monitoring selenium levels in fish and/or wildlife to

1 establish whether, or to what extent, additional bioaccumulation is occurring. See Appendix 3B,
2 *Environmental Commitments* for a description of the environmental commitment BDCP proponents
3 are making with respect to Selenium Management; and Appendix 3.C. of the BDCP for additional
4 detail on this avoidance and minimization measure (AMM27). Data generated as part of the
5 avoidance and minimization measures will assist the State and Regional Water Boards in
6 determining whether beneficial uses are being impacted by selenium, and thus will provide the data
7 necessary to support regulatory actions (including additional TMDL development), should such
8 actions be warranted.

9 Given the factors discussed in the assessment above, any increases in bioaccumulation rates from
10 water-borne selenium that could occur in some areas as a result of increased water residence time
11 would not be of sufficient magnitude and geographic extent that any portion of the Delta would be
12 expected to have measurably higher body burdens of selenium in aquatic organisms and, therefore,
13 would not substantially increase risk for adverse effects to beneficial uses. Furthermore, although
14 the Delta is a 303(d)-listed water body for selenium, given the discussion in the assessment above, it
15 is unlikely that restoration areas would result in measurable increases in selenium in fish tissues or
16 bird eggs such that the beneficial use impairment would be made discernibly worse.

17 Because it is unlikely that substantial increases in selenium in fish tissues or bird eggs would occur
18 such that effects on aquatic life beneficial uses would be anticipated, and because of the avoidance
19 and minimization measures that are designed to further minimize and evaluate the risk of such
20 increases, the effects of WQ-26 are considered not adverse.

21 **CEQA Conclusion:** There would be no substantial, long-term increase in selenium concentrations in
22 water in the rivers and reservoirs upstream of the Delta, water in the Delta, or the waters exported
23 to the CVP and SWP service areas due to implementation of CM2–CM22 relative to Existing
24 Conditions. Waterborne selenium concentrations under this alternative would not exceed applicable
25 water quality objectives/criteria.

26 Given the factors discussed in the assessment above, any increases in bioaccumulation rates from
27 water-borne selenium that could occur in some areas as a result of increased water residence times
28 would not be of sufficient magnitude and geographic extent that any portion of the Delta would be
29 expected to have measurably higher body burdens of selenium in aquatic organisms, and therefore
30 would not substantially increase risk for adverse effects to beneficial uses. CM2-22 would not cause
31 long-term degradation of water quality resulting in sufficient use of available assimilative capacity
32 such that occasionally exceeding water quality objectives/criteria would be likely. Also, CM2-22
33 would not result in substantially increased risk for adverse effects to any beneficial uses.
34 Furthermore, although the Delta is a 303(d)-listed water body for selenium, given the discussion in
35 the assessment above, it is unlikely that restoration areas would result in measurable increases in
36 selenium in fish tissues or bird eggs such that the beneficial use impairment would be made
37 discernibly worse.

38 Since it is unlikely that substantial increases in selenium in fish tissues or bird eggs would occur
39 such that effects on aquatic life beneficial uses would be anticipated, and because of the avoidance
40 and minimization measures that are designed to further minimize and evaluate the risk of such
41 increases (see Appendix 3.C. of the BDCP for more detail on AMM27) as well as the Selenium
42 Management environmental commitment (see Appendix 3B, *Environmental Commitments*), this
43 impact is considered less than significant. No mitigation is required.

1 **Impact WQ-27: Effects on Trace Metal Concentrations Resulting from Facilities Operations**
2 **and Maintenance (CM1)**

3 ***Upstream of the Delta***

4 For the same reasons stated for the No Action Alternative, Alternative 2A would result in negligible,
5 and likely immeasurable, increases in trace metal concentrations in the rivers and reservoirs
6 upstream of the Delta, relative to Existing Conditions and the No Action Alternative. Effects due to
7 the operation and maintenance of the conveyance facilities are expected to be immeasurable, on an
8 annual and long-term average basis. As such, Alternative 2A would not be expected to substantially
9 increase the frequency with which applicable Basin Plan objectives or CTR criteria would be
10 exceeded in water bodies of the affected environment located upstream of the Delta or substantially
11 degrade the quality of these water bodies, with regard to trace metals.

12 ***Delta***

13 For the same reasons stated for the No Action Alternative, Alternative 2A would not result in
14 substantial increases in trace metal concentrations in the Delta relative to Existing Conditions and
15 the No Action Alternative. Effects due to the operation and maintenance of the conveyance facilities
16 are expected to be negligible, on a long-term average basis. As such, Alternative 2A would not be
17 expected to substantially increase the frequency with which applicable Basin Plan objectives or CTR
18 criteria would be exceeded in the Delta or substantially degrade the quality of Delta waters, with
19 regard to trace metals.

20 ***SWP/CVP Export Service Areas***

21 For the same reasons stated for the No Action Alternative, Alternative 2A would not result in
22 substantial increases in trace metal concentrations in the water exported from the Delta or diverted
23 from the Sacramento River through the proposed conveyance facilities. As such, there is not
24 expected to be substantial changes in trace metal concentrations in the SWP/CVP export service
25 area waters under Alternative 2A, relative to Existing Conditions and the No Action Alternative. As
26 such, Alternative 2A would not be expected to substantially increase the frequency with which
27 applicable Basin Plan objectives or CTR criteria would be exceeded in the water bodies of the
28 affected environment in the SWP and CVP Service Area or substantially degrade the quality of these
29 water bodies, with regard to trace metals.

30 ***NEPA Effects:*** In summary, Alternative 2A, relative to the No Action Alternative, would not cause a
31 substantial increase in long-term average trace metals concentrations within the affected
32 environment, nor would it cause an increased frequency of water quality objective/criteria
33 exceedances within the affected environment. The effect on trace metals is determined not to be
34 adverse.

35 ***CEQA Conclusion:*** Effects of CM1 on trace metals under Alternative 2A would be similar to those
36 discussed for Alternative 1A, and are summarized here, then compared to the CEQA thresholds of
37 significance (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for
38 this constituent. For additional details on the effects assessment findings that support this CEQA
39 impact determination, see the effects assessment discussion under Alternative 1A.

40 While greater water demands under the Alternative 2A would alter the magnitude and timing of
41 reservoir releases north, south and east of the Delta, these activities would have no substantial effect
42 on the various watershed sources of trace metals. Moreover, long-term average flow and trace

1 metals at Sacramento River at Hood and San Joaquin River at Vernalis are poorly correlated;
2 therefore, changes in river flows would not be expected to cause a substantial long-term change in
3 trace metal concentrations upstream of the Delta.

4 Average and 95th percentile trace metal concentrations are very similar across the primary source
5 waters to the Delta. Given this similarity, very large changes in source water fraction would be
6 necessary to effect a relatively small change in trace metal concentration at a particular Delta
7 location. Moreover, average and 95th percentile trace metal concentrations for these primary source
8 waters are all below their respective water quality criteria, including those that are hardness-based
9 without a WER adjustment. No mixing of these three source waters could result in a metal
10 concentration greater than the highest source water concentration, and given that trace metals do
11 not already exceed water quality criteria, more frequent exceedances of criteria in the Delta would
12 not be expected to occur under the Alternative 2A.

13 The assessment of the Alternative 2A effects on trace metals in the SWP/CVP Export Service Areas is
14 based on assessment of changes in trace metal concentrations at Banks and Jones pumping plants.
15 As just discussed regarding similarities in Delta source water trace metal concentrations, the
16 Alternative 2A is not expected to result in substantial changes in trace metal concentrations in Delta
17 waters, including Banks and Jones pumping plants, therefore effects on trace metal concentrations
18 in the SWP/CVP Export Service Area are expected to be negligible.

19 Based on the above, there would be no substantial long-term increase in trace metal concentrations
20 in the rivers and reservoirs upstream of the Delta, in the Delta Region, or the SWP/CVP export
21 service area waters under Alternative 2A relative to Existing Conditions. As such, this alternative is
22 not expected to cause additional exceedance of applicable water quality objectives by frequency,
23 magnitude, and geographic extent that would cause adverse effects on any beneficial uses of waters
24 in the affected environment. Because trace metal concentrations are not expected to increase
25 substantially, no long-term water quality degradation for trace metals is expected to occur and, thus,
26 no adverse effects to beneficial uses would occur. Furthermore, any negligible changes in long-term
27 trace metal concentrations that may occur in water bodies of the affected environment would not be
28 expected to make any existing beneficial use impairments measurably worse. The trace metals
29 discussed in this assessment are not considered bioaccumulative, and thus would not directly cause
30 bioaccumulative problems in aquatic life or humans. This impact is considered to be less than
31 significant. No mitigation is required.

32 **Impact WQ-28: Effects on Trace Metal Concentrations Resulting from Implementation of** 33 **CM2–CM22**

34 **NEPA Effects:** Conservation Measures 2–22 proposed under Alternative 2A would be the same as
35 those proposed under Alternative 1A. As such, effects on trace metals resulting from the
36 implementation of CM2–CM22 would be similar to that previously discussed for Alternative 1A. As
37 they pertain to trace metals, implementation of CM2–CM22 would not be expected to adversely
38 affect beneficial uses of the affected environment or substantially degrade water quality with
39 respect to trace metals.

40 In summary, implementation of CM2–CM22 under Alternative 2A, relative to the No Action
41 Alternative, would have negligible, if any, effect on trace metals concentrations. The effect on trace
42 metals from implementing CM2–CM22 is determined not to be adverse.

1 **CEQA Conclusion:** Implementation of CM2–CM22 under Alternative 2A would not cause substantial
2 long-term increase in trace metal concentrations in the rivers and reservoirs upstream of the Delta,
3 in the Delta Region, or the SWP/CVP export service area. As such, this alternative is not expected to
4 cause additional exceedance of applicable water quality objectives by frequency, magnitude, and
5 geographic extent that would cause adverse effects on any beneficial uses of waters in the affected
6 environment. Because trace metal concentrations are not expected to increase substantially, no
7 long-term water quality degradation for trace metals is expected to occur and, thus, no adverse
8 effects to beneficial uses would occur. Furthermore, any negligible changes in long-term trace metal
9 concentrations that may occur throughout the affected environment would not be expected to make
10 any existing beneficial use impairments measurably worse. The trace metals discussed in this
11 assessment are not considered bioaccumulative, and thus would not directly cause bioaccumulative
12 problems in aquatic life or humans. This impact is considered to be less than significant. No
13 mitigation is required.

14 **Impact WQ-29: Effects on TSS and Turbidity Resulting from Facilities Operations and**
15 **Maintenance (CM1)**

16 **NEPA Effects:** Effects of CM1 on TSS and turbidity under Alternative 2A are the same as those
17 discussed for Alternative 1A. The effects on TSS and turbidity from implementing CM1 is determined
18 to not be adverse.

19 **CEQA Conclusion:** Effects of CM1 on TSS and turbidity under Alternative 2A would be similar to
20 those discussed for Alternative 1A, and are summarized here, then compared to the CEQA
21 thresholds of significance (defined in Section 8.3.2) for the purpose of making the CEQA impact
22 determination for this constituent. For additional details on the effects assessment findings that
23 support this CEQA impact determination, see the effects assessment discussion under Alternative
24 1A.

25 Changes river flow rate and reservoir storage that would occur under Alternative 2A, relative to
26 Existing Conditions, would not be expected to result in a substantial adverse change in TSS
27 concentrations and turbidity levels in the reservoirs and rivers upstream of the Delta, given that
28 suspended sediment concentrations are more affected by season than flow. Site-specific and
29 temporal exceptions may occur due to localized temporary construction activities, dredging
30 activities, development, or other land use changes would be site-specific and temporal, which would
31 be regulated to limit both their short-term and long-term effects on TSS and turbidity levels to less
32 than substantial levels.

33 Within the Delta, geomorphic changes associated with sediment transport and deposition are
34 usually gradual, occurring over years, and high storm event inflows would not be substantially
35 affected. Thus, it is expected that the TSS concentrations and turbidity levels in the affected channels
36 would not be substantially different from the levels under Existing Conditions. Consequently, this
37 alternative is expected to have minimal effect on TSS concentrations and turbidity levels in the Delta
38 region, relative to Existing Conditions.

39 There is not expected to be substantial, if even measurable, changes in TSS concentrations and
40 turbidity levels in the SWP/CVP Export Service Areas waters under Alternative 2A, relative to
41 Existing Conditions, because this alternative is not expected to result in substantial changes in TSS
42 concentrations and turbidity levels at the south Delta export pumps, relative to Existing Conditions.

1 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
2 objectives where such objectives are not exceeded under Existing Conditions. Because TSS
3 concentrations and turbidity levels are not expected to be substantially different, long-term water
4 quality degradation is not expected, and, thus, beneficial uses are not expected to be adversely
5 affected. Finally, TSS and turbidity are neither bioaccumulative nor Clean Water Act section 303(d)
6 listed constituents. This impact is considered to be less than significant. No mitigation is required.

7 **Impact WQ-30: Effects on TSS and Turbidity Resulting from Implementation of CM2–CM22**

8 **NEPA Effects:** Effects of CM2–CM22 on TSS and turbidity under Alternative 2A are the same as those
9 discussed for Alternative 1A. The effects on TSS and turbidity from implementing CM2–CM22 is
10 determined to not be adverse.

11 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 2A would be similar to
12 those proposed under Alternative 1A. As such, effects on TSS and turbidity resulting from the
13 implementation of CM2–CM22 would be similar to that previously discussed for Alternative 1A. This
14 impact is considered to be less than significant. No mitigation is required.

15 **Impact WQ-31: Water Quality Effects Resulting from Construction-Related Activities (CM1–** 16 **CM22)**

17 The conveyance features for CM1 under Alternative 2A would be very similar to those discussed for
18 Alternative 1A. The primary difference between Alternative 2A and Alternative 1A is that under
19 Alternative 2A, the locations of two intakes and two intermediate pumping plant locations would
20 differ. As such, construction techniques and locations of major features of the conveyance system
21 within the Delta would be similar. The remainder of the facilities constructed under Alternative 2A,
22 including CM2–CM22, would be very similar to, or the same as, those to be constructed for
23 Alternative 1A.

24 **NEPA Effects:** The types and magnitude of potential construction-related water quality effects
25 associated with implementation of CM1 under Alternative 2A would be very similar to the effects
26 discussed for Alternative 1A, and the effects anticipated with implementation of CM2–CM22 would
27 be essentially identical. Nevertheless, the construction of CM1, and any individual components
28 necessitated by CM2, and CM4–CM10, with the implementation of the BMPs specified in Appendix
29 3B, *Environmental Commitments*. The specific environmental commitments that would be
30 implemented under Alternative 2A would be similar to those described for Alternative 1A.
31 Consequently, relative to the No Action Alternative, Alternative 2A would not be expected to cause
32 exceedance of applicable water quality objectives/criteria or substantial water quality degradation
33 with respect to constituents of concern, and thus would not adversely affect any beneficial uses
34 upstream of the Delta, in the Delta, or in the SWP and CVP service area.

35 In summary, with implementation of environmental commitments in Appendix 3B, the potential
36 construction-related water quality effects are considered to be not adverse.

37 **CEQA Conclusion:** Because environmental commitments would be implemented under Alternative
38 2A for construction-related activities along with agency-issued permits that also contain
39 construction requirements to protect water quality, the construction-related effects, relative to
40 Existing Conditions, would not be expected to cause or contribute to substantial alteration of
41 existing drainage patterns which would result in substantial erosion or siltation on- or off-site,
42 substantial increased frequency of exceedances of water quality objectives/criteria, or substantially

1 degrade water quality with respect to the constituents of concern on a long-term average basis, and
 2 thus would not adversely affect any beneficial uses in water bodies upstream of the Delta, within the
 3 Delta, or in the SWP and CVP service area. Moreover, because the construction-related activities
 4 would be temporary and intermittent in nature, the construction would involve negligible
 5 discharges, if any, of bioaccumulative or 303(d) listed constituents to water bodies of the affected
 6 environment. As such, construction activities would not contribute measurably to bioaccumulation
 7 of contaminants in organisms or humans or cause 303(d) impairments to be discernibly worse.
 8 Based on these findings, this impact is determined to be less than significant. No mitigation is
 9 required.

10 **8.4.3.6 Alternative 2B—Dual Conveyance with East Alignment and Five** 11 **Intakes**

12 Alternative 2B would include the same physical/structural water conveyance components and
 13 eastern alignment as Alternative 1B, but, like Alternative 2A, could entail two different intake and
 14 intake pumping plant locations downstream of Steamboat and Sutter Slough (i.e., Intakes 6 and 7).
 15 Alternative 2B would also include an operable barrier at the head of Old River. Intakes would be
 16 located on the west bank of the Sacramento River and diverted water would be carried by canal to a
 17 new 600 acre forebay at Byron Tract. An intermediate pumping plant would be constructed, but
 18 there would be no intermediate forebay. Water supply and conveyance operations would follow the
 19 guidelines described as Scenario B, which includes fall X2. CM2–CM22 would be implemented under
 20 this alternative, and these conservation measures would be the same as those under Alternative 1A.
 21 See Chapter 3, *Description of Alternatives*, Section 3.5.6, for additional details on Alternative 2B.

22 **Water Quality Effects Resulting from Facilities Operations and Maintenance (CM1)**

23 Alternative 2B has the same diversion and conveyance operations and conservation measures as
 24 Alternative 2A. The primary difference between the two alternatives is that conveyance under
 25 Alternative 2B would be in a lined or unlined canal, instead of pipeline. Because there would be no
 26 difference in conveyance capacity or operations, there would be no differences between these two
 27 alternatives in upstream of the Delta river flows or reservoir operations, Delta inflow, source
 28 fractions to various Delta locations, and hydrodynamics in the Delta. Conveyance of water in an open
 29 channel instead of a pipeline may result in differing physical properties (e.g., DO, pH, temperature)
 30 of the water upon reaching the south Delta export pumps than if the water was conveyed in a
 31 pipeline. However, the physical properties of water arriving at the south Delta export pumps would
 32 continue to change and would equilibrate to similar levels as Alternative 2A as it is conveyed
 33 throughout the SWP/CVP Export Service Areas. Because no substantial differences in water quality
 34 effects are anticipated anywhere in the affected environment under Alternative 2B compared to
 35 those described in detail for Alternative 2A, the water quality effects described for Alternative 2A
 36 also appropriately characterize effects under Alternative 2B.

37 **Water Quality Effects Resulting from Implementation of CM2–CM22**

38 Alternative 2B has the same conservation measures as Alternative 2A. Because no substantial
 39 differences in water quality effects are anticipated anywhere in the affected environment under
 40 Alternative 2B compared to those described in detail for Alternative 2A, the water quality effects
 41 described for Alternative 2A also appropriately characterize effects under Alternative 2B.

1 **Impact WQ-31: Water Quality Effects Resulting from Construction-Related Activities (CM1-**
2 **CM22)**

3 The primary difference between Alternative 2B and Alternative 1A is that under Alternative 2B, a
4 canal would be constructed for CM1 along the eastern side of the Delta to convey the Sacramento
5 River water south, rather than the tunnel/pipeline features. As such, construction techniques and
6 locations of major features of the conveyance system within the Delta would be different (see
7 Chapter 3, *Description of Alternatives*, Section 3.5.6). The remainder of the facilities constructed
8 under Alternative 2B, including CM2–CM22, would be very similar to, or the same as, those to be
9 constructed for Alternative 1A.

10 **NEPA Effects:** The types of potential construction-related water quality effects associated with
11 implementation of CM1 under Alternative 2B would be very similar to the effects discussed for
12 Alternative 1A, and the effects anticipated with implementation of CM2–CM22 would be essentially
13 identical. However, given the substantial differences in the conveyance features under CM1 with
14 construction of a canal, there could be differences in the location, magnitude, duration, and
15 frequency of construction activities and related water quality effects. In particular, relative to the No
16 Action Alternative conditions, construction of the major canal features for CM1 under Alternative 2B
17 would involve extensive general construction activities, material handling/storage/placement
18 activities, surface soil grading/excavation/disposal and associated exposure of disturbed sites to
19 erosion and runoff, and construction site dewatering operations. Nevertheless, the construction of
20 CM1, and any individual components necessitated by CM2, and CM4–CM10, with the
21 implementation of the BMPs specified in Appendix 3B, *Environmental Commitments*, and other
22 agency permitted construction requirements would result in the potential water quality effects
23 being largely avoided and minimized. The specific environmental commitments that would be
24 implemented under Alternative 2B would be similar to those described for Alternative 1A with the
25 exception that Category “B” BMPs for tunnel muck dewatering basin construction and operations, if
26 necessary at all, would be much reduced. Consequently, relative to the No Action Alternative,
27 Alternative 2B would not be expected to cause exceedance of applicable water quality
28 objectives/criteria or substantial water quality degradation with respect to constituents of concern,
29 and thus would not adversely affect any beneficial uses upstream of the Delta, in the Delta, or in the
30 SWP and CVP service area.

31 In summary, with implementation of environmental commitments in Appendix 3B, the potential
32 construction-related water quality effects are considered to be not adverse.

33 **CEQA Conclusion:** Construction-related contaminant discharges would be temporary and
34 intermittent in nature and would involve negligible, if any, discharges of bioaccumulative or 303(d)
35 listed constituents to water bodies of the affected environment. As such, construction activities
36 would not contribute measurably to bioaccumulation of contaminants in organisms or humans or
37 cause 303(d) impairments to be discernibly worse. Because environmental commitments would be
38 implemented under Alternative 2B for construction-related activities along with agency-issued
39 permits that also contain construction related mitigation requirements to protect water quality, the
40 construction-related effects, relative to Existing Conditions, would not be expected to cause or
41 contribute to substantial alteration of existing drainage patterns which would result in substantial
42 erosion or siltation on- or off-site, substantial increased frequency of exceedances of water quality
43 objectives/criteria, or substantially degrade water quality with respect to the constituents of
44 concern on a long-term average basis, and thus would not adversely affect any beneficial uses in

1 water bodies upstream of the Delta, within the Delta, or in the SWP and CVP service area. Based on
2 these findings, this impact is determined to be less than significant. No mitigation is required.

3 **8.4.3.7 Alternative 2C—Dual Conveyance with West Canal and Intakes** 4 **W1-W5 (15,000 cfs; Operational Scenario B)**

5 Alternative 2C would include the same physical/structural water conveyance components and
6 western alignment as Alternative 1C, but would also include an operable barrier at the head of Old
7 River. Intake 1 through 5 would be located on the west bank of the Sacramento River and diverted
8 water would be carried by canals and tunnels to a new 600 acre forebay at Byron Tract. An
9 intermediate pumping plant would be constructed, but there would be no intermediate forebay.
10 Water supply and conveyance operations would follow the guidelines described as Scenario B,
11 which includes fall X2. CM2–CM22 would be implemented under this alternative, and these
12 conservation measures would be the same as those under Alternative 1A. See Chapter 3, *Description*
13 *of Alternatives*, Section 3.5.7, for additional details on Alternative 2C.

14 **Water Quality Effects Resulting from Facilities Operations and Maintenance (CM1)**

15 Alternative 2C has the same diversion and conveyance operations and conservation measures as
16 Alternative 2A. The primary differences between the two alternatives is that conveyance under
17 Alternative 2C would be in a lined or unlined canal, instead of pipeline, and the alignment of the
18 canal would be along the western side of the Delta, rather than the eastern side. Because there
19 would be no difference in conveyance capacity or operations, there would be no differences between
20 these two alternatives in upstream of the Delta river flows or reservoir operations, Delta inflow,
21 source fractions to various Delta locations, and hydrodynamics in the Delta. Conveyance of water in
22 an open channel instead of a pipeline may result in differing physical properties (e.g., DO, pH,
23 temperature) of the water upon reaching the south Delta export pumps than if the water was
24 conveyed in a pipeline. However, the physical properties of water arriving at the south Delta export
25 pumps would continue to change and would equilibrate to similar levels as Alternative 2A as it is
26 conveyed throughout the SWP/CVP Export Service Areas. Because no substantial differences in
27 water quality effects are anticipated anywhere in the affected environment under Alternative 2C
28 compared to those described in detail for Alternative 2A, the water quality effects described for
29 Alternative 2A also appropriately characterize effects under Alternative 2C.

30 **Water Quality Effects Resulting from Implementation of CM2–CM22**

31 Alternative 2C has the same conservation measures as Alternative 2A. Because no substantial
32 differences in water quality effects are anticipated anywhere in the affected environment under
33 Alternative 2C compared to those described in detail for Alternative 2A, the water quality effects
34 described for Alternative 2A also appropriately characterize effects under Alternative 2C.

35 **Impact WQ-31: Water Quality Effects Resulting from Construction-Related Activities (CM1–** 36 **CM22)**

37 The primary difference between Alternative 2C and Alternative 1A is that under Alternative 2C, a
38 canal would be constructed for CM1 along the western side of the Delta to convey the Sacramento
39 River water south, in addition to the tunnel/pipeline features. As such, construction techniques and
40 locations of major features of the conveyance system within the Delta would be different (see
41 Chapter 3, *Description of Alternatives*, Section 3.5.7). The remainder of the facilities constructed

1 under Alternative 2C, including CM2–CM22, would be very similar to, or the same as, those to be
2 constructed for Alternative 1A.

3 **NEPA Effects:** The types of potential construction-related water quality effects associated with
4 implementation of CM1 under Alternative 2C would be very similar to the effects discussed for
5 Alternative 1A, and the effects anticipated with implementation of CM2–CM22 would be essentially
6 identical. Given the substantial differences in the conveyance features under CM1 with construction
7 of a canal in addition to the tunnel/pipeline features, there could be differences in the location,
8 magnitude, duration, and frequency of construction activities and related water quality effects. In
9 particular, relative to the No Action Alternative conditions, construction of the major canal features
10 for CM1 under Alternative 2C would involve extensive general construction activities, material
11 handling/storage/placement activities, surface soil grading/excavation/disposal and associated
12 exposure of disturbed sites to erosion and runoff, and construction site dewatering operations.
13 Nevertheless, the construction of CM1, and any individual components necessitated by CM2, and
14 CM4–CM10, with the implementation of the BMPs specified in Appendix 3B, *Environmental*
15 *Commitments*, and other agency permitted construction requirements would result in the potential
16 water quality effects being largely avoided and minimized. The specific environmental commitments
17 that would be implemented under Alternative 2C would be similar to those described for Alternative
18 1A. However, this alternative would involve environmental commitments associated with both
19 tunnel/pipeline and canal construction activities. Consequently, relative to the No Action
20 Alternative, Alternative 2C would not be expected to cause exceedance of applicable water quality
21 objectives/criteria or substantial water quality degradation with respect to constituents of concern,
22 and thus would not adversely affect any beneficial uses upstream of the Delta, in the Delta, or in the
23 SWP and CVP service area.

24 In summary, with implementation of environmental commitments in Appendix 3B, the potential
25 construction-related water quality effects are considered to be not adverse.

26 **CEQA Conclusion:** Construction-related contaminant discharges would be temporary and
27 intermittent in nature and would involve negligible, if any, discharges of bioaccumulative or 303(d)
28 listed constituents to water bodies of the affected environment. As such, construction activities
29 would not contribute measurably to bioaccumulation of contaminants in organisms or humans or
30 cause 303(d) impairments to be discernibly worse. Because environmental commitments would be
31 implemented under Alternative 2C for construction-related activities along with agency-issued
32 permits that also contain construction related mitigation requirements to protect water quality, the
33 construction-related effects, relative to Existing Conditions, would not be expected to cause or
34 contribute to substantial alteration of existing drainage patterns which would result in substantial
35 erosion or siltation on- or off-site, substantial increased frequency of exceedances of water quality
36 objectives/criteria, or substantially degrade water quality with respect to the constituents of
37 concern on a long-term average basis, and thus would not adversely affect any beneficial uses in
38 water bodies upstream of the Delta, within the Delta, or in the SWP and CVP service area. Based on
39 these findings, this impact is determined to be less than significant. No mitigation is required.

40 **8.4.3.8 Alternative 3—Dual Conveyance with Tunnel and Intakes 1 and 2** 41 **(6,000 cfs; Operational Scenario A)**

42 Alternative 3 would comprise physical/structural components similar to those under Alternative 1A
43 with the principal exception that Alternative 3 would convey up to 6,000 cfs of water from the north
44 Delta to the south Delta. Diverted water would be conveyed through pipelines/tunnels from two

1 screened intakes (i.e., Intakes 1 and 2) located on the east bank of the Sacramento River between
 2 Clarksburg and Walnut Grove. Alternative 3 would include a 750 acre intermediate forebay and
 3 pumping plant. A new 600 acre Byron Tract Forebay, adjacent to and south of Clifton Court Forebay,
 4 would be constructed which would provide water to the south Delta pumping plants. Water supply
 5 and conveyance operations would follow the guidelines described as Scenario A, which does not
 6 include fall X2. Conservation Measures 2–22 (CM2–CM22) would be implemented under this
 7 alternative, and would be the same as those under Alternative 1A. See Chapter 3, *Description of*
 8 *Alternatives*, Section 3.5.8, for additional details on Alternative 3.

9 **Effects of the Alternative on Delta Hydrodynamics**

10 Under the No Action Alternative and Alternatives 1–9, the following two primary factors can
 11 substantially affect water quality within the Delta:

- 12 • Within the south, west, and interior Delta, a decrease in the percentage of Sacramento River-
 13 sourced water and a concurrent increase in San Joaquin River-sourced water can increase the
 14 concentrations of numerous constituents (e.g., boron, bromide, chloride, electrical conductivity,
 15 nitrate, organic carbon, some pesticides, selenium). This source water replacement is caused by
 16 decreased exports of San Joaquin River water (due to increased Sacramento River water
 17 exports), or effects of climate change on timing of flows in the rivers. Changes in channel flows
 18 also can affect water residence time and many related physical, chemical, and biological
 19 variables.
- 20 • Particularly in the west Delta, sea water intrusion as a result of sea level rise or decreased Delta
 21 outflow can increase the concentration of salts (bromide, chloride) and levels of electrical
 22 conductivity. Conversely, increased Delta outflow (e.g., as a result of Fall X2 operations in wet
 23 and above normal water years) will decrease levels of these constituents, particularly in the
 24 west Delta.

25 Since the only difference between Alternative 3 and Alternative 1A is that the north Delta diversion
 26 capacity under Alternative 3 is 6,000 cfs instead of 15,000 cfs under Alternative 1A, effects on Delta
 27 hydrodynamics under Alternative 3 are very similar to Alternative 1A, but are generally of a lesser
 28 extent.

29 Under Alternative 3, over the long term, average annual delta exports are anticipated to increase by
 30 227 TAF relative to Existing Conditions, and decrease by 930 TAF relative to the No Action
 31 Alternative. Since, over the long-term, approximately 35% of the exported water will be from the
 32 new north Delta intakes, average monthly diversions at the south Delta intakes would be decreased
 33 because of the shift in diversions to the north Delta intakes (see Chapter 5, *Water Supply*, for more
 34 information). The result of this is increased San Joaquin River water influence throughout the south,
 35 west, and interior Delta, and a corresponding decrease in Sacramento River water influence. This
 36 can be seen, for example, in Appendix 8D, ALT 3–Old River at Rock Slough for ALL years (1976–
 37 1991), which shows increased San Joaquin River (SJR) percentage and decreased Sacramento River
 38 (SAC) percentage under the alternative, relative to Existing Conditions and the No Action
 39 Alternative.

40 Under Alternative 3, long-term average annual Delta outflow is anticipated to decrease 227 TAF
 41 relative to Existing Conditions, due to both changes in operations (including north Delta intake
 42 capacity of 6,000 cfs and numerous other operational components of Scenario A) and climate
 43 change/sea level rise (see Chapter 5, *Water Supply*, for more information). The result of this is

1 increased sea water intrusion in the west Delta. The increase of sea water intrusion in the west Delta
2 under Alternative 1A is greater relative to the No Action alternative because the No Action
3 alternative includes operations to meet Fall X2, whereas Existing Conditions and Alternative 3 do
4 not. Long-term average annual Delta outflow is anticipated to decrease under Alternative 3 by 977
5 TAF relative to the No Action Alternative, due only to changes in operations. The increases in sea
6 water intrusion (represented by an increase in San Francisco Bay (BAY) percentage) can be seen, for
7 example, in Appendix 8D, ALT 3–Sacramento River at Mallard Island for ALL years (1976–1991).

8 **Impact WQ-1: Effects on Ammonia Concentrations Resulting from Facilities Operations and** 9 **Maintenance (CM1)**

10 ***Upstream of the Delta***

11 For the same reasons stated for the No Action Alternative, Alternative 3 would have negligible, if
12 any, effect on ammonia concentrations in the rivers and reservoirs upstream of the Delta relative to
13 Existing Conditions and the No Action Alternative. Any negligible increases in ammonia-N
14 concentrations that could occur in the water bodies of the affected environment located upstream of
15 the Delta would not be of frequency, magnitude and geographic extent that would adversely affect
16 any beneficial uses or substantially degrade the quality of these water bodies, with regard to
17 ammonia.

18 ***Delta***

19 Assessment of effects of ammonia under Alternative 3 is the same as discussed under Alternative
20 1A, except that because flows in the Sacramento River at Freeport are different between the two
21 alternatives, estimated monthly average and long term annual average predicted ammonia-N
22 concentrations in the Sacramento River downstream of Freeport are different.

23 As Table 8-66 shows, estimated ammonia-N concentrations in the Sacramento River downstream of
24 Freeport (upon full mixing of the SRWTP discharge with river water) under Alternative 3 and the No
25 Action Alternative are expected to be similar. Minor increases in ammonia-N concentrations would
26 occur during February, August, September, and November, and remaining months would be
27 unchanged or have a minor decrease. A minor increase in the annual average concentration would
28 occur under Alternative 3, compared to the No Action Alternative. Moreover, the estimated
29 concentrations downstream of Freeport under Alternative 3 would be similar to existing source
30 water concentrations for the San Francisco Bay and San Joaquin River. Consequently, changes in
31 source water fraction anticipated under Alternative 3, relative to the No Action Alternative, are not
32 expected to substantially increase ammonia concentrations at any Delta locations.

33 Any negligible increases in ammonia-N concentrations that could occur at certain locations in the
34 Delta would not be of frequency, magnitude and geographic extent that would adversely affect any
35 beneficial uses or substantially degrade the water quality at these locations, with regards to
36 ammonia.

Table 8-66. Estimated Ammonia-N (mg-L as N) Concentrations in the Sacramento River Downstream of the Sacramento Regional Wastewater Treatment Plant for the No Action Alternative and Alternative 3

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual Average
No Action Alternative	0.074	0.084	0.069	0.060	0.057	0.060	0.058	0.064	0.067	0.060	0.067	0.064	0.065
Alternative 3	0.068	0.089	0.068	0.060	0.058	0.060	0.058	0.062	0.064	0.064	0.073	0.076	0.067

SWP/CVP Export Service Areas

The assessment of effects on ammonia in the SWP/CVP Export Service Area is based on assessment of ammonia-N concentrations at Banks and Jones pumping plants. Similar to the discussion for Alternative 1A, under Alternative 3 for areas of the Delta that are influenced by Sacramento River water, including Banks and Jones pumping plants, ammonia-N concentrations are expected to decrease, relative to Existing Conditions (in association with less diversion of water influenced by the SRWTP). This decrease in ammonia-N concentrations for water exported via the south Delta pumps is not expected to result in adverse effects on beneficial uses or substantially degrade water quality of exported water, with regards to ammonia.

Furthermore, as discussed above for the Plan Area, for all areas of the Delta, including Banks and Jones pumping plants, ammonia-N concentrations are not expected to be substantially different under Alternative 3, relative to No Action Alternative. Any negligible increases in ammonia-N concentrations that could occur at Banks and Jones pumping plants would not be of frequency, magnitude and geographic extent that would adversely affect any beneficial uses or substantially degrade the water quality at these locations, with regards to ammonia.

NEPA Effects: In summary, based on the discussion above, effects on ammonia from implementation of CM1 are considered to be not adverse.

CEQA Conclusion: Key findings discussed in the effects assessment provided above are summarized here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this constituent. For additional details on the effects assessment findings that support this CEQA impact determination, see the effects assessment discussion that immediately precedes this conclusion.

Ammonia-N concentrations are generally low in the reservoirs and rivers of the watersheds, owing to the lack of substantial point and nonpoint sources of ammonia-N upstream of the SRWTP in the Sacramento River watershed, in the watersheds of the eastern tributaries (Cosumnes, Mokelumne, and Calaveras Rivers), or upstream of the Delta in the San Joaquin River watershed. Consequently, any modified reservoir operations and subsequent changes in river flows under Alternative 3, relative to Existing Conditions, are expected to have negligible, if any, effects on reservoir and river ammonia-N concentrations upstream of Freeport in the Sacramento River watershed and upstream of the Delta in the San Joaquin River watershed.

Ammonia-N concentrations in the Sacramento River downstream of the SRWTP would be substantially lower under Alternative 3, relative to Existing Conditions, due to upgrades to the SRWTP that are assumed to be in place, and thus, ammonia concentrations for all areas of the Delta that are influenced by Sacramento River water are expected to decrease. At locations which are not

1 influenced notably by Sacramento River water, concentrations are expected to remain relatively
 2 unchanged, due to the similarity in SJR and BAY concentrations and the lack of expected changes in
 3 either of these concentrations.

4 The assessment of effects on ammonia in the SWP/CVP Export Service Areas is based on assessment
 5 of ammonia-N concentrations at Banks and Jones pumping plants. As discussed above for the Plan
 6 Area, for areas of the Delta that are influenced by Sacramento River water, including Banks and
 7 Jones pumping plants, ammonia-N concentrations are expected to decrease under Alternative 3,
 8 relative to Existing Conditions.

9 Based on the above, there would be no substantial, long-term increase in ammonia-N concentrations
 10 in the rivers and reservoirs upstream of the Delta, in the Plan Area, or the waters exported to the
 11 CVP and SWP service areas under Alternative 3 relative to Existing Conditions. As such, this
 12 alternative is not expected to cause additional exceedance of applicable water quality
 13 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
 14 on any beneficial uses of waters in the affected environment. Because ammonia concentrations are
 15 not expected to increase substantially, no long-term water quality degradation is expected to occur
 16 and, thus, no adverse effects on beneficial uses would occur. Ammonia is not 303(d) listed within the
 17 affected environment and thus any minor increases that could occur in some areas would not make
 18 any existing ammonia-related impairment measurably worse because no such impairments
 19 currently exist. Because ammonia-N is not bioaccumulative, minor increases that could occur in
 20 some areas would not bioaccumulate to greater levels in aquatic organisms that would, in turn, pose
 21 substantial health risks to fish, wildlife, or humans. This impact is considered to be less than
 22 significant. No mitigation is required.

23 **Impact WQ-2: Effects on Ammonia Concentrations Resulting from Implementation of CM2-** 24 **CM22**

25 **NEPA Effects:** Effects of CM2–CM22 on ammonia under Alternative 3 are the same as those
 26 discussed for Alternative 1A and are considered to be not adverse.

27 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 3 would be similar to
 28 those proposed under Alternative 1A. As such, effects on ammonia resulting from the
 29 implementation of CM2–CM22 would be similar to that previously discussed for Alternative 1A. This
 30 impact is considered to be less than significant. No mitigation is required.

31 **Impact WQ-3: Effects on Boron Concentrations Resulting from Facilities Operations and** 32 **Maintenance (CM1)**

33 ***Upstream of the Delta***

34 Effects of CM1 on boron under Alternative 3 in areas upstream of the Delta would be very similar to
 35 the effects discussed for Alternative 1A. There would be no expected change to the sources of boron
 36 in the Sacramento and east-side tributary watersheds, and resultant changes in flows from altered
 37 system-wide operations would have negligible, if any, effects on the concentration of boron in the
 38 rivers and reservoirs of these watersheds. The modeled long-term annual average lower San Joaquin
 39 River flow at Vernalis would decrease slightly compared to Existing Conditions (in association with
 40 project operations, climate change, and increased water demands) and would be similar compared
 41 to the No Action Alternative considering only changes due to Alternative 3 operations. The reduced
 42 flow would result in possible increases in long-term average boron concentrations of up to about

1 3% relative to the Existing Conditions (Appendix 8F, Table 24). The increased boron concentrations
2 would not increase the frequency of exceedances of any applicable objectives or criteria and would
3 not be expected to cause further degradation at measurable levels in the lower San Joaquin River,
4 and thus would not cause the existing impairment there to be discernibly worse. Consequently,
5 Alternative 3 would not be expected to cause exceedance of boron objectives/criteria or
6 substantially degrade water quality with respect to boron, and thus would not adversely affect any
7 beneficial uses of the Sacramento River, the east-side tributaries, associated reservoirs upstream of
8 the Delta, or the San Joaquin River.

9 ***Delta***

10 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
11 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
12 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
13 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
14 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
15 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

16 Effects of CM1 on boron under Alternative 3 in the Delta would be similar to the effects discussed for
17 Alternative 1A. Relative to the Existing Conditions and No Action Alternative, Alternative 3 would
18 result in unchanged or reduced long-term average boron concentrations for the 16-year period
19 modeled at northern and eastern Delta locations, and would increase at interior and western Delta
20 locations (by as much as 8% at the SF Mokelumne River at Staten Island, 9% at Franks Tract, 6% at
21 Old River at Rock Slough, and 4% at the Sacramento River at Emmaton) (Appendix 8F, Table Bo-10).
22 This comparison to Existing Conditions reflects changes due to both Alternative 3 operations
23 (including north Delta intake capacity of 6,000 cfs and numerous other operational components of
24 Scenario A) and climate change/sea level rise. This comparison to the No Action Alternative reflects
25 changes due only to operations.

26 Implementation of tidal habitat restoration under CM4 also may contribute to increased boron
27 concentrations at western Delta assessment locations (more discussion of this phenomenon is
28 included in Section 8.3.1.3), and thus would not be anticipated to substantially affect agricultural
29 diversions which occur primarily at interior Delta locations. The long-term annual average and
30 monthly average boron concentrations, for either the 16-year period or drought period modeled,
31 would never exceed the 2,000 µg/L human health advisory objective (i.e., for children) or 500 µg/L
32 agricultural objective at any of the eleven Delta assessment locations, which represents no change
33 from the Existing Conditions and No Action Alternative conditions (Appendix 8F, Table Bo-3A).
34 Reductions in long-term average assimilative capacity of up to 4% at interior Delta locations (i.e.,
35 Franks Tract and Old River at Rock Slough) would be small with respect to the 500 µg/L agricultural
36 objective (Appendix 8F, Table Bo-11). However, because the absolute boron concentrations would
37 still be well below the lowest 500 µg/L objective for the protection of the agricultural beneficial use
38 under Alternative 3, the levels of boron degradation would not be of sufficient magnitude to
39 substantially increase the risk of exceeding objectives or cause adverse effects to municipal and
40 agricultural water supply beneficial uses, or any other beneficial uses, in the Delta (Appendix 8F,
41 Figure Bo-2).

42 ***SWP/CVP Export Service Areas***

43 Effects of CM1 on boron under Alternative 3 in the Delta would be very similar to the effects
44 discussed for Alternative 1A. Under Alternative 3, long-term average boron concentrations would

1 decrease by as much as 15% at the Banks Pumping Plant and by as much as 14% at Jones Pumping
2 Plant relative to Existing Conditions and No Action Alternative (Appendix 8F, Table Bo-10) as a
3 result of export of a greater proportion of low-boron Sacramento River water. Commensurate with
4 the decrease in exported boron concentrations, boron concentrations in the lower San Joaquin River
5 may be reduced and would likely alleviate or lessen any expected increase in boron concentrations
6 at Vernalis associated with flow reductions (see discussion of Upstream of the Delta), as well as
7 locations in the Delta receiving a large fraction of San Joaquin River water. Reduced export boron
8 concentrations also may contribute to reducing the existing 303(d) impairment in the lower San
9 Joaquin River and associated TMDL actions for reducing boron loading.

10 Maintenance of SWP and CVP facilities under Alternative 3 would not be expected to create new
11 sources of boron or contribute towards a substantial change in existing sources of boron in the
12 affected environment. Maintenance activities would not be expected to cause any substantial
13 increases in boron concentrations or degradation with respect to boron such that objectives would
14 be exceeded more frequently, or any beneficial uses would be adversely affected anywhere in the
15 affected environment.

16 **NEPA Effects:** In summary, relative to the No Action Alternative conditions, Alternative 3 would
17 result in relatively small increases in long-term average boron concentrations in the Delta and not
18 appreciably change boron levels in the lower San Joaquin River. However, the predicted changes
19 would not be expected to cause exceedances of applicable objectives or further measurable water
20 quality degradation, and thus would not constitute an adverse effect on water quality.

21 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
22 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
23 purpose of making the CEQA impact determination for this constituent. For additional details on the
24 effects assessment findings that support this CEQA impact determination, see the effects assessment
25 discussion that immediately precedes this conclusion.

26 Boron is not a constituent of concern in the Sacramento River watershed upstream of the Delta, thus
27 river flow rate and reservoir storage reductions that would occur under the Alternative 3, relative to
28 Existing Conditions, would not be expected to result in a substantial adverse change in boron levels.
29 Additionally, relative to Existing Conditions, Alternative 3 would not result in reductions in river
30 flow rates (i.e., less dilution) or increased boron loading such that there would be any substantial
31 increases in boron concentration upstream of the Delta in the San Joaquin River watershed.

32 Small increased boron levels predicted for interior and western Delta locations (i.e., up to 9%
33 increase) in response to a shift in the Delta source water percentages and tidal habitat restoration
34 under this alternative would not be expected to cause exceedances of objectives, or substantial
35 degradation of these water bodies. Alternative 3 maintenance also would not result in any
36 substantial increases in boron concentrations in the affected environment. Boron concentrations
37 would be reduced in water exported from the Delta to the CVP/SWP Export Service Areas, thus
38 reflecting a potential improvement to boron loading in the lower San Joaquin River.

39 Boron is not a bioaccumulative constituent, thus any increased concentrations under Alternative 3
40 would not result in adverse boron bioaccumulation effects to aquatic life or humans. Relative to
41 Existing Conditions, Alternative 3 would not result in substantially increased boron concentrations
42 such that frequency of exceedances of municipal and agricultural water supply objectives would
43 increase. The levels of boron degradation that may occur under Alternative 3 would not be of
44 sufficient magnitude to cause substantially increased risk for adverse effects to municipal or

1 agricultural beneficial uses within the affected environment. Long-term average boron
 2 concentrations would decrease in Delta water exports to the SWP and CVP service area, which may
 3 contribute to reducing the existing 303(d) impairment of agricultural beneficial uses in the lower
 4 San Joaquin River. Based on these findings, this impact is determined to be less than significant. No
 5 mitigation is required.

6 **Impact WQ-4: Effects on Boron Concentrations Resulting from Implementation of CM2–CM22**

7 **NEPA Effects:** Effects of CM2–CM22 on boron under Alternative 3 are the same as those discussed
 8 for Alternative 1A and are determined to be not adverse.

9 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 3 would be similar to
 10 those proposed under Alternative 1A. As such, effects on boron resulting from the implementation
 11 of CM2–CM22 would be similar to that previously discussed for Alternative 1A. This impact is
 12 considered to be less than significant. No mitigation is required.

13 **Impact WQ-5: Effects on Bromide Concentrations Resulting from Facilities Operations and** 14 **Maintenance (CM1)**

15 ***Upstream of the Delta***

16 Under Alternative 3 there would be no expected change to the sources of bromide in the Sacramento
 17 and eastside tributary watersheds. Bromide loading in these watersheds would remain unchanged
 18 and resultant changes in flows from altered system-wide operations under Alternative 3 would have
 19 negligible, if any, effects on the concentration of bromide in the rivers and reservoirs of these
 20 watersheds. Consequently, Alternative 3 would not be expected to adversely affect the MUN
 21 beneficial use, or any other beneficial uses, of the Sacramento River, the eastside tributaries, or their
 22 associated reservoirs upstream of the Delta.

23 Under Alternative 3, modeling indicates that long-term annual average flows on the San Joaquin
 24 River would decrease by 6%, relative to Existing Conditions and would remain virtually the same
 25 relative to the No Action Alternative (Appendix 5A). These decreases in flow would result in
 26 possible increases in long-term average bromide concentrations of about 3% relative to Existing
 27 Conditions and less than <1% relative to No Action Alternative (Appendix 8E, Bromide Table 22).
 28 The small increases in lower San Joaquin River bromide levels that could occur under Alternative 3,
 29 relative to existing and No Action Alternative conditions would not be expected to adversely affect
 30 the MUN beneficial use, or any other beneficial uses, of the lower San Joaquin River.

31 ***Delta***

32 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 33 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 34 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 35 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 36 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
 37 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

38 Under Alternative 3, the geographic extent of effects pertaining to long-term average bromide
 39 concentrations in the Delta would be similar to that previously described for Alternative 1A,
 40 although the magnitude of predicted long-term change and relative frequency of concentration
 41 threshold exceedances would be different. Using the mass-balance modeling approach for bromide

1 (see Section 8.3.1.3), relative to Existing Conditions, modeled long-term average bromide
2 concentrations would increase at Staten Island, Emmaton, and Barker Slough, while modeled long-
3 term average bromide concentrations would generally decrease at other assessment locations
4 (Appendix 8E, *Bromide*, Table 8). Overall effects would be greatest at Barker Slough, where
5 predicted long-term average bromide concentrations would increase from 51 µg/L to 69 µg/L (34%
6 relative increase) for the modeled 16-year hydrologic period and would increase from 54 µg/L to 99
7 µg/L (85% relative increase) for the modeled drought period. At Barker Slough, the predicted 50
8 µg/L exceedance frequency would decrease slightly from 49% under Existing Conditions to 48%
9 under Alternative 3, but would increase from 55% to 77% during the drought period. At Barker
10 Slough, the predicted 100 µg/L exceedance frequency would increase from 0% under Existing
11 Conditions to 22% under Alternative 3, and would increase from 0% to 47% during the drought
12 period. In contrast, increases in bromide at Staten Island would result in a 50 µg/L bromide
13 threshold exceedance increase from 47% under Existing Conditions to 71% under Alternative 3
14 (52% to 73% during the modeled drought period). However, unlike Barker Slough, modeling shows
15 that long-term average bromide concentration at Staten Island would exceed the 100 µg/L
16 assessment threshold concentration 1% under Existing Conditions and 3% under Alternative 3 (0%
17 to 2% during the modeled drought period). The long-term average bromide concentrations would
18 be 60 µg/L (62 µg/L for the modeled drought period) at Staten Island under Alternative 3. Changes
19 in exceedance frequency of the 50 µg/L and 100 µg/L concentration thresholds, as well as relative
20 change in long-term average concentration, at other assessment locations would be less substantial.
21 This comparison to Existing Conditions reflects changes in bromide due to both Alternative 3
22 operations (including north Delta intake capacity of 6,000 cfs and numerous other operational
23 components of Scenario A) and climate change/sea level rise.

24 In comparison, Alternative 3 relative to the No Action Alternative would result in predicted
25 increases in long-term average bromide concentrations at all locations with the exception of the
26 Banks and Jones pumping plants (Appendix 8E, *Bromide*, Table 8). These increases would continue
27 to be greatest at Barker Slough, where long-term average concentrations are predicted to increase
28 by about 38% (about 85% in drought years) relative to the No Action Alternative. Increases in long-
29 term average bromide concentrations would be less than 29% at the remaining assessment
30 locations. Due to the relatively small differences between modeled Existing Conditions and No
31 Action baselines, changes in the frequency with which concentration thresholds of 50 µg/L and 100
32 µg/L are exceeded are of similar magnitude to the previously described existing condition
33 comparison. Unlike the comparison to Existing Conditions, this comparison to the No Action
34 Alternative reflects changes in bromide due only to Alternative 3 operations.

35 At Barker Slough, modeled long-term average bromide concentrations for the two baseline
36 conditions are very similar (Appendix 8E, *Bromide* Table 8). Such similarity demonstrates that the
37 modeled Alternative 3 change in bromide is almost entirely due to Alternative 3 operations, and not
38 climate change/sea level rise. Therefore, operations are the primary driver of effects on bromide at
39 Barker Slough, regardless whether Alternative 3 is compared to Existing Conditions, or compared to
40 the No Action Alternative.

41 Results of the modeling approach which used relationships between EC and chloride and between
42 chloride and bromide (see Section 8.3.1.3) differed somewhat from what is presented above for the
43 mass-balance approach (see Appendix 8E, Table 9). For most locations, the frequency of exceedance
44 of the 50 µg/L and 100 µg/L were similar. The greatest difference between the methods was
45 predicted for Barker Slough. The increases in frequency of exceedance of the 100 µg/L threshold,
46 relative to Existing Conditions and the No Action Alternative, were not as great using this alternative

1 EC to chloride and chloride to bromide relationship modeling approach as compared to that
2 presented above from the mass-balance modeling approach. However, there were still substantial
3 increases, resulting in 9% exceedance over the modeled period under Alternative 3, as compared to
4 1% under Existing Conditions and 2% under the No Action Alternative. For the drought period,
5 exceedance frequency increased from 0% under Existing Conditions and the No Action Alternative,
6 to 18% under Alternative 3. Because the mass-balance approach predicts a greater level of impact at
7 Barker Slough, determination of impacts was based on the mass-balance results.

8 The increase in long-term average bromide concentrations predicted at Barker Slough, principally
9 the relative increase in 100 µg/L exceedance frequency, would result in a substantial change in
10 source water quality for existing drinking water treatment plants drawing water from the North Bay
11 Aqueduct. As discussed for Alternative 1A, drinking water treatment plants obtaining water via the
12 North Bay Aqueduct utilize a variety of conventional and enhanced treatment technologies in order
13 to achieve DBP drinking water criteria. While the implications of such a modeled change in bromide
14 at Barker Slough are difficult to predict, the substantial modeled increases could lead to adverse
15 changes in the formation of disinfection byproducts such that considerable treatment plant
16 upgrades may be necessary in order to achieve equivalent levels of health protection. Because many
17 of the other modeled locations already frequently exceed the 100 µg/L threshold under Existing
18 Conditions and the No Action Alternative, these locations likely already require treatment plant
19 technologies to achieve equivalent levels of health protection, and thus no additional treatment
20 technologies would be triggered by the small increases in the frequency of exceeding the 100 µg/L
21 threshold. Hence, no further impact on the drinking water beneficial use would be expected at these
22 locations.

23 The seasonal intakes at Mallard Slough and City of Antioch are infrequently used due to water
24 quality constraints related to sea water intrusion. On a long-term average basis, bromide at these
25 locations is in excess of 3,000 µg/L, but during seasonal periods of high Delta outflow can be <300
26 µg/L. Based on modeling using the mass-balance approach, use of the seasonal intakes at Mallard
27 Slough and City of Antioch under Alternative 3 would experience a period average increase in
28 bromide during the months when these intakes would most likely be utilized. For those wet and
29 above normal water year types where mass balance modeling would predict water quality typically
30 suitable for diversion, predicted long-term average bromide would increase from 103 µg/L to 149
31 µg/L (45% increase) at City of Antioch and would increase from 150 µg/L to 201 µg/L (34%
32 increase) at Mallard Slough relative to Existing Conditions (Appendix 8E, Bromide Table 23).
33 Increases would be similar for the No Action Alternative comparison. Modeling results using the EC
34 to chloride and chloride to bromide relationships show increases during these months, but the
35 relative magnitude of the increases is much lower (Appendix 8E, Bromide Table 24). Regardless of
36 the differences in the data between the two modeling approaches, the decisions surrounding the use
37 of these seasonal intakes is largely driven by acceptable water quality, and thus have historically
38 been opportunistic. Opportunity to use these intakes would remain, and the predicted increases in
39 bromide concentrations at the City of Antioch and Mallard Slough intake would not be expected to
40 adversely affect MUN beneficial uses, or any other beneficial use, at these locations.

41 ***SWP/CVP Export Service Areas***

42 Under Alternative 3, improvement in long-term average bromide concentrations would occur at the
43 Banks and Jones pumping plants. Long-term average bromide concentrations for the modeled 16-
44 year hydrologic period at these locations would decrease by as much as 31% relative to Existing
45 Conditions and 21% relative to the No Action Alternative. Relative change in long-term average

1 bromide concentration would generally be less for the drought period ($\leq 31\%$), but would still
2 represent considerable improvement (Appendix 8E, Bromide Table 8). As a result, less frequent
3 bromide concentration exceedances of the 50 $\mu\text{g}/\text{L}$ and 100 $\mu\text{g}/\text{L}$ assessment thresholds would be
4 predicted and an overall improvement in Export Service Areas water quality would be experienced
5 respective to bromide. Commensurate with the decrease in exported bromide, an improvement in
6 lower San Joaquin River bromide would also be observed since bromide in the lower San Joaquin
7 River is principally related to irrigation water deliveries from the Delta. While the magnitude of this
8 expected lower San Joaquin River improvement in bromide is difficult to predict, the relative
9 decrease in overall loading of bromide to the Export Service Areas would likely alleviate or lessen
10 any expected increase in bromide concentrations at Vernalis (see discussion of Upstream of the
11 Delta) as well as locations in the Delta receiving a large fraction of San Joaquin River water, such as
12 much of the south Delta.

13 **NEPA Effects:** The discussion above is based on results of the mass-balance modeling approach.
14 Results of the modeling approach which used relationships between EC and chloride and between
15 chloride and bromide (see Section 8.3.1.3) were consistent with the discussion above, and
16 assessment of bromide using these data results in the same conclusions as are presented above for
17 the mass-balance approach (see Appendix 8E, *Bromide*, Table 9).

18 Similar to the discussion pertaining to the No Action Alternative, maintenance of SWP and CVP
19 facilities under Alternative 3 would not be expected to create new sources of bromide or contribute
20 towards a substantial change in existing sources of bromide in the affected environment.
21 Maintenance activities would not be expected to cause any substantial change in bromide such that
22 MUN beneficial uses, or any other beneficial use, would be adversely affected anywhere in the
23 affected environment.

24 In summary, Alternative 3 operations and maintenance, relative to the No Action Alternative, would
25 result in small increases (i.e., $<1\%$) in long-term average bromide concentrations at Vernalis related
26 to relatively small declines in long-term average flow on the San Joaquin River. However, Alternative
27 3 operation and maintenance activities would cause substantial degradation to water quality with
28 respect to bromide at Barker Slough, source of the North Bay Aqueduct. Resultant substantial
29 change in long-term average bromide at Barker Slough could necessitate changes in water treatment
30 plant operations or require treatment plant upgrades in order to maintain DBP compliance, and thus
31 would constitute an adverse effect on water quality. Mitigation Measure WQ-5 is available to reduce
32 these effects (implementation of this measure along with a separate, non-environmental
33 commitment as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*, relating to the
34 potential increased treatment costs associated with bromide-related changes would reduce these
35 effects).

36 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
37 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
38 purpose of making the CEQA impact determination for this constituent. For additional details on the
39 effects assessment findings that support this CEQA impact determination, see the effects assessment
40 discussion that immediately precedes this conclusion.

41 Under Alternative 3 there would be no expected change to the sources of bromide in the Sacramento
42 and eastside tributary watersheds. Bromide loading in these watersheds would remain unchanged
43 and resultant changes in flows from altered system-wide operations under Alternative 3 would have
44 negligible, if any, effects on the concentration of bromide in the rivers and reservoirs of these

1 watersheds. However, south of the Delta, the San Joaquin River is a substantial source of bromide,
2 primarily due to the use of irrigation water imported from the southern Delta. Concentrations of
3 bromide at Vernalis are inversely correlated to net river flow. Under Alternative 3, long-term
4 average flows at Vernalis would decrease only slightly, resulting in less than substantial predicted
5 increases in long-term average bromide of about 3% relative to Existing Conditions.

6 Relative to Existing Conditions, Alternative 3 would result in small decreases in long-term average
7 bromide concentration at most Delta assessment locations, with principal exceptions being the
8 North Bay Aqueduct at Barker Slough, Staten Island, and Emmaton on the Sacramento River. Overall
9 effects would be greatest at Barker Slough, where substantial increases in long-term average
10 bromide concentrations would be predicted. The increase in long-term average bromide
11 concentrations predicted for Barker Slough would result in a substantial change in source water
12 quality to existing drinking water treatment plants drawing water from the North Bay Aqueduct.
13 These modeled increases in bromide at Barker Slough could lead to adverse changes in the
14 formation of disinfection byproducts at drinking water treatment plants such that considerable
15 water treatment plant upgrades would be necessary in order to achieve equivalent levels of drinking
16 water health protection.

17 The assessment of effects on bromide in the SWP/CVP Export Service Areas is based on assessment
18 of changes in bromide concentrations at Banks and Jones pumping plants. Under Alternative 3,
19 substantial improvement would occur at the Banks and Jones pumping plants, where predicted
20 long-term average bromide concentrations are predicted to decrease by as much as 31% relative to
21 Existing Conditions. An overall improvement in bromide-related water quality would be predicted
22 in the SWP/CVP Export Service Areas.

23 Based on the above, Alternative 3 operation and maintenance would not result in any substantial
24 change in long-term average bromide concentration upstream of the Delta. Furthermore, under
25 Alternative 3, water exported from the Delta to the SWP/CVP service area would be substantially
26 improved relative to bromide. Bromide is not bioaccumulative, therefore change in long-term
27 average bromide concentrations would not directly cause bioaccumulative problems in aquatic life
28 or humans. Additionally, bromide is not a constituent related to any 303(d) listings. Alternative 3
29 operation and maintenance activities would not cause substantial long-term degradation to water
30 quality respective to bromide with the exception of water quality at Barker Slough, source of the
31 North Bay Aqueduct. At Barker Slough, modeled long-term annual average concentrations of
32 bromide would increase by 34%, and 85% during the modeled drought period. For the modeled 16-
33 year hydrologic period the frequency of predicted bromide concentrations exceeding 100 µg/L
34 would increase from 0% under Existing Conditions to 22% under Alternative 3, while for the
35 modeled drought period, the frequency would increase from 0% to 47%. Substantial changes in
36 long-term average bromide could necessitate changes in treatment plant operation or require
37 treatment plant upgrades in order to maintain DBP compliance. The model predicted change at
38 Barker Slough is substantial and, therefore, would represent a substantially increased risk for
39 adverse effects on existing MUN beneficial uses should treatment upgrades not be undertaken. The
40 impact is considered significant.

41 Implementation of Mitigation Measure WQ-5 along with a separate, non-environmental
42 commitment relating to the potential increased treatment costs associated with bromide-related
43 changes would reduce these effects. While mitigation measures to reduce these water quality effects
44 in affected water bodies to less than significant levels are not available, implementation of
45 Mitigation Measure WQ-5 is recommended to attempt to reduce the effect that increased bromide

1 concentrations may have on Delta beneficial uses. However, because the effectiveness of this
 2 mitigation measure to result in feasible measures for reducing water quality effects is uncertain, this
 3 impact is considered to remain significant and unavoidable. Please see Mitigation Measure WQ-5
 4 under Impact WQ-5 in the discussion of Alternative 1A.

5 In addition to and to supplement Mitigation Measure WQ-5, the BDCP proponents have incorporated
 6 into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*, a separate, non-
 7 environmental commitment to address the potential increased water treatment costs that could
 8 result from bromide-related concentration effects on municipal water purveyor operations.
 9 Potential options for making use of this financial commitment include funding or providing other
 10 assistance towards implementation of the North Bay Aqueduct AIP, acquiring alternative water
 11 supplies, or other actions to indirectly reduce the effects of elevated bromide and DOC in existing
 12 water supply diversion facilities. Please refer to Appendix 3B, *Environmental Commitments*, for the
 13 full list of potential actions that could be taken pursuant to this commitment in order to reduce the
 14 water quality treatment costs associated with water quality effects relating to chloride, electrical
 15 conductivity, and bromide.

16 **Mitigation Measure WQ-5: Avoid, Minimize, or Offset, as Feasible, Adverse Water Quality**
 17 **Conditions**

18 Please see Mitigation Measure WQ-5 under Impact WQ-5 in the discussion of Alternative 1A.

19 **Impact WQ-6: Effects on Bromide Concentrations Resulting from Implementation of CM2-**
 20 **CM22**

21 **NEPA Effects:** Conservation Measures 2–22 proposed under Alternative 3 would be the same as
 22 those proposed under Alternative 1A. As discussed for Alternative 1A, implementation of the CM2–
 23 CM22 would not present new or substantially changed sources of bromide to the study area. Some
 24 conservation measures may replace or substitute for existing irrigated agriculture in the Delta. This
 25 replacement or substitution is not expected to substantially increase or present new sources of
 26 bromide. CM2–CM22 would not be expected to cause any substantial change in bromide such that
 27 MUN beneficial uses, or any other beneficial use, would be adversely affected anywhere in the
 28 affected environment.

29 In summary, implementation of CM2–CM22 under Alternative 3, relative to the No Action
 30 Alternative, would have negligible, if any, effects on bromide concentrations. The effects on bromide
 31 from implementing CM2–CM22 are determined to not be adverse.

32 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 3 would be similar to
 33 those proposed under Alternative 1A. As such, effects on bromide resulting from the
 34 implementation of CM2–CM22 would be similar to that previously discussed for Alternative 1A. This
 35 impact is considered to be less than significant. No mitigation is required.

36 **Impact WQ-7: Effects on Chloride Concentrations Resulting from Facilities Operations and**
 37 **Maintenance (CM1)**

38 ***Upstream of the Delta***

39 Under Alternative 3 there would be no expected change to the sources of chloride in the Sacramento
 40 and eastside tributary watersheds. Chloride loading in these watersheds would remain unchanged
 41 and resultant changes in flows from altered system-wide operations would have negligible, if any,

1 effects on the concentration of chloride in the rivers and reservoirs of these watersheds. The
2 modeled long-term annual average flows on the lower San Joaquin River at Vernalis would decrease
3 slightly compared to Existing Conditions and be similar compared to the No Action Alternative (as a
4 result of climate change). The reduced flow would result in possible increases in long-term average
5 chloride concentrations of about 2%, relative to the Existing Conditions and no change relative to No
6 Action Alternative (Appendix 8G, Table CI-62). Consequently, Alternative 3 would not be expected to
7 cause exceedance of chloride objectives/criteria or substantially degrade water quality with respect
8 to chloride, and thus would not adversely affect any beneficial uses of the Sacramento River, the
9 eastside tributaries, associated reservoirs upstream of the Delta, or the San Joaquin River.

10 **Delta**

11 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
12 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
13 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
14 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
15 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
16 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

17 Relative to Existing Conditions, modeling predicts that Alternative 3 would result in similar or
18 reduced long-term average chloride concentrations for the 16-year period modeled at most of the
19 assessment locations, and, depending on modeling approach (see Section 8.3.1.3), would result in
20 increased concentrations at the North Bay Aqueduct at Barker Slough (i.e., $\leq 28\%$), San Joaquin River
21 at Staten Island (i.e., $\leq 19\%$), Sacramento River at Emmaton (i.e., $\leq 16\%$), and Sacramento River at
22 Mallard Island (i.e., $\leq 5\%$) (Appendix 8G, *Chloride*, Table CI-19 and Table CI-20). Additionally,
23 implementation of tidal habitat restoration under CM4 would increase the tidal exchange volume in
24 the Delta, and thus may contribute to increased chloride concentrations in the Bay source water as a
25 result of increased salinity intrusion. More discussion of this phenomenon is included in Section
26 8.3.1.3. Consequently, while uncertain, the magnitude of chloride increases may be greater than
27 indicated herein and would affect the western Delta assessment locations the most which are
28 influenced to the greatest extent by the Bay source water. This comparison to Existing Conditions
29 reflects changes in chloride due to both Alternative 3 operations (including north Delta intake
30 capacity of 6,000 cfs and numerous other operational components of Scenario A) and climate
31 change/sea level rise.

32 Relative to the No Action Alternative conditions, the mass balance analysis of modeling results
33 indicated that Alternative 3A would result in increased long-term average chloride concentrations
34 for the 16-year period modeled at nine of the assessment locations (Appendix 8G, Table CI-19). The
35 increases in long-term average chloride concentrations would generally be largest compared to the
36 No Action Alternative condition, ranging from 2% at the San Joaquin River at Buckley Cove to 32%
37 at the North Bay Aqueduct at Barker Slough. Long-term average chloride concentrations would
38 decrease at the Banks pumping plant and Jones pumping plant locations. The comparison to the No
39 Action Alternative reflects chloride changes due only to operations.

40 The following outlines the modeled chloride changes relative to the applicable objectives and
41 beneficial uses of Delta waters.

1 *Municipal Beneficial Uses—Relative to Existing Conditions*

2 Estimates of chloride concentrations generated using EC-chloride relationships and DSM2 EC output
3 (see Section 8.3.1.3) were used to evaluate the 150 mg/L Bay-Delta WQCP objective for municipal
4 and industrial beneficial uses on a basis of the percent of years the chloride objective is exceeded for
5 the modeled 16-year period. The objective is exceeded if chloride concentrations exceed 150 mg/L
6 for a specified number of days in a given water year at both the Antioch and Contra Costa Pumping
7 Plant #1 locations. For Alternative 3, the modeled frequency of objective exceedance would
8 approximately double from 6% of years under Existing Conditions, to 13% of years under
9 Alternative 3 (Appendix 8G, Table CI-64).

10 Similarly, estimates of chloride concentrations generated using EC-chloride relationships and DSM2
11 EC output (see Section 8.3.1.3) were also used to evaluate the 250 mg/L Bay-Delta WQCP objective
12 for chloride at Contra Costa Pumping Plant #1 where daily average objectives apply. The basis for
13 the evaluation was the predicted number of days the objective was exceeded for the modeled 16-
14 year period. For Alternative 3, the modeled frequency of objective exceedance would decrease
15 slightly, from 6% of modeled days under Existing Conditions, to 4% of modeled days under
16 Alternative 3 (Appendix 8G, Table CI-63).

17 Given the limitations inherent to estimating future chloride concentrations (see Section 8.3.1.3),
18 estimation of chloride concentrations through both a mass balance approach and an EC-chloride
19 relationship approach was used to evaluate the 250 mg/L Bay-Delta WQCP objectives in terms of
20 both frequency of exceedance and use of assimilative capacity. When utilizing the mass balance
21 approach to model monthly average chloride concentrations for the 16-year period, the predicted
22 frequency of exceeding the 250 mg/L objective would occur for the 16-year period modeled at the
23 San Joaquin River at Antioch (i.e., from 66% under Existing Conditions to 74%) and Sacramento
24 River at Mallard Island (i.e., from 85% under Existing Conditions to 87%) (Appendix 8G, Table CI-
25 21), and would cause further degradation at Antioch in March and April (Appendix 8G, Table CI-23).
26 The frequency of exceedances at the Contra Costa Canal at Pumping Plant #1 would not increase
27 (Appendix 8G, Table CI-21); however, available assimilative capacity would be reduced by up to
28 100% (i.e., eliminated) in October and November compared to Existing Conditions (Appendix 8G,
29 Table CI-23), reflecting substantial degradation during these months when average concentrations
30 would be near, or exceed, the objective.

31 In comparison, when utilizing the chloride-EC relationship to model monthly average chloride
32 concentrations for the 16-year period, trends in frequency of exceedance and use of assimilative
33 capacity would be similar to that discussed when utilizing the mass balance modeling approach
34 (Appendix 8G, Table CI-22 and Table CI-24). However, as with Alternative 1A the modeling approach
35 utilizing the chloride-EC relationships predicted changes of lesser magnitude, where predictions of
36 change utilizing the mass balance approach were generally of greater magnitude, and thus more
37 conservative. As discussed in Section 8.3.1.3, in cases of such disagreement, the approach that
38 yielded the more conservative predictions was used as the basis for determining adverse impacts.

39 Based on the additional predicted annual and seasonal exceedances of one or both Bay Delta WQCP
40 objectives for chloride, and the magnitude of associated long-term average water quality
41 degradation at interior and western Delta locations, the potential exists for substantial adverse
42 effects on the municipal and industrial beneficial uses through reduced opportunity for diversion of
43 water with acceptable chloride levels.

1 *303(d) Listed Water Bodies—Relative to Existing Conditions*

2 With respect to the 303(d) listing for chloride in Tom Paine Slough, the monthly average chloride
3 concentrations for the 16-year period modeled at Old River at Tracy Road would generally be
4 similar compared to Existing Conditions, and thus, would not be further degraded on a long-term
5 basis (Appendix 8G, Figure Cl-2). With respect to Suisun Marsh, the monthly average chloride
6 concentrations for the 16-year period modeled would increase compared to Existing Conditions in
7 some months during October through May at the Sacramento River at Collinsville (Appendix 8G,
8 Figure Cl-3), Mallard Island (Appendix 8G, Figure Cl-1), and increase substantially at Montezuma
9 Slough at Beldon's Landing (i.e., up to a tripling of concentration in December through February)
10 (Appendix 8G, Figure Cl-4), thereby contributing to additional, measureable long-term degradation
11 that potentially would adversely affect the necessary actions to reduce chloride loading for any
12 TMDL that is developed.

13 *Municipal Beneficial Uses—Relative to No Action Alternative*

14 Similar to the assessment conducted for Existing Conditions, estimates of chloride concentrations
15 generated using EC-chloride relationships and DSM2 EC output (see Section 8.3.1.3) were used to
16 evaluate the 150 mg/L Bay-Delta WQCP objective for municipal and industrial beneficial uses. For
17 Alternative 3, the modeled frequency of objective exceedance would increase from 6% under the No
18 Action Alternative to 13% of years under Alternative 3 (Appendix 8G, Table Cl-64).

19 Similarly, estimates of chloride concentrations generated using EC-chloride relationships and DSM2
20 EC output (see Section 8.3.1.3) were also used to evaluate the 250 mg/L Bay-Delta WQCP objective
21 for chloride at Contra Costa Pumping Plant #1 where daily average objectives apply. For Alternative
22 3, the modeled frequency of objective exceedance would decrease slightly from 5% of modeled days
23 under the No Action Alternative to 4% of modeled days under Alternative 3 (Appendix 8G, Table Cl-
24 63).

25 Similar to Existing Conditions, a comparative assessment of modeling approaches was utilized to
26 evaluate the 250 mg/L Bay-Delta WQCP objectives in terms of both frequency of exceedance and use
27 of assimilative capacity on a monthly average basis. When utilizing the mass balance approach to
28 model monthly average chloride concentrations for the 16-year period, a small increase in
29 exceedance frequency would be predicted relative to the No Action Alternative at the Contra Costa
30 Canal at Pumping Plant #1 (i.e., from 14% for the No Action Alternative to 20%), San Joaquin River
31 at Antioch (i.e., from 73% to 74%), and Sacramento River at Mallard Island (i.e., from 86% to 87%)
32 (Appendix 8G, Table Cl-21). Additionally, the available assimilative capacity would be reduced at the
33 Contra Costa Canal at Pumping Plant #1 in September through November (i.e., ranging from 29% to
34 100% [i.e., elimination]) and at the Antioch location in April (i.e., up to 46%) (Appendix 8G, Table Cl-
35 23), reflecting substantial degradation during these months when average concentrations would be
36 near, or exceed, the objective.

37 In comparison, when utilizing the chloride-EC relationship to model monthly average chloride
38 concentrations for the 16-year period, trends in frequency of exceedance and use of assimilative
39 capacity would be similar to that discussed when utilizing the mass balance modeling approach
40 (Appendix 8G, Table Cl-22 and Table Cl-24). However, as with Alternative 1A the modeling approach
41 utilizing the chloride-EC relationships predicted changes of lesser magnitude, where predictions of
42 change utilizing the mass balance approach were generally of greater magnitude, and thus more
43 conservative. As discussed in Section 8.3.1.3, in cases of such disagreement, the approach that
44 yielded the more conservative predictions was used as the basis for determining adverse impacts.

1 Based on the additional predicted annual and seasonal exceedances of one or both Bay Delta WQCP
2 objectives for chloride, and the magnitude of associated long-term average water quality
3 degradation at interior and western Delta locations, the potential exists for substantial adverse
4 effects on the municipal and industrial beneficial uses through reduced opportunity for diversion of
5 water with acceptable chloride levels.

6 *303(d) Listed Water Bodies—Relative to No Action Alternative*

7 With respect to the 303(d) listing for chloride, Alternative 3 would generally result in similar
8 changes to those discussed for the comparison to Existing Conditions. Monthly average chloride
9 concentrations at Tom Paine Slough would not be further degraded on a long-term basis (Appendix
10 8G, Figure Cl-2). Monthly average chloride concentrations at source water channel locations for the
11 Suisun Marsh (Appendix 8G, Figures Cl-1, Cl-3 and Cl-4) would increase substantially in some
12 months during October through May compared to the No Action Alternative conditions. Therefore,
13 additional, measureable long-term degradation would occur in Suisun Marsh that potentially would
14 adversely affect the necessary actions to reduce chloride loading for any TMDL that is developed.

15 ***SWP/CVP Export Service Areas***

16 Under Alternative 3, long-term average chloride concentrations based on the mass balance analysis
17 of modeling results for the 16-year period modeled at the Banks and Jones pumping plants would
18 decrease by as much as 30% relative to Existing Conditions and 21% compared to No Action
19 Alternative (Appendix 8G, *Chloride*, Table Cl-19). The modeled frequency of exceedances of
20 applicable water quality objectives/criteria would decrease relative to Existing Conditions and No
21 Action Alternative, for both the 16-year period and the drought period modeled (Appendix 8G,
22 *Chloride*, Table Cl-21). Consequently, water exported into the SWP/CVP service area would
23 generally be of similar or better quality with regards to chloride relative to Existing Conditions and
24 the No Action Alternative conditions.

25 Results of the modeling approach which used relationships between EC and chloride (see Section
26 8.3.1.3) were consistent with the discussion above, and assessment of chloride using these data
27 results in the same conclusions as are presented above for the mass-balance approach (Appendix
28 8G, Table Cl-20 and Table Cl-22).

29 Commensurate with the reduced chloride concentrations in water exported to the service area,
30 reduced chloride loading in the lower San Joaquin River would be anticipated which would likely
31 alleviate or lessen any expected increase in chloride at Vernalis related to decreased annual average
32 San Joaquin River flows (see discussion of Upstream of the Delta).

33 Maintenance of SWP and CVP facilities would not be expected to create new sources of chloride or
34 contribute towards a substantial change in existing sources of chloride in the affected environment.
35 Maintenance activities would not be expected to cause any substantial change in chloride such that
36 any long-term water quality degradation would occur, thus, beneficial uses would not be adversely
37 affected anywhere in the affected environment.

38 ***NEPA Effects:*** In summary, relative to the No Action Alternative conditions, Alternative 3 would
39 result in increased water quality degradation and frequency of exceedance of the 150 mg/L
40 objective at Contra Costa Pumping Plant #1 and Antioch, the 250 mg/L municipal and industrial
41 objective at interior and western Delta locations on a monthly average chloride basis, and
42 measureable water quality degradation relative to the 303(d) impairment in Suisun Marsh. The

1 predicted chloride increases constitute an adverse effect on water quality (see Mitigation Measure
2 WQ-7 below; implementation of this measure along with a separate, non-environmental
3 commitment relating to the potential increased chloride treatment costs would reduce these
4 effects). Additionally, the predicted changes relative to the No Action Alternative conditions indicate
5 that in addition to the effects of climate change/sea level rise, implementation of CM1 and CM4
6 under Alternative 3 would contribute substantially to the adverse water quality effects.

7 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
8 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
9 purpose of making the CEQA impact determination for this constituent. For additional details on the
10 effects assessment findings that support this CEQA impact determination, see the effects assessment
11 discussion that immediately precedes this conclusion.

12 Chloride is not a constituent of concern in the Sacramento River watershed upstream of the Delta,
13 thus river flow rate and reservoir storage reductions that would occur under the Alternative 3,
14 relative to Existing Conditions, would not be expected to result in a substantial adverse change in
15 chloride levels. Additionally, relative to Existing Conditions, the Alternative 3 would not result in
16 reductions in river flow rates (i.e., less dilution) or increased chloride loading such that there would
17 be any substantial increase in chloride concentrations upstream of the Delta in the San Joaquin River
18 watershed.

19 Relative to Existing Conditions, the Alternative 3 would result in substantially increased chloride
20 concentrations in the Delta such that frequency of exceeding the 150 mg/L Bay-Delta WQCP
21 objective would approximately double. Moreover, the frequency of exceedance of the 250 mg/L Bay-
22 Delta WQCP objective would increase at the San Joaquin River at Antioch (by 8%) and at Mallard
23 Slough (by 2%), and long-term degradation may occur at Antioch, Mallard Slough, and Contra Costa
24 Canal at Pumping Plant #1, that may result in adverse effects on the municipal and industrial water
25 supply beneficial use (see Mitigation Measure WQ-7 below; implementation of this measure along
26 with a separate, non-environmental commitment relating to the potential increased chloride
27 treatment costs would reduce these effects). Relative to the Existing Conditions, the modeled
28 increased chloride concentrations and degradation in the western Delta could further contribute, at
29 measurable levels (i.e., over a tripling of concentration), to the existing 303(d) listed impairment
30 due to chloride in Suisun Marsh for the protection of fish and wildlife.

31 Chloride concentrations would be reduced in water exported from the Delta to the CVP/SWP Export
32 Service Areas, thus reflecting a potential improvement to chloride loading in the lower San Joaquin
33 River.

34 Chloride is not a bioaccumulative constituent, thus any increased concentrations under Alternative
35 3 would not result in substantial chloride bioaccumulation impacts on aquatic life or humans.
36 Alternative 3 maintenance would not result in any substantial changes in chloride concentration
37 upstream of the Delta or in the SWP/CVP Export Service Areas. However, based on these findings,
38 this impact is determined to be significant due to increased chloride concentrations and degradation
39 at western Delta locations and its effects on municipal and industrial water supply, and fish and
40 wildlife beneficial uses.

41 While mitigation measures to reduce these water quality effects in affected water bodies to less than
42 significant levels are not available, implementation of Mitigation Measure WQ-7 is recommended to
43 attempt to reduce the effect that increased chloride concentrations may have on Delta beneficial
44 uses. However, because the effectiveness of this mitigation measure to result in feasible measures

1 for reducing water quality effects is uncertain, this impact is considered to remain significant and
 2 unavoidable. Please see Mitigation Measure WQ-7 under Impact WQ-7 in the discussion of
 3 Alternative 1A.

4 In addition to and to supplement Mitigation Measure WQ-7, the BDCP proponents have incorporated
 5 into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*, a separate, non-
 6 environmental commitment to address the potential increased water treatment costs that could
 7 result from chloride concentration effects on municipal, industrial and agricultural water purveyor
 8 operations. Potential options for making use of this financial commitment include funding or
 9 providing other assistance towards acquiring alternative water supplies or towards modifying
 10 existing operations when chloride concentrations at a particular location reduce opportunities to
 11 operate existing water supply diversion facilities. Please refer to Appendix 3B, *Environmental*
 12 *Commitments*, for the full list of potential actions that could be taken pursuant to this commitment in
 13 order to reduce the water quality treatment costs associated with water quality effects relating to
 14 chloride, electrical conductivity, and bromide.

15 **Impact WQ-8: Effects on Chloride Concentrations Resulting from Implementation of CM2-
 16 CM22**

17 **NEPA Effects:** Under Alternative 3, the types and geographic extent of effects on chloride
 18 concentrations in the Delta as a result of implementation of the other conservation measures (i.e.,
 19 CM2–CM22) would be similar to, and undistinguishable from, those effects previously described for
 20 Alternative 1A. The conservation measures would present no new direct sources of chloride to the
 21 affected environment. Moreover, some habitat restoration conservation measures (CM4–CM10)
 22 would occur on lands within the Delta currently used for irrigated agriculture, thus replacing
 23 agricultural land uses with restored tidal wetlands, floodplain, and related channel margin and off-
 24 channel habitats. The potential reduction in irrigated lands within the Delta may result in reduced
 25 discharges of agricultural field drainage with elevated chloride concentrations, which would be
 26 considered an improvement compared to No Action Alternative conditions.

27 In summary, based on the discussion above, the effects on chloride from implementing CM2-CM22
 28 are considered to be not adverse.

29 **CEQA Conclusion:** Implementation of the CM2–CM22 for Alternative 3 would not present new or
 30 substantially changed sources of chloride to the affected environment upstream of the Delta, within
 31 Delta, or in the SWP/CVP service area. Replacement of irrigated agricultural land uses in the Delta
 32 with habitat restoration conservation measures may result in some reduction in discharge of
 33 agricultural field drainage with elevated chloride concentrations, thus resulting in improved water
 34 quality conditions. Based on these findings, this impact is considered to be less than significant. No
 35 mitigation is required.

36 **Impact WQ-9: Effects on Dissolved Oxygen Resulting from Facilities Operations and
 37 Maintenance (CM1)**

38 **NEPA Effects:** Effects of CM1 on DO under Alternative 3 are the same as those discussed for
 39 Alternative 1A and are considered to not be adverse.

40 **CEQA Conclusion:** Effects of CM1 on DO under Alternative 3 would be similar to those discussed for
 41 Alternative 1A, and are summarized here, then compared to the CEQA thresholds of significance
 42 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this

1 constituent. For additional details on the effects assessment findings that support this CEQA impact
2 determination, see the effects assessment discussion under Alternative 1A.

3 River flow rate and reservoir storage reductions that would occur under Alternative 3, relative to
4 Existing Conditions, would not be expected to result in a substantial adverse change in DO levels in
5 the reservoirs and rivers upstream of the Delta, given that mean monthly flows would remain within
6 the ranges historically seen under Existing Conditions and the affected river are large and turbulent.
7 Any reduced DO saturation level that may be caused by increased water temperature would not be
8 expected to cause DO levels to be outside of the range seen historically. Finally, amounts of oxygen
9 demanding substances and salinity would not be expected to change sufficiently to affect DO levels.

10 It is expected there would be no substantial change in Delta DO levels in response to a shift in the
11 Delta source water percentages under this alternative or substantial degradation of these water
12 bodies, with regard to DO. DO levels would be affected by nutrient loading, which the state has
13 begun to aggressively regulate the discharges of, and this loading would not be expected to lower DO
14 levels relative to Existing Conditions based on historical DO levels. Further, the anticipated changes
15 in salinity would have relatively minor effects on DO levels, and tidal exchange, which contribute to
16 the reaeration of Delta waters would not be expected to change substantially.

17 There is not expected to be substantial, if even measurable, changes in DO levels in the SWP/CVP
18 Export Service Areas waters under Alternative 3, relative to Existing Conditions, because the
19 biochemical oxygen demand of the exported water would not be expected to substantially differ
20 from that under Existing Conditions (due to ever increasing water quality regulations), canal
21 turbulence and exposure of the water to the atmosphere and the algal communities that exist within
22 the canals would establish an equilibrium for DO levels within the canals. The same would occur in
23 downstream reservoirs.

24 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
25 objectives by frequency, magnitude, and geographic extent that would result in significant impacts
26 on any beneficial uses within affected water bodies. Because no substantial changes in DO levels are
27 expected, long-term water quality degradation would not be expected to occur, and, thus, beneficial
28 uses would not be adversely affected. Various Delta waterways are 303(d)-listed for low DO, but
29 because no substantial decreases in DO levels would be expected, greater degradation and DO-
30 related impairment of these areas would not be expected. This impact would be less than significant.
31 No mitigation is required.

32 **Impact WQ-10: Effects on Dissolved Oxygen Resulting from Implementation of CM2–CM22**

33 **NEPA Effects:** Effects of CM2–CM22 on DO under Alternative 3 are the same as those discussed for
34 Alternative 1A and are considered to not be adverse.

35 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 3 would be similar to
36 those proposed under Alternative 1A. As such, effects on DO resulting from the implementation of
37 CM2–CM22 would be similar to that previously discussed for Alternative 1A. This impact is
38 considered to be less than significant. No mitigation is required.

1 **Impact WQ-11: Effects on Electrical Conductivity Concentrations Resulting from Facilities**
 2 **Operations and Maintenance (CM1)**

3 ***Upstream of the Delta***

4 For the same reasons stated for the No Action Alternative, EC levels (highs, lows, typical conditions)
 5 in the Sacramento River and its tributaries, the eastside tributaries, their associated reservoirs, and
 6 the San Joaquin River upstream of the Delta under Alternative 3 are not expected to be outside the
 7 ranges occurring under Existing Conditions or would occur under the No Action Alternative. Any
 8 minor changes in EC levels that could occur under Alternative 3 in water bodies upstream of the
 9 Delta would not be of sufficient magnitude, frequency and geographic extent that would cause
 10 adverse effects on beneficial uses or substantially degrade water quality with regard to EC.

11 ***Delta***

12 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 13 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 14 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 15 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 16 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
 17 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

18 Relative to Existing Conditions, Alternative 3 would result in a fewer number of days when Bay-
 19 Delta WQCP compliance locations in the western, interior, and southern Delta would exceed EC
 20 objectives or be out of compliance with the EC objectives, with the exception of the Sacramento
 21 River at Emmaton in the western Delta and San Joaquin River at San Andreas Landing in the interior
 22 Delta (Appendix 8H, Table EC-3). The percent of days the Emmaton EC objective would be exceeded
 23 for the entire period modeled (1976–1991) would increase from 6% under Existing Conditions to
 24 27% under Alternative 3, and the days out of compliance with the EC objective would increase from
 25 11% under Existing Conditions to 39% under Alternative 3. The percent of days the San Andreas
 26 Landing EC objective would be exceeded would increase from 1% under Existing Conditions to 2%
 27 under Alternative 3. Further, the percent of days out of compliance with the EC objective would
 28 increase from 1% under Existing Conditions to 4% under Alternative 3. Average EC levels at the
 29 western and southern Delta compliance locations, except at Emmaton in the western Delta, would
 30 decrease from 1–28% for the entire period modeled and 2–30% during the drought period modeled
 31 (1987–1991) (Appendix 8H, Table EC-14). At Emmaton, average EC would increase by 14% for the
 32 entire period modeled and 12% for the drought period modeled. At the two interior Delta locations,
 33 there would be increases in average EC: the S. Fork Mokelumne River at Terminous average EC
 34 would increase 4% for the entire period modeled and 3% during the drought period modeled; and
 35 San Joaquin River at San Andreas Landing average EC would increase 12% for the entire period
 36 modeled and 13% during the drought period modeled. On average, EC would increase at Emmaton
 37 during December and March through September. Average EC would increase at San Andreas
 38 Landing during all months except November. Average EC in the S. Fork Mokelumne River at
 39 Terminous would increase during all months (Appendix 8H, Table EC-14). Of the Clean Water Act
 40 section 303(d) listed sections of the Delta—western, northwestern, and southern—the western
 41 portion of the Delta at Emmaton would have an increased frequency of exceedance of EC objectives
 42 (Appendix 8H, Table EC-1) and increased average EC. Thus, Alternative 3 could contribute to
 43 additional impairment and adversely affect beneficial uses for section 303(d) listed Delta
 44 waterways, relative to Existing Conditions. These EC changes are similar to that described for

1 Alternative 1A. The comparison to Existing Conditions reflects changes in EC due to both Alternative
2 3 operations (including north Delta intake capacity of 6,000 cfs and numerous other operational
3 components of Scenario A) and climate change/sea level rise.

4 Relative to the No Action Alternative, the percent of days exceeding EC objectives and percent of
5 days out of compliance would increase at: Sacramento River at Emmaton, San Joaquin River at
6 Jersey Point, San Andreas Landing, and Prisoners Point; and Old River near Middle River; and Old
7 River at Tracy Bridge (Appendix 8H, Table EC-3). The increase in percent of days exceeding the EC
8 objective would be 1% or less and the increase in percent of days out of compliance would be 3% or
9 less, with the exception of Emmaton, which would have a 15% increase in days exceeding the EC
10 objective and a 17% increase in days out of compliance. Average EC would increase at some
11 compliance locations for the entire period modeled: Sacramento River at Emmaton (13%), San
12 Joaquin River at Jersey Point (2%), S. Fork Mokelumne River at Terminous (4%), San Joaquin River
13 at San Andreas Landing (18%), and San Joaquin River at Prisoners Point (9%) (Appendix 8H, Table
14 EC-14). For the drought period modeled, the locations with an average EC increase, relative to the
15 No Action Alternative, would be: Sacramento River at Emmaton (1%), S. Fork Mokelumne River at
16 Terminous (4%), San Joaquin River at San Andreas Landing (13%), San Joaquin River at Brandt
17 Bridge (1%), Old River at Tracy Bridge (1%), and San Joaquin River at Prisoners Point (5%)
18 (Appendix 8H, Table EC-14). Given that the western and southern Delta are Clean Water Act section
19 303(d) listed as impaired due to elevated EC, the increase in the incidence of exceedance of EC
20 objectives and increases in long-term and drought period average EC at the western and southern
21 Delta locations under Alternative 3, relative to the No Action Alternative, has the potential to
22 contribute to additional impairment and potentially adversely affect beneficial uses. These EC
23 changes are similar to that described for Alternative 1A. The comparison to the No Action
24 Alternative reflects changes in EC due only to Alternative 3 operations (including north Delta intake
25 capacity of 6,000 cfs and numerous other operational components of Scenario A).

26 For Suisun Marsh, October–May is the period when Bay-Delta WQCP EC objectives for protection of
27 fish and wildlife apply. Long-term average EC would increase under Alternative 3, relative to
28 Existing Conditions, during the months of March through May by 0.3–0.9 mS/cm in the Sacramento
29 River at Collinsville (Appendix 8H, Table EC-21). Long-term average EC would decrease relative to
30 Existing Conditions in Montezuma Slough at National Steel during October–May (Appendix 8H,
31 Table EC-22). The most substantial increase would occur near Beldon Landing, with long-term
32 average EC levels increasing by 1.8–6.1 mS/cm, depending on the month, which would be a doubling
33 or tripling of long-term average EC relative to Existing Conditions (Appendix 8H, Table EC-23).
34 Sunrise Duck Club and Volanti Slough also would have long-term average EC increases during all
35 months of 1.7–4.0 mS/cm (Appendix 8H, Tables EC-24 and EC-25). The degree to which the long-
36 term average EC increases would cause exceedance of Bay-Delta WQCP objectives is unknown,
37 because objectives are expressed as a monthly average of daily high tide EC, which does not have to
38 be met if it can be demonstrated “equivalent or better protection will be provided at the location”
39 (State Water Resources Control Board 2006:14). The described long-term average EC increase may,
40 or may not, contribute to adverse effects on beneficial uses, depending on how and when wetlands
41 are flooded, soil leaching cycles, and how agricultural use of water is managed, and future actions
42 taken with respect to the marsh. However, the EC increases at certain locations would be substantial
43 and it is uncertain the degree to which current management plans for the Suisun Marsh would be
44 able to address these substantially higher EC levels and protect beneficial uses. Thus, these
45 increased EC levels in Suisun Marsh are considered to have a potentially adverse effect on marsh
46 beneficial uses. Long-term average EC increases in Suisun Marsh under Alternative 3 relative to the

1 No Action Alternative would be similar to the increases relative to Existing Conditions. Suisun Marsh
2 is section 303(d) listed as impaired due to elevated EC, and the potential increases in long-term
3 average EC concentrations could contribute to additional impairment, because the increases would
4 be double or triple that relative to Existing Conditions and the No Action Alternative. These EC
5 changes are similar to that described for Alternative 1A.

6 ***SWP/CVP Export Service Areas***

7 At the Banks and Jones pumping plants, Alternative 3 would result in no exceedances of the Bay-
8 Delta WQCP's 1,000 $\mu\text{mhos/cm}$ EC objective for the entire period modeled (Appendix 8H, Table EC-
9 10). Thus, there would be no adverse effect on the beneficial uses in the SWP/CVP Export Service
10 Areas using water pumped at this location under Alternative 3.

11 At the Banks pumping plant, relative to Existing Conditions, average EC levels under Alternative 3
12 would decrease 18% for the entire period modeled and 18% during the drought period modeled.
13 Relative to the No Action Alternative, average EC levels would decrease by 12% for the entire period
14 modeled and drought period modeled. (Appendix 8H, Table EC-14)

15 At the Jones pumping plant, relative to Existing Conditions, average EC levels under Alternative 3
16 would decrease 17% for the entire period modeled and 20% during the drought period modeled.
17 Relative to the No Action Alternative, average EC levels would decrease by 13% for the entire period
18 modeled and 16% during the drought period modeled. (Appendix 8H, Table EC-14)

19 Based on the decreases in long-term average EC levels that would occur at the Banks and Jones
20 pumping plants, Alternative 3 would not cause degradation of water quality with respect to EC in
21 the SWP/CVP Export Service Areas; rather, Alternative 3 would improve long-term average EC
22 conditions in the SWP/CVP Export Service Areas.

23 Commensurate with the EC decrease in exported waters, an improvement in lower San Joaquin
24 River average EC levels would be expected since EC in the lower San Joaquin River is, in part, related
25 to irrigation water deliveries from the Delta. While the magnitude of this expected lower San
26 Joaquin River improvement in EC is difficult to predict, the relative decrease in overall loading of EC-
27 elevating constituents to the Export Service Areas would likely alleviate or lessen any expected
28 increase in EC at Vernalis related to decreased annual average San Joaquin River flows (see EC
29 impact discussion under the No Action Alternative).

30 The export area of the Delta is listed on the state's CWA Section 303(d) list as impaired due to
31 elevated EC. Alternative 3 would result in lower average EC levels relative to Existing Conditions and
32 the No Action Alternative and, thus, would not contribute to additional beneficial use impairment
33 related to elevated EC in the SWP/CVP Export Service Areas waters.

34 ***NEPA Effects:*** In summary, the increased frequency of exceedance of EC objectives and increased
35 long-term and drought period average EC levels that would occur at western and southern Delta
36 compliance locations under Alternative 3, relative to the No Action Alternative, would contribute to
37 adverse effects on the agricultural beneficial uses. Given that the western and southern Delta are
38 Clean Water Act section 303(d) listed as impaired due to elevated EC, the increase in the incidence
39 of exceedance of EC objectives and increases in long-term and drought period average EC in the
40 southern Delta under Alternative 3 has the potential to contribute to additional beneficial use
41 impairment. The increases in long-term average EC levels that would occur in Suisun Marsh would
42 further degrade existing EC levels and could contribute additionally to adverse effects on the fish
43 and wildlife beneficial uses. Suisun Marsh is section 303(d) listed as impaired due to elevated EC,

1 and the potential increases in long-term average EC levels could contribute to additional beneficial
2 use impairment. These increases in EC constitute an adverse effect on water quality. Mitigation
3 Measure WQ-11 would be available to reduce these effects (implementation of this measure along
4 with a separate, non-environmental commitment as set forth in EIR/EIS Appendix 3B,
5 *Environmental Commitments*, relating to the potential EC-related changes would reduce these
6 effects).

7 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
8 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
9 purpose of making the CEQA impact determination for this constituent. For additional details on the
10 effects assessment findings that support this CEQA impact determination, see the effects assessment
11 discussion that immediately precedes this conclusion.

12 River flow rate and reservoir storage reductions that would occur under Alternative 3, relative to
13 Existing Conditions, would not be expected to result in a substantial adverse change in EC levels in
14 the reservoirs and rivers upstream of the Delta, given that: changes in the quality of watershed
15 runoff and reservoir inflows would not be expected to occur in the future; the state's aggressive
16 regulation of point-source discharge effects on Delta salinity-elevating parameters and the expected
17 further regulation as salt management plans are developed; the salt-related TMDLs adopted and
18 being developed for the San Joaquin River; and the expected improvement in lower San Joaquin
19 River average EC levels commensurate with the lower EC of the irrigation water deliveries from the
20 Delta.

21 Relative to Existing Conditions, Alternative 3 would not result in any substantial increases in long-
22 term average EC levels in the SWP/CVP Export Service Areas. There would be no exceedance of the
23 EC objective at the Jones and Banks pumping plants. Average EC levels for the entire period modeled
24 would decrease at both plants and, thus, this alternative would not contribute to additional
25 beneficial use impairment related to elevated EC in the SWP/CVP Export Service Areas waters.
26 Rather, this alternative would improve long-term EC levels in the SWP/CVP Export Service Areas,
27 relative to Existing Conditions.

28 In the Plan Area, Alternative 3 would result in an increase in the frequency with which Bay-Delta
29 WQCP EC objectives for agricultural beneficial use protection are exceeded in the Sacramento River
30 at Emmaton (21%; western Delta) and San Joaquin River at San Andreas Landing (1%; interior
31 Delta) for the entire period modeled (1976–1991). Further, average EC levels at Emmaton would
32 increase by 14% for the entire period modeled and 12% during the drought period modeled.
33 Average EC levels at San Andreas Landing would increase by 12% for the entire period modeled and
34 13% during the drought period modeled. Because EC is not bioaccumulative, the increases in long-
35 term average EC levels would not directly cause bioaccumulative problems in aquatic life or
36 humans. The interior Delta is not Clean Water Act section 303(d) listed for elevated EC; however,
37 the western Delta is. The increases in long-term and drought period average EC levels and increased
38 frequency of exceedance of EC objectives that would occur in the Sacramento River at Emmaton and
39 San Joaquin River at San Andreas Landing would potentially contribute to adverse effects on the
40 agricultural beneficial uses in the interior Delta. This impact is considered to be significant.

41 Further, relative to Existing Conditions, Alternative 3 would result in substantial increases in long-
42 term average EC during the months of October through May in Suisun Marsh, such that EC levels
43 would be double or triple that occurring under Existing Conditions. The increases in long-term
44 average EC levels that would occur in Suisun Marsh could further degrade existing EC levels and

1 thus contribute additionally to adverse effects on the fish and wildlife beneficial uses. Because EC is
 2 not bioaccumulative, the increases in long-term average EC levels would not directly cause
 3 bioaccumulative problems in wildlife. Suisun Marsh is Clean Water Act section 303(d) listed for
 4 elevated EC and the increases in long-term average EC that would occur in the marsh could make
 5 beneficial use impairment measurably worse. This impact is considered to be significant.

6 Implementation of Mitigation Measure WQ-11 along with a separate, non-environmental
 7 commitment relating to the potential increased costs associated with EC-related changes would
 8 reduce these effects. While mitigation measures to reduce these water quality effects in affected
 9 water bodies to less than significant levels are not available, implementation of Mitigation Measure
 10 WQ-11 is recommended to attempt to reduce the effect that increased EC concentrations may have
 11 on Delta beneficial uses. However, because the effectiveness of this mitigation measure to result in
 12 feasible measures for reducing water quality effects is uncertain, this impact is considered to remain
 13 significant and unavoidable. Please see Mitigation Measure WQ-11 under Impact WQ-11 in the
 14 discussion of Alternative 1A.

15 In addition to and to supplement Mitigation Measure WQ-11, the BDCP proponents have
 16 incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*, a
 17 separate, non-environmental commitment to address the potential increased water treatment costs
 18 that could result from EC concentration effects on municipal, industrial and agricultural water
 19 purveyor operations. Potential options for making use of this financial commitment include funding
 20 or providing other assistance towards acquiring alternative water supplies or towards modifying
 21 existing operations when EC concentrations at a particular location reduce opportunities to operate
 22 existing water supply diversion facilities. Please refer to Appendix 3B, *Environmental Commitments*,
 23 for the full list of potential actions that could be taken pursuant to this commitment in order to
 24 reduce the water quality treatment costs associated with water quality effects relating to chloride,
 25 electrical conductivity, and bromide.

26 **Mitigation Measure WQ-11: Avoid, Minimize, or Offset, as Feasible, Reduced Water**
 27 **Quality Conditions**

28 Please see Mitigation Measure WQ-11 under Impact WQ-11 in the discussion of Alternative 1A.

29 **Impact WQ-12: Effects on Electrical Conductivity Resulting from Implementation of CM2–**
 30 **CM22**

31 **NEPA Effects:** Effects of CM2–CM22 on EC under Alternative 3 are the same as those discussed for
 32 Alternative 1A and are considered not to be adverse.

33 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 3 would be similar to
 34 those proposed under Alternative 1A. As such, effects on EC resulting from the implementation of
 35 CM2–CM22 would be similar to that previously discussed for Alternative 1A. This impact is
 36 considered to be less than significant. No mitigation is required.

1 **Impact WQ-13: Effects on Mercury Concentrations Resulting from Facilities Operations and**
2 **Maintenance (CM1)**

3 ***Upstream of the Delta***

4 Under Alternative 3, the magnitude and timing of reservoir releases and river flows upstream of the
5 Delta in the Sacramento River watershed and east-side tributaries would be altered, relative to
6 Existing Conditions and the No Action Alternative.

7 The Sacramento River at Freeport and San Joaquin River at Vernalis (as summarized for water
8 quality average concentrations in Tables 8-48 and 8-49) were examined for flow/concentration
9 relationships for mercury and methylmercury. No significant, predictive regression relationships
10 were discovered for mercury or methylmercury, except for total mercury with flow at Freeport
11 (monthly or annual)(Figures 8I-10 through 8I-13, Appendix 8I). Such a positive relationship
12 between total mercury and flow is to be expected based on the association of mercury with
13 suspended sediment and the mobilization of sediments during storm flows. However, the changes in
14 flow in the Sacramento River under Alternative 3 relative to Existing Conditions and the No Action
15 Alternative are not of the magnitude of storm flows, in which substantial sediment-associated
16 mercury is mobilized. Therefore mercury loading should not be substantially different due to
17 changes in flow. In addition, even though it may be flow-affected, total mercury concentrations
18 remain well below criteria at upstream locations. Any negligible changes in mercury concentrations
19 that may occur in the water bodies of the affected environment located upstream of the Delta would
20 not be of frequency, magnitude, and geographic extent that would adversely affect any beneficial
21 uses or substantially degrade the quality of these water bodies as related to mercury. Both
22 waterborne methylmercury concentrations and largemouth bass fillet mercury concentrations are
23 expected to remain above guidance levels at upstream of Delta locations, but will not change
24 substantially relative to Existing Conditions or the No Action Alternative due to changes in flows
25 under Alternative 3.

26 The upstream of Delta areas in the north will benefit from the implementation of the Cache Creek,
27 Sulfur Creek, Harley Gulch, and Clear Lake Mercury TMDLs and the American River methylmercury
28 TMDL. These projects will target specific sources of mercury and methylation upstream of the Delta
29 and could result in net improvement to Delta mercury loading in the future. The implementation of
30 these projects could help to ensure that upstream of Delta environments will not be substantially
31 degraded for water quality with respect to mercury or methylmercury.

32 ***Delta***

33 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
34 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
35 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
36 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
37 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
38 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

39 The water quality impacts of waterborne concentrations of mercury and methylmercury and fish
40 tissue mercury concentrations were evaluated for 9 Delta locations. The analysis of percentage
41 change in assimilative capacity of waterborne total mercury of Alternative 3 relative to the 25 ng/L
42 ecological risk benchmark as compared to Existing Conditions showed the greatest decrease to be
43 0.7% for Franks Tract, Old River at Rock Slough, and Contra Costa Pumping Plant, and 0.8% for the

1 Mokelumne River (South Fork) at Staten Island and Franks Tract relative to the No Action
2 Alternative (Figures 8-53 and 8-54). These changes are not expected to result in adverse effects to
3 beneficial uses. Similarly, changes in methylmercury concentration are expected to be very small.
4 The greatest annual average methylmercury concentration for drought conditions was 0.167 ng/L
5 for the San Joaquin River at Buckley Cove which was slightly higher than Existing Conditions (0.161
6 ng/L), and the same as the No Action Alternative (Appendix 8I, Table I-6) (Appendix 8I, Figure I-3).
7 All modeled input concentrations exceeded the methylmercury TMDL guidance objective of 0.06
8 ng/L, therefore percentage change in assimilative capacity was not evaluated for methylmercury.

9 Fish tissue showed small increases in exceedance quotients based on long-term annual average
10 concentrations for mercury at the Delta locations. There was a 6% increase at the Mokelumne River
11 (South Fork) at Staten Island, the San Joaquin River at Buckley Cove, Franks Tract, and Old River at
12 Rock Slough relative to Existing Conditions, and a 8% increase at the Mokelumne River (South Fork)
13 at Staten Island relative to the No Action Alternative (Figure 8-55, Appendix 8I, Table I-10b). All
14 water export locations except Contra Costa Pumping Plant #1 showed improved bass tissue mercury
15 estimates (Figure 8-55, Appendix 8I, Table I-10a,b).

16 ***SWP/CVP Export Service Areas***

17 The analysis of mercury and methylmercury in the SWP/CVP Export Service Areas was based on
18 concentrations estimated at the Banks and Jones pumping plants. Both waterborne total and
19 methylmercury concentrations for Alternative 3 are projected to be lower than Existing Conditions,
20 and the No Action Alternative at the Jones and Banks pumping plants (Appendix 8I, Figures 8I-2 and
21 8I-3). Therefore, mercury shows an increased assimilative capacity at these locations (Figures 8-53
22 and 8-54). Bass tissue mercury concentrations are also improved under Alternative 3, relative to
23 Existing Conditions and the No Action Alternative (Figure 8-55; Appendix 8I, Table I-10a,b).

24 ***NEPA Effects:*** In summary, based on the above discussion, the effects of mercury and
25 methylmercury in comparison of Alternative 3 to the No Action Alternative (as waterborne and
26 bioaccumulated forms) are not considered to be adverse.

27 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
28 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
29 purpose of making the CEQA impact determination for this constituent. For additional details on the
30 effects assessment findings that support this CEQA impact determination, see the effects assessment
31 discussion that immediately precedes this conclusion.

32 Under Alternative 3, greater water demands and climate change would alter the magnitude and
33 timing of reservoir releases and river flows upstream of the Delta in the Sacramento River
34 watershed and east-side tributaries, relative to Existing Conditions. Concentrations of mercury and
35 methylmercury upstream of the Delta will not be substantially different relative to Existing
36 Conditions due to the lack of important relationships between mercury/methylmercury
37 concentrations and flow for the major rivers.

38 Methylmercury concentrations exceed criteria at all locations in the Delta and no assimilative
39 capacity exists. However, monthly average waterborne concentrations of total and methylmercury,
40 over the period of record, are very similar to Existing Conditions. Similarly, estimates of fish tissue
41 mercury concentrations show almost no differences would occur among sites for Alternative 3 as
42 compared to Existing Conditions for Delta sites.

1 Assessment of effects of mercury in the SWP and CVP Export Service Areas were based on effects on
 2 mercury concentrations and fish tissue mercury concentrations at the Banks and Jones pumping
 3 plants. The Banks and Jones pumping plants are expected to show increased assimilative capacity
 4 for waterborne mercury and decreased fish tissue concentrations of mercury for Alternative 3 as
 5 compared to Existing Conditions.

6 As such, this alternative is not expected to cause additional exceedance of applicable water quality
 7 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
 8 on any beneficial uses of waters in the affected environment. Because mercury concentrations are
 9 not expected to increase substantially, no long-term water quality degradation is expected to occur
 10 and, thus, no adverse effects to beneficial uses would occur. Because any increases in mercury or
 11 methylmercury concentrations are not likely to be measurable, changes in mercury concentrations
 12 or fish tissue mercury concentrations would not make any existing mercury-related impairment
 13 measurably worse. In comparison to Existing Conditions, Alternative 3 would not increase levels of
 14 mercury by frequency, magnitude, and geographic extent such that the affected environment would
 15 be expected to have measurably higher body burdens of mercury in aquatic organisms, thereby
 16 substantially increasing the health risks to wildlife (including fish) or humans consuming those
 17 organisms. This impact is considered to be less than significant. No mitigation is required.

18 **Impact WQ-14: Effects on Mercury Concentrations Resulting from Implementation of CM2-22**

19 **NEPA Effects:** Some habitat restoration activities under Alternative 3 would occur on lands in the
 20 Delta formerly used for irrigated agriculture. Tidal and other restoration proposed under
 21 Alternative 3 have the potential to increase water residence times and increase accumulation of
 22 organic sediments that are known to enhance methylmercury bioaccumulation in biota in the
 23 restored habitat. Therefore, increases in mercury methylation in the habitat restoration areas is
 24 possible but uncertain depending on the specific restoration design implemented at a particular
 25 Delta location. Models to estimate the potential for methylmercury formation in restored areas are
 26 not currently available. However, DSM2 modeling for Alternative 3 operations does incorporate
 27 assumptions for certain habitat restoration activities proposed under CM2 and CM4 (see Section
 28 8.3.1.3) that result in changes to Delta hydrodynamics compared to the No Action Alternative. These
 29 modeled restoration assumptions provide some insight into potential hydrodynamic changes that
 30 could be expected related to implementing CM2 and CM4 and are considered in the evaluation of the
 31 potential for increased mercury and methylmercury concentrations under Alternative 3.

32 BDCP Conservation Measure 12 (CM12) addresses the potential for methylmercury bioaccumulation
 33 associated with restoration activities and acknowledges the uncertainties associated with mitigating
 34 or minimizing this potential effect. CM12 proposes project-specific mercury management plans for
 35 restoration actions that will incorporate relevant approaches recommended in Phase 1
 36 Methylmercury TMDL control studies. Specific approaches recommended under CM12 that are
 37 intended to minimize or mitigate for potential increases in methylmercury bioaccumulation at
 38 future restoration sites include:

- 39 ● Characterizing mercury, methylmercury, organic carbon, iron, and sulfate concentrations to
 40 better inform restoration design,
- 41 ● Sequestering methylmercury at restoration sites using low intensity chemical dosing
 42 techniques,

- 1 • Minimizing microbial methylation associated with anoxic conditions by reducing the amount of
- 2 organic material at a restoration site,
- 3 • Designing restoration sites to enhance photo degeneration that converts methylmercury into a
- 4 biologically unavailable, inorganic form of mercury,
- 5 • Remediating restoration site soils with iron to reduce methylation in sulfide rich soils, and
- 6 • Considering capping mercury laden sediments, where possible to reduce methylation potential
- 7 at a site.

8 Because of the uncertainties associated with site-specific estimates of methylmercury
 9 concentrations and the uncertainties in source modeling and tissue modeling, the effectiveness of
 10 methylmercury management proposed under CM12 to reduce methylmercury concentrations would
 11 need to be evaluated separately for each restoration effort, as part of design and implementation.

12 In summary, because of this uncertainty and the known potential for methylmercury creation in the
 13 Delta this potential effect of implementing CM2–CM22 is considered adverse.

14 **CEQA Conclusion:** There would be no substantial, long-term increase in mercury or methylmercury
 15 concentrations or loads in the rivers and reservoirs upstream of the Delta or the waters exported to
 16 the CVP and SWP service areas due to implementation of CM2–CM22 relative to Existing Conditions.
 17 However, uptake of mercury from water and/or methylation of inorganic mercury may increase to
 18 an unquantified degree as part of the creation of new, marshy, shallow, or organic-rich restoration
 19 areas. Methylmercury is 303(d)-listed within the affected environment, and therefore any potential
 20 measurable increase in methylmercury concentrations would make existing mercury-related
 21 impairment measurably worse. Because mercury is bioaccumulative, increases in water-borne
 22 mercury or methylmercury that could occur in some areas could bioaccumulate to somewhat
 23 greater levels in aquatic organisms and would, in turn, pose health risks to fish, wildlife, or humans.
 24 Design of restoration sites under Alternative 3 would be guided by CM12 which requires
 25 development of site specific mercury management plans as restoration actions are implemented.
 26 The effectiveness of minimization and mitigation actions implemented according to the mercury
 27 management plans is not known at this time although the potential to reduce methylmercury
 28 concentrations exists based on current research. Although the BDCP will implement CM12 with the
 29 goal to reduce this potential effect the uncertainties related to site specific restoration conditions
 30 and the potential for increases in methylmercury concentrations in the Delta result in this potential
 31 impact being considered significant. No mitigation measures would be available until specific
 32 restoration actions are proposed. Therefore this programmatic impact is considered significant and
 33 unavoidable.

34 **Impact WQ-15: Effects on Nitrate Concentrations Resulting from Facilities Operations and** 35 **Maintenance (CM1)**

36 ***Upstream of the Delta***

37 For the same reasons stated for the No Action Alternative, Alternative 3 would have negligible, if
 38 any, impact on nitrate concentrations in the rivers and reservoirs upstream of the Delta in the
 39 Sacramento River watershed relative to Existing Conditions and the No Action Alternative.

40 Under Alternative 3, modeling indicates that long-term annual average flows on the San Joaquin
 41 River would decrease by an estimated 6%, relative to Existing Conditions, and would remain
 42 virtually the same relative to the No Action Alternative (Appendix 5A). Given these relatively small

1 decreases in flows and the weak correlation between nitrate and flows in the San Joaquin River (see
 2 Nitrate Appendix 8J, Figure 2), it is expected that nitrate concentrations in the San Joaquin River
 3 would be minimally affected, if at all, by changes in flow rates under Alternative 3.

4 Any negligible changes in nitrate-N concentrations that may occur in the water bodies of the affected
 5 environment located upstream of the Delta would not be of frequency, magnitude and geographic
 6 extent that would adversely affect any beneficial uses or substantially degrade the quality of these
 7 water bodies, with regards to nitrate.

8 **Delta**

9 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 10 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 11 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 12 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 13 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
 14 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

15 Results of the mixing calculations indicate that under Alternative 3, relative to Existing Conditions,
 16 and the No Action Alternative, nitrate concentrations throughout the Delta are anticipated to remain
 17 low (<1.4 mg/L-N) relative to adopted objectives (Nitrate Appendix 8J, Table 13 and 14). Although
 18 changes at specific Delta locations and for specific months may be substantial on a relative basis, the
 19 absolute concentration of nitrate in Delta waters would remain low (<1.4 mg/L-N) in relation to the
 20 drinking water MCL of 10 mg/L-N, as well as all other thresholds identified in Table 8-50. Long-term
 21 average nitrate concentrations are anticipated to remain below 1 mg/L-N at all 11 assessment
 22 locations except the San Joaquin River at Buckley Cove, where long-term average concentrations
 23 would be somewhat above 1 mg/L-N. Nevertheless, at this location, long-term average nitrate
 24 concentration would be somewhat reduced under Alternative 3, relative to Existing Conditions and
 25 would be nearly the same (i.e., any increase would be negligible) as that under the No Action
 26 Alternative. No additional exceedances of the MCL are anticipated at any location (Nitrate Appendix
 27 8J, Table 13). On a monthly average basis and on a long term annual average basis, for all modeled
 28 years and for the drought period (1987–1991) only, use of assimilative capacity available under
 29 Existing Conditions and the No Action Alternative, relative to the drinking water MCL of 10 mg/L-N,
 30 was low or negligible (i.e., <5%) for all locations and months, except for Jones PP in November,
 31 where use of assimilative capacity available under Existing Conditions was 6.5% in the drought
 32 period (1987–1991) (Nitrate Appendix 8J, Table 15).

33 Nitrate concentrations will likely be higher than the modeling results indicate in certain locations.
 34 This includes in the Sacramento River between Freeport and Mallard Island and other areas in the
 35 Delta downstream of Freeport that are influenced by Sacramento River water. These increases are
 36 associated with ammonia and nitrate that are discharged from the SRWTP, which are not included in
 37 the modeling.

- 38 • Under Existing Conditions, most of the ammonia discharged from the SRWTP is converted to
 39 nitrate downstream of the facility's discharge at Freeport, and thus, nitrate concentrations
 40 under Existing Conditions in these areas are expected to be higher than the modeling
 41 predicts, the increase becoming greater with increasing distance downstream. However, the
 42 increase in nitrate concentrations downstream of the SRWTP is expected to be small—the
 43 existing increase appears to be from approximately 0.1 mg/L-N to approximately 0.4–0.5

1 mg/L-N over this reach, due to approximately a 1:1 conversion of ammonia-N to nitrate-N
2 (Central Valley Water Board 2010a:32).

- 3 • Under Alternative 3, the planned upgrades to the SRWTP, which include nitrification/partial
4 denitrification, would substantially decrease ammonia concentrations in the discharge, but
5 would increase nitrate concentrations in the discharge up to 10 mg/L-N, which is
6 substantially higher than under Existing Conditions.
- 7 • Overall, under Alternative 3, the nitrogen load from the SRWTP discharge is expected to
8 decrease (by up to 50%), relative to Existing Conditions, due to nitrification/partial
9 denitrification upgrades at the SRWTP facility. Thus, while concentrations of nitrate
10 downstream of the facility are expected to be higher than modeling results indicate for both
11 Existing Conditions and Alternative 3, the increase is expected to be greater under Existing
12 Conditions than for Alternative 3 due to the upgrades that are assumed under Alternative 3.

13 The other areas in which nitrate concentrations will be higher than the modeling results indicate are
14 immediately downstream of other wastewater treatment plants that practice nitrification, but not
15 denitrification (e.g., City of Rio Vista Beach WWTF, Town of Discovery Bay WWTF, City of Stockton
16 RWCF). For all such facilities in the Delta, the Regional Water Boards have issued NPDES permits
17 that allow discharge of wastewater containing nitrate into the Delta, and under these permits, the
18 State has determined that no beneficial uses are adversely affected by the discharge, and that the
19 discharger's use of available assimilative capacity of the water body is acceptable. When dilution is
20 necessary in order for the discharge to be in compliance with the Basin Plans (which incorporate the
21 10 mg/L-N MCL by reference), not all of the assimilative capacity of the receiving water is granted to
22 the discharger. Thus, limited decreases in flows are not anticipated to result in systemic
23 exceedances of the MCLs by these POTWs. Furthermore, NPDES permits are renewed on a 5-year
24 basis, and thus, if under changes in flows, dilution was no longer sufficient to maintain nitrate below
25 the MCL in the receiving water, the NPDES permit renewal process would address such cases.

26 Therefore, any increases in nitrate-N concentrations that may occur at certain locations within the
27 Delta would not be of frequency, magnitude and geographic extent that would adversely affect any
28 beneficial uses or substantially degrade the water quality at these locations, with regards to nitrate.

29 ***SWP/CVP Export Service Areas***

30 Assessment of effects of nitrate in the SWP and CVP Export Service Areas is based on effects on
31 nitrate-N at the Banks and Jones pumping plants.

32 Results of the mixing calculations indicate that under Alternative 3, relative to Existing Conditions
33 and the No Action Alternative, nitrate concentrations at Banks and Jones pumping plants are
34 anticipated to decrease on a long-term average annual basis (Nitrate Appendix 8J, Table 13 and 14).
35 During the late summer, particularly in the drought period assessed, concentrations are expected to
36 increase substantially on a relative basis (i.e., >50%), but the absolute value of these changes (i.e., in
37 mg/L-N) is small. Additionally, given the many factors that contribute to potential algal blooms in
38 the SWP and CVP canals within the Export Service Area, and the lack of studies that have shown a
39 direct relationship between nutrient concentrations in the canals and reservoirs and problematic
40 algal blooms in these water bodies, there is no basis to conclude that these small (i.e., generally <0.3
41 mg/L-N), seasonal increases in nitrate concentrations would increase the potential for problem algal
42 blooms in the SWP and CVP Export Service Area. No additional exceedances of the MCL are
43 anticipated (Nitrate Appendix 8J, Table 13). On a monthly average basis and on a long term annual

1 average basis, for all modeled years and for the drought period (1987–1991) only, use of
2 assimilative capacity available under Existing Conditions and the No Action Alternative, relative to
3 the 10 mg/L-N MCL, was negligible (<4%) for both Banks and Jones pumping plants (Nitrate
4 Appendix 8J, Table 15).

5 Any increases in nitrate-N concentrations that may occur in water exported via Banks and Jones
6 pumping plants are not expected to result in adverse effects to beneficial uses or substantially
7 degrade the quality of exported water, with regards to nitrate.

8 **NEPA Effects:** In summary, based on the discussion above, the effects on nitrate from implementing
9 CM1 are considered to be not adverse.

10 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
11 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
12 purpose of making the CEQA impact determination for this constituent. For additional details on the
13 effects assessment findings that support this CEQA impact determination, see the effects assessment
14 discussion that immediately precedes this conclusion.

15 Nitrate-N concentrations are generally low in the reservoirs and rivers of the watersheds, owing to
16 substantial dilution available for point sources and the lack of substantial nonpoint sources of
17 nitrate-N upstream of the SRWTP in the Sacramento River watershed, and in the watersheds of the
18 eastern tributaries (Cosumnes, Mokelumne, and Calaveras Rivers). Although higher in the San
19 Joaquin River watershed, nitrate-N concentrations are not well-correlated with flow rates.
20 Consequently, any modified reservoir operations and subsequent changes in river flows under
21 Alternative 3, relative to Existing Conditions, are expected to have negligible, if any, effects on
22 reservoir and river nitrate-N concentrations upstream of Freeport in the Sacramento River
23 watershed and upstream of the Delta in the San Joaquin River watershed.

24 In the Delta, results of the mixing calculations indicate that under Alternative 3, relative to Existing
25 Conditions, nitrate concentrations throughout the Delta are anticipated to remain low (<1.4 mg/L-
26 N) relative to adopted objectives. No additional exceedances of the MCL are anticipated at any
27 location, and use of assimilative capacity available under Existing Conditions, relative to the
28 drinking water MCL of 10 mg/L-N, was low or negligible (i.e., <5%) for virtually all locations and
29 months.

30 Assessment of effects of nitrate in the SWP and CVP Export Service Areas is based on effects on
31 nitrate-N concentrations at the Banks and Jones pumping plants. Results of the mixing calculations
32 indicate that under Alternative 3, relative to Existing Conditions, long-term average nitrate
33 concentrations at Banks and Jones pumping plants are anticipated to change negligibly. No
34 additional exceedances of the MCL are anticipated, and use of assimilative capacity available under
35 Existing Conditions, relative to the MCL was negligible (i.e., <4%) for both Banks and Jones pumping
36 plants for all months.

37 Based on the above, there would be no substantial, long-term increase in nitrate-N concentrations in
38 the rivers and reservoirs upstream of the Delta, in the Delta Region, or the waters exported to the
39 CVP and SWP service areas under Alternative 3 relative to Existing Conditions. As such, this
40 alternative is not expected to cause additional exceedance of applicable water quality objectives/
41 criteria by frequency, magnitude, and geographic extent that would cause adverse effects on any
42 beneficial uses of waters in the affected environment. Because nitrate concentrations are not
43 expected to increase substantially, no long-term water quality degradation is expected to occur and,

1 thus, no adverse effects to beneficial uses would occur. Nitrate is not 303(d) listed within the
 2 affected environment and thus any increases that may occur in some areas and months would not
 3 make any existing nitrate-related impairment measurably worse because no such impairments
 4 currently exist. Because nitrate is not bioaccumulative, increases that may occur in some areas and
 5 months would not bioaccumulate to greater levels in aquatic organisms that would, in turn, pose
 6 substantial health risks to fish, wildlife, or humans. This impact is considered to be less than
 7 significant. No mitigation is required.

8 **Impact WQ-16: Effects on Nitrate Concentrations Resulting from Implementation of CM2–**
 9 **CM22**

10 **NEPA Effects:** Effects of CM2–CM22 on nitrate under Alternative 3 are the same as those discussed
 11 for Alternative 1A and are considered not to be adverse.

12 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 3 would be similar to
 13 those proposed under Alternative 1A. As such, effects on nitrate resulting from the implementation
 14 of CM2–CM22 would be similar to that previously discussed for Alternative 1A. This impact is
 15 considered to be less than significant. No mitigation is required.

16 **Impact WQ-17: Effects on Dissolved Organic Carbon Concentrations Resulting from Facilities**
 17 **Operations and Maintenance (CM1)**

18 ***Upstream of the Delta***

19 Under Alternative 3, there would be no substantial change to the sources of DOC within the
 20 watersheds upstream of the Delta. Moreover, long-term average flow and DOC levels in the
 21 Sacramento River at Hood and San Joaquin River at Vernalis are poorly correlated. Thus changes in
 22 system operations and resulting reservoir storage levels and river flows would not be expected to
 23 cause a substantial long-term change in DOC concentrations in the water bodies upstream of the
 24 Delta. Any negligible changes in DOC levels in water bodies upstream of the Delta under Alternative
 25 3, relative to Existing Conditions and the No Action Alternative, would not be of sufficient frequency,
 26 magnitude and geographic extent that would adversely affect any beneficial uses or substantially
 27 degrade the quality of these water bodies, with regards to DOC.

28 ***Delta***

29 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 30 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 31 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 32 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 33 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
 34 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

35 Under Alternative 3, the geographic extent of effects pertaining to long-term average DOC
 36 concentrations in the Delta would be similar to that previously described for Alternative 1A,
 37 although the magnitude of predicted long-term change and relative frequency of concentration
 38 threshold exceedances would be less. Modeled effects would be greatest at Franks Tract, Rock
 39 Slough, and Contra Costa PP No. 1., where for the 16-year hydrologic period and the modeled
 40 drought period, long-term average concentration increases ranging from 0.2–0.3 mg/L would be
 41 predicted ($\leq 8\%$ net increase) (Appendix 8K, DOC Table 4). Increases in long-term average

1 concentrations would correspond to more frequent concentration threshold exceedances, with the
 2 greatest change occurring at Rock Slough and Contra Costa PP No. 1 locations. For Rock Slough,
 3 long-term average DOC concentrations exceeding 3 mg/L would increase from 52% under Existing
 4 Conditions to 65% under the Alternative 3 (an increase from 47% to 63% for the drought period),
 5 and concentrations exceeding 4 mg/L would increase from 30% to 33% (32% to 38% for the
 6 drought period). For Contra Costa PP No. 1, long-term average DOC concentrations exceeding 3
 7 mg/L would increase from 52% under Existing Conditions to 65% under Alternative 3 45% to 67%
 8 for the drought period), and concentrations exceeding 4 mg/L would increase from 32% to 37%
 9 (35% to 42% for the drought period). Relative change in frequency of threshold exceedance for
 10 other assessment locations would be similar or less. While Alternative 3 would generally lead to
 11 slightly higher long-term average DOC concentrations (≤ 0.3 mg/L) at some municipal water intakes
 12 and Delta interior locations, the predicted change would not be expected to adversely affect MUN
 13 beneficial uses, or any other beneficial use. This comparison to Existing Conditions reflects changes
 14 in DOC due to both Alternative 3 operations (including north Delta intake capacity of 6,000 cfs and
 15 numerous other operational components of Scenario A) and climate change/sea level rise.

16 In comparison, Alternative 3 relative to the No Action Alternative would generally result in a similar
 17 magnitude of change to that discussed for the comparison to Existing Conditions. Maximum
 18 increases of 0.1–0.2 mg/L DOC (i.e., $\leq 7\%$) would be predicted at Franks Tract, Rock Slough, and
 19 Contra Costa PP No. 1 relative to No Action Alternative (Appendix 8K, DOC Table 4). Threshold
 20 concentration exceedance frequency trends would also be similar to that discussed for the existing
 21 condition comparison, with exception to the predicted 4 mg/L exceedance frequency at Buckley
 22 Cove. In comparison to the No Action Alternative, the frequency which long-term average DOC
 23 concentrations exceeded 4 mg/L at Buckley Cove would increase from 27% to 33% (42% to 63% for
 24 the modeled drought period). While the Alternative 3 would generally lead to slightly higher long-
 25 term average DOC concentrations at some Delta assessment locations when compared to No Action
 26 Alternative conditions, the predicted change would not be expected to adversely affect MUN
 27 beneficial uses, or any other beneficial use, particularly when considering the relatively small
 28 change in long-term annual average concentration. Unlike the comparison to Existing Conditions,
 29 this comparison to the No Action Alternative reflects changes in DOC due to only Alternative 3
 30 operations.

31 As discussed for Alternative 1A, substantial change in ambient DOC concentrations would need to
 32 occur before significant changes in drinking water treatment plant design or operations are
 33 triggered. The increases in long-term average DOC concentrations estimated to occur at various
 34 Delta locations under Alternative 3 are of sufficiently small magnitude that they would not require
 35 existing drinking water treatment plants to substantially upgrade treatment for DOC removal above
 36 levels currently employed.

37 Relative to existing and No Action Alternative conditions, Alternative 3 would lead to predicted
 38 improvements in long-term average DOC concentrations at Barker Slough, as well as Banks and
 39 Jones pumping plants (discussed below). At Barker Slough, long-term average DOC concentrations
 40 would be predicted to decrease by as much as 0.1–0.2 mg/L, depending on baseline conditions
 41 comparison and modeling period.

42 ***SWP/CVP Export Service Areas***

43 Under Alternative 3, modeled long-term average DOC concentrations would decrease at Banks and
 44 Jones pumping plants for both the modeled 16-year hydrologic period and the modeled drought

1 period, relative to Existing Conditions and the No Action Alternative. Relative to Existing Conditions,
2 long-term average DOC concentrations at Banks would be predicted to decrease by 0.3 mg/L (0.1
3 mg/L during drought period) (Appendix 8K, DOC Tables 4). At Jones, long-term average DOC
4 concentrations would be predicted to decrease by 0.2 mg/L (<0.1 mg/L during drought period).
5 Such decreases in long-term average DOC, however, would not necessarily translate into lower
6 exceedance frequencies for concentration thresholds. To the contrary, long-term average DOC
7 concentrations at Banks exceeding 3 mg/L would increase from 64% under Existing Conditions to
8 69% under Alternative 3 (57% to 92% for the drought period), and at Jones would increase from
9 71% to 77% (72% to 88% for the drought period). In contrast, however, the frequency of
10 concentrations exceeding 4 mg/L at Banks and Jones would decrease or remain relatively
11 unchanged. Comparisons to the No Action Alternative yield similar trends, but with slightly smaller
12 16-year hydrologic period and drought period changes. Overall, modeling results for the SWP/CVP
13 Export Service Areas predict an overall long-term improvement in Export Service Areas water
14 quality, primarily through a reduction in exports of water exceeding 4 mg/L.

15 Similar to the discussion pertaining to the No Action Alternative, maintenance of SWP and CVP
16 facilities under Alternative 3 would not be expected to create new sources of DOC or contribute
17 towards a substantial change in existing sources of DOC in the affected area. Maintenance activities
18 would not be expected to cause any substantial change in long-term average DOC concentrations
19 such that MUN beneficial uses, or any other beneficial use, would be adversely affected.

20 **NEPA Effects:** In summary, Alternative 3, relative to the No Action Alternative, would not cause a
21 substantial long-term change in DOC concentrations in the water bodies upstream of the Delta.
22 Long-term average DOC concentrations at Banks and Jones pumping plants are predicted to
23 decrease by as much as 0.4 mg/L, while long-term average DOC concentrations for some Delta
24 interior locations, including Contra Costa PP #1, are predicted to increase by as much as 0.2 mg/L.
25 The increase in long-term average DOC concentration that could occur within the Delta interior
26 would not be of sufficient magnitude to adversely affect the MUN beneficial use, or any other
27 beneficial uses, of Delta waters. The effect of Alternative 1A operations and maintenance (CM1) on
28 DOC is determined not to be adverse.

29 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
30 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
31 purpose of making the CEQA impact determination for this constituent. For additional details on the
32 effects assessment findings that support this CEQA impact determination, see the effects assessment
33 discussion that immediately precedes this conclusion.

34 While greater water demands under the Alternative 3 would alter the magnitude and timing of
35 reservoir releases north, south and east of the Delta, these activities would have no substantial effect
36 on the various watershed sources of DOC. Moreover, long-term average flow and DOC at Sacramento
37 River at Hood and San Joaquin River at Vernalis are poorly correlated; therefore, changes in river
38 flows would not be expected to cause a substantial long-term change in DOC concentrations
39 upstream of the Delta.

40 Relative to Existing Conditions, Alternative 3 would result in relatively small increases (i.e., ≤8%) in
41 long-term average DOC concentrations at some Delta interior locations, including Franks Tract, Rock
42 Slough, and Contra Costa PP No. 1. However, these increases would not substantially increase the
43 frequency with which long-term average DOC concentrations exceeds 2, 3, or 4 mg/L. While
44 Alternative 3 would generally lead to slightly higher long-term average DOC concentrations (≤0.3

1 mg/L) within the Delta interior and some municipal water intakes, the predicted change would not
2 be expected to adversely affect MUN beneficial uses, or any other beneficial use.

3 The assessment of Alternative 3 effects on DOC in the SWP/CVP Export Service Areas is based on
4 assessment of changes in DOC concentrations at Banks and Jones pumping plants. Relative to the
5 existing condition, long-term average DOC concentrations would decrease by as much as 0.3 mg/L at
6 Banks and Jones pumping plants, although slightly more frequent export of >3 mg/L DOC water is
7 predicted. Nevertheless, an overall improvement in DOC-related water quality would be predicted in
8 the SWP/CVP Export Service Areas.

9 Based on the above, Alternative 3 operation and maintenance would not result in any substantial
10 change in long-term average DOC concentration upstream of the Delta or result in substantial
11 increase in the frequency with which long-term average DOC concentrations exceeds 2, 3, or 4 mg/L
12 levels at the 11 assessment locations analyzed for the Delta. Modeled long-term average DOC
13 concentrations would increase by no more than 0.3 mg/L at any single Delta assessment location
14 (i.e., ≤8% relative increase), with long-term average concentrations estimated to remain at or below
15 4.0 mg/L at all Delta locations assessed, with the exception of Buckley Cove on the San Joaquin River
16 during the drought period modeled. Nevertheless, long-term average concentrations at Buckley
17 Cove are predicted to remain the same during the drought period, relative to Existing Conditions.
18 The increases in long-term average DOC concentration that could occur within the Delta would not
19 be of sufficient magnitude to adversely affect the MUN beneficial use, or any other beneficial uses, of
20 Delta waters or waters of the SWP/CVP Service Area. Because DOC is not bioaccumulative, the
21 increases in long-term average DOC concentrations would not directly cause bioaccumulative
22 problems in aquatic life or humans. Finally, DOC is not causing beneficial use impairments and thus
23 is not 303(d) listed for any water body within the affected environment. Thus, the increases in long-
24 term average DOC that could occur at various locations would not make any beneficial use
25 impairment measurably worse. Because long-term average DOC concentrations are not expected to
26 increase substantially, no long-term water quality degradation with respect to DOC is expected to
27 occur and, thus, no adverse effects on beneficial uses would occur. This impact is considered to be
28 less than significant. No mitigation is required.

29 **Impact WQ-18: Effects on Dissolved Organic Carbon Concentrations Resulting from** 30 **Implementation of CM2–CM22**

31 **NEPA Effects:** Conservation Measures 2–22 proposed under Alternative 3 would be the same as
32 those proposed under Alternative 1A. As such, effects on DOC resulting from the implementation of
33 CM2–CM22 would be similar to that previously discussed for Alternative 1A. In summary, CM4–CM7
34 and CM10 could contribute substantial amounts of DOC to raw drinking water supplies, largely
35 depending on final design and operational criteria for the related wetland and riparian habitat
36 restoration activities. Substantially increased long-term average DOC in raw water supplies could
37 lead to a need for treatment plant upgrades in order to appropriately manage DBP formation in
38 treated drinking water. This potential for future DOC increases would lead to substantially greater
39 associated risk of long-term adverse effects on the MUN beneficial use.

40 In addition to and to supplement Mitigation Measure WQ-18, the BDCP proponents have
41 incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*, a
42 separate, non-environmental commitment to address the potential increased water treatment costs
43 that could result from DOC concentration effects on municipal and industrial water purveyor
44 operations. Potential options for making use of this financial commitment include funding or

1 providing other assistance towards implementing treatment for DOC and/or DBPs or DOC source
 2 control strategies. Please refer to Appendix 3B, *Environmental Commitments*, for the full list of
 3 potential actions that could be taken pursuant to this commitment in order to reduce the water
 4 quality treatment costs associated with water quality effects relating to DOC.

5 In summary, the habitat restoration elements of CM4–CM7 and CM10 under Alternative 3 would
 6 present new localized sources of DOC to the study area, and in some circumstances would substitute
 7 for existing sources related to replaced agriculture. Depending on localized hydrodynamics and
 8 proximity to municipal drinking water intakes, such restoration activities could contribute
 9 substantial amounts of DOC to municipal raw water. Substantial increases in municipal raw water
 10 DOC could necessitate changes in water treatment plant operations or require treatment plant
 11 upgrades in order to maintain DBP compliance, and thus would constitute an adverse effect on
 12 water quality. Mitigation Measure WQ-18 is available to reduce these effects.

13 **CEQA Conclusion:** Effects of CM4–CM7 and CM10 on DOC under Alternative 3 would be similar to
 14 those discussed for Alternative 1A. Similar to the discussion for Alternative 1A, this impact is
 15 considered to be significant and mitigation is required. It is uncertain whether implementation of
 16 Mitigation Measure WQ-18 would reduce identified impacts to a less-than-significant level. Hence,
 17 this impact remains significant and unavoidable.

18 **Mitigation Measure WQ-18: Design Wetland and Riparian Habitat Features to Minimize**
 19 **Effects on Municipal Intakes**

20 Please see Mitigation Measure WQ-18 under Impact WQ-18 in the discussion of Alternative 1A.

21 **Impact WQ-19: Effects on Pathogens Resulting from Facilities Operations and Maintenance**
 22 **(CM1)**

23 **NEPA Effects:** Effects of CM1 on pathogens under Alternative 3 are the same as those discussed for
 24 Alternative 1A and are considered to not be adverse.

25 **CEQA Conclusion:** Effects of CM1 on pathogens under Alternative 3 are the same as those discussed
 26 for Alternative 1A, and are summarized here, then compared to the CEQA thresholds of significance
 27 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this
 28 constituent. For additional details on the effects assessment findings that support this CEQA impact
 29 determination, see the effects assessment discussion under Alternative 1A.

30 River flow rate and reservoir storage reductions that would occur due to implementation of CM1
 31 (water facilities and operations) under Alternative 3, relative to Existing Conditions, would not be
 32 expected to result in a substantial adverse change in pathogen concentrations in the reservoirs and
 33 rivers upstream of the Delta, given the small magnitude of urban runoff contributions relative to the
 34 magnitude of river flows, that pathogen concentrations in the rivers have a minimal relationship to
 35 river flow rate, and the expected reduced pollutant loadings in response to NPDES stormwater-
 36 related regulations.

37 It is expected there would be no substantial change in Delta pathogen concentrations in response to
 38 a shift in the Delta source water percentages under this alternative or substantial degradation of
 39 these water bodies, with regard to pathogens. This conclusion is based on the Pathogens Conceptual
 40 Model, which found that pathogen sources in close proximity to a Delta site appear to have the
 41 greatest influence on pathogen levels at the site, rather than the primary source(s) of water to the

1 site. In-Delta potential pathogen sources, including water-based recreation, tidal habitat, wildlife,
2 and livestock-related uses, would continue under this alternative.

3 In the SWP/CVP Export Service Areas waters, relative to Existing Conditions, an increased
4 proportion of water coming from the Sacramento River would not adversely affect beneficial uses in
5 the SWP/CVP Export Service Areas. The pathogen levels in the Sacramento River are similar to or
6 lower than the water diverted at the Delta export pumps. Further, it is localized sources of
7 pathogens that appear to have the greatest influence on concentrations. Thus, an increased
8 proportion of Sacramento River water diverted to the SWP/CVP Export Service Areas would result
9 in minimal changes in pathogen levels in the SWP/CVP Export Service Areas waters.

10 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
11 objectives by frequency, magnitude, and geographic extent that would cause adverse effects on any
12 beneficial uses of waters in the affected environment. Because pathogen concentrations are not
13 expected to increase substantially, no long-term water quality degradation for pathogens is
14 expected to occur and, thus, no adverse effects on beneficial uses would occur. The San Joaquin
15 River in the Stockton Deep Water Ship Channel is Clean Water Act section 303(d) listed for
16 pathogens. Because no measurable increase in Deep Water Ship Channel pathogen concentrations
17 are expected to occur on a long-term basis, further degradation and impairment of this area is not
18 expected to occur. Finally, pathogens are not bioaccumulative constituents. This impact is
19 considered to be less than significant. No mitigation is required.

20 **Impact WQ-20: Effects on Pathogens Resulting from Implementation of CM2–CM22**

21 **NEPA Effects:** Effects of CM2–CM22 on pathogens under Alternative 3 are the same as those
22 discussed for Alternative 1A and are considered to not be adverse.

23 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 3 would be similar to
24 those proposed under Alternative 1A. As such, effects on pathogens resulting from the
25 implementation of CM2–CM22 would be similar to that previously discussed for Alternative 1A. This
26 impact is considered to be less than significant. No mitigation is required.

27 **Impact WQ-21: Effects on Pesticide Concentrations Resulting from Facilities Operations and** 28 **Maintenance (CM1)**

29 ***Upstream of the Delta***

30 For the same reasons stated for the No Action Alternative, under Alternative 3, no specific
31 operations or maintenance activity of the SWP or CVP would substantially drive a change in
32 pesticide use, and thus pesticide sources would remain unaffected upstream of the Delta.
33 Nevertheless, changes in the timing and magnitude of reservoir releases could have an effect on
34 available dilution capacity along river segments such as the Sacramento, Feather, American, and San
35 Joaquin Rivers.

36 Under Alternative 3, winter (November–March) and summer (April–October) season average flow
37 rates on the Sacramento River at Freeport, American River at Nimbus, Feather River at Thermalito
38 and the San Joaquin River at Vernalis would change. Relative to existing condition and No Action
39 Alternative, seasonal average flow rates on the Sacramento would decrease no more than 7% during
40 the summer and 2% during the winter (Appendix 8L, Seasonal average flows Table 1-4). On the
41 Feather River, average flow rates would decrease no more than 14% during the summer, but would

1 increase by as much as 18% in the winter. Similarly, American River average flow rates would
 2 decrease by as much as 16% in the summer but would increase by as much as 6% in the winter.
 3 Seasonal average flow rates on the San Joaquin River would decrease by as much as 12% in the
 4 summer, but increase by as much as 1% in the winter. For the same reasons stated for the No Action
 5 Alternative, decreased seasonal average flow of $\leq 16\%$ is not considered to be of sufficient
 6 magnitude to substantially increase pesticide concentrations or alter the long-term risk of pesticide-
 7 related toxicity to aquatic life, nor adversely affect other beneficial uses of water bodies upstream of
 8 the Delta.

9 ***Delta***

10 Sources of diuron, OP and pyrethroid insecticides to the Plan Area include direct input of surface
 11 runoff from in-Delta agriculture and Delta urbanized areas as well as inputs from rivers upstream of
 12 the Delta. Similar to Upstream of the Delta, CVP/SWP operations would not affect these sources.

13 Under Alternative 3, the distribution and mixing of Delta source waters would change. Percent
 14 change in monthly average source water fraction were evaluated for the modeled 16-year (1976–
 15 1991) hydrologic period and a representative drought period (1987–1991), with special attention
 16 given to changes in San Joaquin River, Sacramento River and Delta Agriculture sources water
 17 fractions. Relative to Existing Conditions, under Alternative 3 modeled San Joaquin River fractions
 18 would increase greater than 10% at (not including Banks and Jones, discussed below) Rock Slough
 19 and Contra Costa PP No. 1 (Appendix 8D, Source Water Fingerprinting). At Rock Slough, San Joaquin
 20 River source water fractions when modeled for the 16-year hydrologic period would increase 11%
 21 during March, while at Contra Costa PP No. 1 San Joaquin River source water fractions when
 22 modeled for the 16-year hydrologic period would increase 14% during March. Corresponding
 23 increases for the modeled drought period would not be greater than 7% at Rock Slough or Contra
 24 Costa PP No. 1. Relative to Existing Conditions, there would be no modeled increases in Sacramento
 25 River fractions greater than 10% (with exception to Banks and Jones which are discussed below)
 26 and Delta agricultural fractions greater than 7%. These modeled changes in the source water
 27 fractions of Sacramento, San Joaquin and Delta agriculture water are not of sufficient magnitude to
 28 substantially alter the long-term risk of pesticide-related toxicity to aquatic life, nor adversely affect
 29 other beneficial uses of the Delta.

30 When compared to the No Action Alternative, changes in source water fractions would be similar in
 31 season, geographic extent, and magnitude to those discussed for Existing Conditions with exception
 32 to Buckley Cove during the modeled drought period. At Buckley Cove, modeled drought period San
 33 Joaquin River fractions would increase 13% in July and 24% in August when compared to No Action
 34 Alternative (Appendix 8D, Source Water Fingerprinting). These increases would primarily balance
 35 through decreases in Sacramento River water and eastside tributary waters. Nevertheless, the San
 36 Joaquin River would only account for 37% of the total source water volume at Buckley Cove in July
 37 and August during the modeled drought period. As such, these modeled changes in the source water
 38 fractions of Sacramento, San Joaquin and Delta agriculture water are not of sufficient magnitude to
 39 substantially alter the long-term risk of pesticide-related toxicity to aquatic life, nor adversely affect
 40 other beneficial uses of the Delta.

41 ***SWP/CVP Export Service Areas***

42 Assessment of effects in SWP/CVP Export Service Areas is based on effects seen in the Plan Area at
 43 the Banks and Jones pumping plants. Under Alternative 3, Sacramento River source water fractions
 44 would increase substantially at both Banks and Jones pumping plants relative to Existing Conditions

1 and the No Action Alternative (Appendix 8D, Source Water Fingerprinting). At Banks pumping plant,
2 Sacramento source water fractions would generally increase from 12–34% for the period of January
3 through June (12–22% for March through May of the modeled drought period) and at Jones
4 pumping plant Sacramento source water fractions would generally increase from 18–39% for the
5 period of January through June (12–36% for February through June of the modeled drought period).
6 These increases in Sacramento source water fraction would primarily balance through equivalent
7 decreases in San Joaquin River water. Based on the general observation that San Joaquin River, in
8 comparison to the Sacramento River, is a greater contributor of OP insecticides in terms of greater
9 frequency of incidence and presence at concentrations exceeding water quality benchmarks,
10 modeled increases in Sacramento River fraction at Banks and Jones would generally represent an
11 improvement in export water quality respective to pesticides.

12 **NEPA Effects:** In summary, the changes in long-term average flows on the Sacramento, Feather,
13 American, and San Joaquin Rivers, under Alternative 3 relative to the No Action Alternative, are of
14 insufficient magnitude to substantially increase the long-term risk of pesticide-related water quality
15 degradation and related toxicity to aquatic life in these water bodies upstream of the Delta.
16 Similarly, modeled changes in source water fractions to the Delta are of insufficient magnitude to
17 substantially alter the long-term risk of pesticide-related water quality degradation and related
18 toxicity to aquatic life in the Delta or CVP/SWP export service areas. The effects on pesticides from
19 operations and maintenance (CM1) are determined not to be adverse.

20 **CEQA Conclusion:** Key findings discussed in the effects assessment relative to Existing Conditions is
21 provided above are summarized here, and are then compared to the CEQA thresholds of significance
22 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this
23 constituent. For additional details on the effects assessment findings that support this CEQA impact
24 determination, see the effects assessment discussion that immediately precedes this conclusion.

25 Sources of pesticides upstream of the Delta include direct input of pesticide containing surface
26 runoff from agriculture and urbanized areas. Flows in rivers receiving these discharges dilute these
27 pesticide inputs. Relative to Existing Conditions, however, modeled changes in long-term average
28 flows on the Sacramento, Feather, American, and San Joaquin Rivers are of insufficient magnitude to
29 substantially increase the long-term risk of pesticide-related water quality degradation and related
30 toxicity to aquatic life in these water bodies upstream of the Delta.

31 In the Delta, sources of pesticides include direct input of surface runoff from Delta agriculture and
32 Delta urbanized areas as well as inputs from rivers upstream of the Delta. While facilities operations
33 and maintenance activities would not affect these sources, changes in Delta source water fraction
34 could change the relative risk associated with pesticide related toxicity to aquatic life. Under
35 Alternative 3, however, modeled changes in source water fractions relative to Existing Conditions
36 are of insufficient magnitude to substantially alter the long-term risk of pesticide-related toxicity to
37 aquatic life within the Delta, nor would such changes result in adverse pesticide-related effects on
38 any other beneficial uses of Delta waters.

39 The assessment of Alternative 3 effects on pesticides in the SWP/CVP Export Service Areas is based
40 on assessment of changes predicted at Banks and Jones pumping plants. As just discussed regarding
41 effects to pesticides in the Delta, modeled changes in source water fractions at the Banks and Jones
42 pumping plants are of insufficient magnitude to substantially alter the long-term risk of pesticide-
43 related toxicity to aquatic life beneficial uses, or any other beneficial uses, in water bodies of the
44 SWP and CVP export service area.

1 Based on the above, Alternative 3 would not result in any substantial change in long-term average
2 pesticide concentration or result in substantial increase in the anticipated frequency with which
3 long-term average pesticide concentrations would exceed aquatic life toxicity thresholds or other
4 beneficial use effect thresholds upstream of the Delta, at the 11 assessment locations analyzed for
5 the Delta, or the SWP/CVP service area. Numerous pesticides are currently used throughout the
6 affected environment, and while some of these pesticides may be bioaccumulative, those present-
7 use pesticides for which there is sufficient evidence for their presence in waters affected by SWP
8 and CVP operations (i.e., diazinon, chlorpyrifos, diuron, and pyrethroids) are not considered
9 bioaccumulative, and thus changes in their concentrations would not directly cause bioaccumulative
10 problems in aquatic life or humans. Furthermore, while there are numerous 303(d) listings
11 throughout the affected environment that name pesticides as the cause for beneficial use
12 impairment, the modeled changes in upstream river flows and Delta source water fractions would
13 not be expected to make any of these beneficial use impairments measurably worse. Because long-
14 term average pesticide concentrations are not expected to increase substantially, no long-term
15 water quality degradation with respect to pesticides is expected to occur and, thus, no adverse
16 effects on beneficial uses would occur. This impact is considered to be less than significant. No
17 mitigation is required.

18 **Impact WQ-22: Effects on Pesticide Concentrations Resulting from Implementation of CM2- 19 CM22**

20 **NEPA Effects:** Conservation Measures 2-22 proposed under Alternative 3 would be the same as
21 those proposed under Alternative 1A. As such, effects on pesticides resulting from the
22 implementation of CM2-CM22 would be similar to that previously discussed for Alternative 1A. In
23 summary, CM13 proposes the use of herbicides to control invasive aquatic vegetation around
24 habitat restoration sites. Herbicides directly applied to water could include adverse effects on non-
25 target aquatic life, such as aquatic invertebrates and beneficial aquatic plants. As such, aquatic life
26 toxicity objectives could be exceeded with sufficient frequency and magnitude such that beneficial
27 uses would be impacted, thus constituting an adverse effect on water quality.

28 In summary, based on the discussion above, the effects on pesticides from implementing CM2-CM22
29 are considered to be adverse. Mitigation Measure WQ-22 would be available to reduce this adverse
30 effect.

31 **CEQA Conclusion:** Effects of CM2-CM22 on pesticides under Alternative 3 are similar to those
32 discussed for Alternative 1A. Potential environmental effects related only to CM13 are considered to
33 be significant. Mitigation is required. While Mitigation Measure WQ-22 is available to partially
34 reduce this impact of pesticides, no feasible mitigation is available that would reduce it to a level
35 that would be less than significant.

36 **Mitigation Measure WQ-22: Implement Least Toxic Integrated Pest Management 37 Strategies**

38 Please see Mitigation Measure WQ-22 under Impact WQ-22 in the discussion of Alternative 1A.

39 **Impact WQ-23: Effects on Phosphorus Concentrations Resulting from Facilities Operations 40 and Maintenance (CM1)**

41 **NEPA Effects:** Effects of water facilities and operations (CM1) on phosphorus levels in water bodies
42 of the affected environment under Alternative 3 would be very similar (i.e., nearly the same) to

1 those discussed for Alternative 1A. Consequently, the environmental consequences to phosphorus
2 levels discussed in detail for Alternative 1A also adequately represent the effects under Alternative
3 3, which are considered to be not adverse.

4 **CEQA Conclusion:** Key findings discussed in the effects assessment relative to Existing Conditions is
5 provided above are summarized here, and are then compared to the CEQA thresholds of significance
6 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this
7 constituent. For additional details on the effects assessment findings that support this CEQA impact
8 determination, see the effects assessment discussion that immediately precedes this conclusion.

9 Because phosphorus loading to waters upstream of the Delta is not anticipated to change, and
10 because changes in flows do not necessarily result in changes in concentrations or loading of
11 phosphorus to these water bodies, substantial changes in phosphorus concentration upstream of the
12 Delta are not anticipated for Alternative 3, relative to Existing Conditions.

13 Because phosphorus concentrations in the major source waters to the Delta are similar for much of
14 the year, phosphorus concentrations in the Delta are not anticipated to change substantially on a
15 long term-average basis under Alternative 3, relative to Existing Conditions. Algal growth rates are
16 limited by availability of light in the Delta, and therefore any minor increases in phosphorus levels
17 that may occur at some locations and times within the Delta would be expected to have little effect
18 on primary productivity in the Delta.

19 The assessment of effects of phosphorus under Alternative 3 in the SWP and CVP Export Service
20 Areas is based on effects on phosphorus at the Banks and Jones pumping plants. As noted above,
21 phosphorus concentrations in the Delta (including Banks and Jones pumping plants) are not
22 anticipated to change substantially on a long term-average basis.

23 Based on the above, there would be no substantial, long-term increase in phosphorus concentrations
24 in the rivers and reservoirs upstream of the Delta, in the Delta Region, or the waters exported to the
25 CVP and SWP service areas under Alternative 3 relative to Existing Conditions. As such, this
26 alternative is not expected to cause additional exceedance of applicable water quality
27 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
28 on any beneficial uses of waters in the affected environment. Because phosphorus concentrations
29 are not expected to increase substantially, no long-term water quality degradation is expected to
30 occur and, thus, no adverse effects to beneficial uses would occur. Phosphorus is not 303(d) listed
31 within the affected environment and thus any minor increases that may occur in some areas would
32 not make any existing phosphorus-related impairment measurably worse because no such
33 impairments currently exist. Because phosphorus is not bioaccumulative, minor increases that may
34 occur in some areas would not bioaccumulate to greater levels in aquatic organisms that would, in
35 turn, pose substantial health risks to fish, wildlife, or humans. This impact is considered to be less
36 than significant. No mitigation is required.

37 **Impact WQ-24: Effects on Phosphorus Concentrations Resulting from Implementation of** 38 **CM2–CM22**

39 **NEPA Effects:** Effects of CM2–CM22 on phosphorus levels in water bodies of the affected
40 environment under Alternative 3 would be very similar (i.e., nearly the same) to those discussed for
41 Alternative 1A. Consequently, the environmental consequences to phosphorus levels from
42 implementing CM2–CM22 discussed in detail for Alternative 1A also adequately represent the
43 effects of these same actions under Alternative 3, which are considered to be not adverse.

1 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 3 would be similar to
 2 those proposed under Alternative 1A. As such, effects on phosphorus resulting from the
 3 implementation of CM2–CM22 would be similar to that previously discussed for Alternative 1A. This
 4 impact is considered to be less than significant. No mitigation is required.

5 **Impact WQ-25: Effects on Selenium Concentrations Resulting from Facilities Operations and**
 6 **Maintenance (CM1)**

7 ***Upstream of the Delta***

8 For the same reasons stated for the No Action Alternative, Alternative 3 would have negligible, if
 9 any, effect on selenium concentrations in the rivers and reservoirs upstream of the Delta relative to
 10 Existing Conditions and the No Action Alternative. Any negligible increases in selenium
 11 concentrations that could occur in the water bodies of the affected environment located upstream of
 12 the Delta would not be of frequency, magnitude and geographic extent that would adversely affect
 13 any beneficial uses or substantially degrade the quality of these water bodies, with regard to
 14 selenium.

15 ***Delta***

16 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 17 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 18 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 19 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 20 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
 21 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

22 Alternative 3 would result in small changes in average selenium concentrations in water at all
 23 modeled Delta assessment locations relative to Existing Conditions and the No Action Alternative
 24 (Appendix 8M, Table M-10A). These changes are reflected in small percent changes (10% or less) in
 25 available assimilative capacity for selenium for all years. Relative to Existing Conditions, Alternative
 26 3 would result in the largest modeled increase in available assimilative capacity at Buckley Cove
 27 (5%), and relative to the No Action Alternative, the largest increase would be at Staten Island (1%)
 28 (Figures 8-59 and 8-60). Relative to Existing Conditions and the No Action Alternative, the largest
 29 decrease in available assimilative capacity would be at North Bay Aqueduct at Barker Slough
 30 Pumping Plant (Barker Slough PP [1%]). Although some small negative changes in selenium
 31 concentrations in water are expected, the effect of Alternative 3 would generally be minimal for the
 32 Delta locations. The modeled selenium concentrations in water (Appendix 8M, Table M-10A) for
 33 Alternative 3 (range 0.21–0.70 µg/L) are very similar to Existing Conditions (range 0.21–0.76 µg/L)
 34 and the No Action Alternative (range 0.21–0.69 µg/L), and all would be below the ecological risk
 35 benchmark (2 µg/L).

36 Relative to Existing Conditions and the No Action Alternative, Alternative 3 would result in minimal
 37 changes in estimated selenium concentrations in biota (whole-body fish, bird eggs [invertebrate
 38 diet], bird eggs [fish diet], and fish fillets) (Appendix 8M, Table M-14 and Addendum M.A to
 39 Appendix 8M, Table M.A-2). Relative to Existing Conditions, the largest increase of selenium
 40 concentrations in biota would be at Barker Slough PP for drought years (except for bird eggs
 41 [assuming a fish diet] at Barker Slough for all years) and for sturgeon at the San Joaquin River at
 42 Antioch in all years, and the largest decrease would be at Buckley Cove for drought years. Relative to
 43 the No Action Alternative, the largest increase also would be at Barker Slough PP for drought years

1 (except for bird eggs [assuming a fish diet] at Barker Slough for all years) and the largest decrease
 2 would be at Staten Island for drought years (except for bird eggs [assuming a fish diet] at Buckley
 3 Cove for drought years). Except for sturgeon in the western Delta, concentrations of selenium in
 4 whole-body fish and bird eggs (invertebrate and fish diets) would exceed only the lower
 5 benchmarks (4 and 6 mg/kg dry weight, respectively, indicating a low potential for effects), under
 6 drought conditions, at Buckley Cove for Alternative 3 (as it would for Existing Conditions and the No
 7 Action Alternative) (Figures 8-61 through 8-63). Exceedance Quotients for all these exceedances of
 8 the lower benchmarks are between 1.0 and 1.5, indicating a low risk to biota in the Delta and no
 9 substantial difference from Existing Conditions and the No Action Alternative. Selenium
 10 concentrations in fish filets would not exceed the screening value for protection of human health
 11 (Figure 8-64). For sturgeon in the western Delta, whole-body selenium concentrations would
 12 increase from 12.3 mg/kg under Existing Conditions and the No Action Alternative to 12.7 mg/kg
 13 under Alternative 3, a 3% increase (Table M.A-2). Although all of these values exceed both the low
 14 and high toxicity benchmarks, it is unlikely that the modeled increases in whole-body selenium for
 15 sturgeon would be measurable in the environment (see also the discussion of results provided in
 16 Addendum M.A to Appendix 8M).

17 Relative to Existing Conditions and the No Action Alternative, Alternative 3 would result in
 18 essentially no change in selenium concentrations throughout the Delta. Alternative 3 would not be
 19 expected to substantially increase the frequency with which applicable benchmarks would be
 20 exceeded in the Delta or substantially degrade the quality of water, with regard to selenium.

21 ***SWP/CVP Export Service Areas***

22 Alternative 3 would result in small changes in average selenium concentrations in water at both
 23 modeled Export Service Area assessment locations relative to Existing Conditions and the No Action
 24 Alternative (Appendix 8M, Table M-10A). These small changes are reflected in small percent
 25 changes (10% or less) in available assimilative capacity for selenium for all years. Relative to
 26 Existing Conditions and the No Action Alternative, Alternative 3 would result in modeled increases
 27 in assimilative capacity at Jones PP (4% and 5%, respectively) and at Banks PP (4% and 3%)
 28 (Figures 8-59 and 8-60) and generally have a small positive effect on the Export Service Area
 29 locations. The modeled selenium concentrations in water (Appendix 8M, Table M-10A) for
 30 Alternative 3 (range 0.37–0.52 µg/L) would generally be similar to those for Existing Conditions
 31 (range 0.37–0.58 µg/L) and the No Action Alternative (range 0.37–0.59 µg/L), and all would be
 32 below the ecological risk benchmark (2 µg/L).

33 Relative to Existing Conditions and the No Action Alternative, Alternative 3 would result in small
 34 changes in estimated selenium concentrations in biota (Appendix 8M, Table M-14). Relative to
 35 Existing Conditions the largest increase of selenium concentrations in biota would be at Banks PP
 36 for drought years (except for bird eggs (assuming a fish diet) at Banks PP for all years), and the
 37 largest decrease would be at Jones PP for all years (except for bird eggs [assuming a fish diet] at
 38 Jones PP for drought years). Relative to the No Action Alternative, the largest increase of selenium in
 39 biota would be at Banks PP for drought years (except for bird eggs (assuming a fish diet) at Banks
 40 PP for all years), and the largest decrease would be at Jones PP for drought years. Furthermore,
 41 concentrations in biota would not exceed any benchmarks for Alternative 3 (Figures 8-61 through 8-
 42 64).

43 Thus, relative to Existing Conditions and the No Action Alternative, Alternative 3 would result in
 44 minimal changes in selenium concentrations throughout at Export Service Area locations. Selenium

1 concentrations in water and biota generally would decrease for Alternative 3 and would not exceed
2 ecological benchmarks at any location, whereas the lower benchmark for bird eggs (fish diet) would
3 be exceeded under Existing Conditions and the No Action Alternative at Jones PP under drought
4 conditions. This small positive change in selenium concentrations under Alternative 3 would be
5 expected to slightly decrease the frequency with which applicable benchmarks would be exceeded
6 or slightly improve the quality of water in at Export Service Area locations, with regard to selenium.

7 **NEPA Effects:** Based on the discussion above, the effects on selenium (both as waterborne and as
8 bioaccumulated in biota) from Alternative 3 are not considered to be adverse.

9 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
10 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
11 purpose of making the CEQA impact determination for selenium. For additional details on the effects
12 assessment findings that support this CEQA impact determination, see the effects assessment
13 discussion that immediately precedes this conclusion.

14 There are no substantial point sources of selenium in watersheds upstream of the Delta, and no
15 substantial nonpoint sources of selenium in the watersheds of the Sacramento River and the eastern
16 tributaries. Nonpoint sources in the San Joaquin Valley that contribute selenium to the Delta will be
17 controlled through a TMDL developed by the Central Valley Water Board (2001) for the lower San
18 Joaquin River, established limits for the Grassland Bypass Project, and Basin Plan objectives (Central
19 Valley Water Board 2010c) and State Water Board (2010d, 2010e) that are expected to result in
20 decreasing discharges of selenium from the San Joaquin River to the Delta. Consequently, any
21 modified reservoir operations and subsequent changes in river flows under Alternative 3, relative to
22 Existing Conditions, are expected to cause negligible changes in selenium concentrations in water.
23 Any negligible changes in selenium concentrations that may occur in the water bodies of the affected
24 environment located upstream of the Delta would not be of frequency, magnitude, and geographic
25 extent that would adversely affect any beneficial uses or substantially degrade the quality of these
26 water bodies as related to selenium.

27 Relative to Existing Conditions, modeling estimates indicate that Alternative 3 would result in
28 essentially no change in selenium concentrations throughout the Delta.

29 Assessment of effects of selenium in the SWP and CVP Export Service Areas is based on effects on
30 selenium concentrations at the Banks and Jones pumping plants. Relative to Existing Conditions,
31 Alternative 3 would slightly decrease the frequency with which applicable benchmarks would be
32 exceeded or slightly improve the quality of water in selenium concentrations at the Banks and Jones
33 pumping plants locations.

34 Based on the above, selenium concentrations that would occur in water under Alternative 3 would
35 not cause additional exceedances of applicable state or federal numeric or narrative water quality
36 objectives/criteria, or other relevant water quality effects thresholds identified for this assessment
37 (Table 8-54), by frequency, magnitude, and geographic extent that would result in adverse effects to
38 one or more beneficial uses within affected water bodies. In comparison to Existing Conditions,
39 water quality conditions under this alternative would not increase levels of selenium by frequency,
40 magnitude, and geographic extent such that the affected environment would be expected to have
41 measurably higher body burdens of selenium in aquatic organisms, thereby substantially increasing
42 the health risks to wildlife (including fish) or humans consuming those organisms. Water quality
43 conditions under this alternative with respect to selenium would not cause long-term degradation of
44 water quality in the affected environment, and therefore would not result in use of available

1 assimilative capacity such that exceedances of water quality objectives/criteria would be likely and
 2 would result in substantially increased risk for adverse effects to one or more beneficial uses. This
 3 alternative would not further degrade water quality by measurable levels, on a long-term basis, for
 4 selenium and, thus, cause the 303(d)-listed impairment of beneficial use to be made discernibly
 5 worse. This impact is considered to be less than significant. No mitigation is required.

6 **Impact WQ-26: Effects on Selenium Concentrations Resulting from Implementation of CM2–**
 7 **CM22**

8 **NEPA Effects:** In general, with the possible exception of changes in Delta hydrodynamics resulting
 9 from habitat restoration, CM2–CM11 would not substantially increase selenium concentrations in
 10 the water bodies of the affected environment. Modeling scenarios included assumptions regarding
 11 how certain habitat restoration activities (CM2 and CM4) would affect Delta hydrodynamics, and
 12 thus such effects of these restoration measures were included in the assessment of CM1 facilities
 13 operations and maintenance (see Impact WQ-25).

14 However, implementation of these conservation measures may increase water residence time
 15 within the restoration areas. Increased restoration area water residence times could potentially
 16 increase the bioaccumulation of selenium in biota, thereby potentially increasing fish tissue and bird
 17 egg concentrations of selenium, but models are not available to quantitatively estimate the level of
 18 changes in residence time and the associated selenium bioavailability. If increases in fish tissue or
 19 bird egg selenium were to occur, the increases would likely be of concern only where fish tissues or
 20 bird eggs are already elevated in selenium to near or above thresholds of concern. That is, where
 21 biota concentrations are currently low and not approaching thresholds of concern, changes in
 22 residence time alone would not be expected to cause them to then approach or exceed thresholds of
 23 concern. In consideration of this factor, although the Delta as a whole is a 303(d)-listed water body
 24 for selenium, and although monitoring data of fish tissue or bird eggs in the Delta are sparse, the
 25 most likely areas in which biota tissues would be at levels high enough that additional
 26 bioaccumulation due to increased residence time from restoration areas would be a concern are the
 27 western Delta and Suisun Bay, and the South Delta in areas that receive San Joaquin River water.

28 The western Delta and Suisun Bay receive elevated selenium loads from North San Francisco Bay
 29 (including San Pablo Bay, Carquinez Strait, and Suisun Bay) and from the San Joaquin River. Point
 30 sources of selenium in North San Francisco Bay (i.e., refineries) that contribute selenium to Suisun
 31 Bay are expected to be reduced through a TMDL under development by the San Francisco Bay Water
 32 Board (San Francisco Bay Water Board 2012) that is expected to result in decreasing discharges of
 33 selenium. Nonpoint sources of selenium in the San Joaquin Valley that contribute selenium to the
 34 San Joaquin River, and thus the Delta and Suisun Bay, will be controlled through a TMDL developed
 35 by the Central Valley Water Board (2001) for the lower San Joaquin River, established limits for the
 36 Grassland Bypass Project, and Basin Plan objectives (Central Valley Water Board 2010c, d) that are
 37 expected to result in decreasing discharges of selenium from the San Joaquin River to the Delta. If
 38 selenium levels are not sufficiently reduced via these efforts, it is expected that the State Water
 39 Board and the San Francisco Bay and Central Valley Water Boards would initiate additional actions
 40 to further control sources of selenium.

41 The South Delta receives elevated selenium loads from the San Joaquin River. In contrast to Suisun
 42 Bay and possibly the western Delta in the future, the South Delta lacks the overbite clam (*Corbula*
 43 [*Potamocorbula*] *amurensis*), which is considered a key driver of selenium bioaccumulation in
 44 Suisun Bay, due to its high bioaccumulation of selenium and its role in the benthic food web that

1 includes long-lived sturgeon. The South Delta does have *Corbicula fluminea*, another bivalve that
2 bioaccumulates selenium, but it is not as invasive as the overbite clam and thus likely makes up a
3 smaller fraction of sturgeon diet. Also, as mentioned above, nonpoint sources of selenium in the San
4 Joaquin Valley that contribute selenium to the Delta will be controlled through a TMDL developed by
5 the Central Valley Water Board (2001) for the lower San Joaquin River, established limits for the
6 Grassland Bypass Project, and Basin Plan objectives (Central Valley Water Board 2010c, d) that are
7 expected to result in decreasing discharges of selenium from the San Joaquin River to the Delta.
8 Further, if selenium levels in the San Joaquin River are not sufficiently reduced via these efforts, it is
9 expected that the State Water Board and Central Valley Water Board would initiate additional
10 TMDLs to further control nonpoint sources of selenium.

11 Wetland restoration areas will not be designed such that water flows in and does not flow out.
12 Exchange of water between the restoration areas and existing Delta channels is an important design
13 factor, since one goal of the restoration areas is to export food produced in these areas to the rest of
14 the Delta (see BDCP Chapter 3, *Conservation Strategy*, Section 3.3, Biological Goals and Objectives).
15 Thus, these areas can be thought of as “flow-through” systems. Consequently, although water
16 residence times associated with BDCP restoration could increase, they are not expected to increase
17 without bound. and selenium concentrations in the water column would not continue to build up
18 and be recycled in sediments and organisms as may be the case within a closed system.

19 However, because increases in bioavailable selenium in the habitat restoration areas are uncertain,
20 proposed avoidance and minimization measures would require evaluating risks of selenium
21 exposure at a project level for each restoration area, minimizing to the extent practicable potential
22 risk of additional bioaccumulation, and monitoring selenium levels in fish and/or wildlife to
23 establish whether, or to what extent, additional bioaccumulation is occurring. See Appendix 3B,
24 *Environmental Commitments* for a description of the environmental commitment BDCP proponents
25 are making with respect to Selenium Management; and Appendix 3.C. of the BDCP for additional
26 detail on this avoidance and minimization measure (AMM27). Data generated as part of the
27 avoidance and minimization measures will assist the State and Regional Water Boards in
28 determining whether beneficial uses are being impacted by selenium, and thus will provide the data
29 necessary to support regulatory actions (including additional TMDL development), should such
30 actions be warranted.

31 Given the factors discussed in the assessment above, any increases in bioaccumulation rates from
32 water-borne selenium that could occur in some areas as a result of increased water residence time
33 would not be of sufficient magnitude and geographic extent that any portion of the Delta would be
34 expected to have measurably higher body burdens of selenium in aquatic organisms and, therefore,
35 would not substantially increase risk for adverse effects to beneficial uses. Furthermore, although
36 the Delta is a 303(d)-listed water body for selenium, given the discussion in the assessment above, it
37 is unlikely that restoration areas would result in measurable increases in selenium in fish tissues or
38 bird eggs such that the beneficial use impairment would be made discernibly worse.

39 Because it is unlikely that substantial increases in selenium in fish tissues or bird eggs would occur
40 such that effects on aquatic life beneficial uses would be anticipated, and because of the avoidance
41 and minimization measures that are designed to further minimize and evaluate the risk of such
42 increases, the effects of WQ-26 are considered not adverse.

43 **CEQA Conclusion:** There would be no substantial, long-term increase in selenium concentrations in
44 water in the rivers and reservoirs upstream of the Delta, water in the Delta, or the waters exported

1 to the CVP and SWP service areas due to implementation of CM2–CM22 relative to Existing
2 Conditions. Waterborne selenium concentrations under this alternative would not exceed applicable
3 water quality objectives/criteria.

4 Given the factors discussed in the assessment above, any increases in bioaccumulation rates from
5 water-borne selenium that could occur in some areas as a result of increased water residence times
6 would not be of sufficient magnitude and geographic extent that any portion of the Delta would be
7 expected to have measurably higher body burdens of selenium in aquatic organisms, and therefore
8 would not substantially increase risk for adverse effects to beneficial uses. CM2-22 would not cause
9 long-term degradation of water quality resulting in sufficient use of available assimilative capacity
10 such that occasionally exceeding water quality objectives/criteria would be likely. Also, CM2-22
11 would not result in substantially increased risk for adverse effects to any beneficial uses.

12 Furthermore, although the Delta is a 303(d)-listed water body for selenium, given the discussion in
13 the assessment above, it is unlikely that restoration areas would result in measurable increases in
14 selenium in fish tissues or bird eggs such that the beneficial use impairment would be made
15 discernibly worse.

16 Since it is unlikely that substantial increases in selenium in fish tissues or bird eggs would occur
17 such that effects on aquatic life beneficial uses would be anticipated, and because of the avoidance
18 and minimization measures that are designed to further minimize and evaluate the risk of such
19 increases (see Appendix 3.C. of the BDCP for more detail on AMM27) as well as the Selenium
20 Management environmental commitment (see Appendix 3B, *Environmental Commitments*), this
21 impact is considered less than significant. No mitigation is required.

22 **Impact WQ-27: Effects on Trace Metal Concentrations Resulting from Facilities Operations** 23 **and Maintenance (CM1)**

24 ***Upstream of the Delta***

25 For the same reasons stated for the No Action Alternative, Alternative 3 would result in negligible,
26 and likely immeasurable, increases in trace metal concentrations in the rivers and reservoirs
27 upstream of the Delta, relative to Existing Conditions and the No Action Alternative. Effects due to
28 the operation and maintenance of the conveyance facilities are expected to be immeasurable, on an
29 annual and long-term average basis. As such, Alternative 3 would not be expected to substantially
30 increase the frequency with which applicable Basin Plan objectives or CTR criteria would be
31 exceeded in water bodies of the affected environment located upstream of the Delta or substantially
32 degrade the quality of these water bodies, with regard to trace metals.

33 ***Delta***

34 For the same reasons stated for the No Action Alternative, Alternative 3 would not result in
35 substantial increases in trace metal concentrations in the Delta relative to Existing Conditions and
36 the No Action Alternative. Effects due to the operation and maintenance of the conveyance facilities
37 are expected to be negligible, on a long-term average basis. As such, Alternative 3 would not be
38 expected to substantially increase the frequency with which applicable Basin Plan objectives or CTR
39 criteria would be exceeded in the Delta or substantially degrade the quality of Delta waters, with
40 regard to trace metals.

1 **SWP/CVP Export Service Areas**

2 For the same reasons stated for the No Action Alternative, Alternative 3 would not result in
3 substantial increases in trace metal concentrations in the water exported from the Delta or diverted
4 from the Sacramento River through the proposed conveyance facilities. As such, there is not
5 expected to be substantial changes in trace metal concentrations in the SWP/CVP export service
6 area waters under Alternative 3, relative to Existing Conditions and the No Action Alternative. As
7 such, Alternative 3 would not be expected to substantially increase the frequency with which
8 applicable Basin Plan objectives or CTR criteria would be exceeded in the water bodies of the
9 affected environment in the SWP and CVP Service Area or substantially degrade the quality of these
10 water bodies, with regard to trace metals.

11 **NEPA Effects:** In summary, Alternative 3, relative to the No Action Alternative, would not cause a
12 substantial increase in long-term average trace metals concentrations within the affected
13 environment, nor would it cause an increased frequency of water quality objective/criteria
14 exceedances within the affected environment. The effect on trace metals is determined not to be
15 adverse.

16 **CEQA Conclusion:** Effects of CM1 on trace metals under Alternative 3 would be similar to those
17 discussed for Alternative 1A, and are summarized here, then compared to the CEQA thresholds of
18 significance (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for
19 this constituent. For additional details on the effects assessment findings that support this CEQA
20 impact determination, see the effects assessment discussion under Alternative 1A.

21 While greater water demands under the Alternative 3 would alter the magnitude and timing of
22 reservoir releases north, south and east of the Delta, these activities would have no substantial effect
23 on the various watershed sources of trace metals. Moreover, long-term average flow and trace
24 metals at Sacramento River at Hood and San Joaquin River at Vernalis are poorly correlated;
25 therefore, changes in river flows would not be expected to cause a substantial long-term change in
26 trace metal concentrations upstream of the Delta.

27 Average and 95th percentile trace metal concentrations are very similar across the primary source
28 waters to the Delta. Given this similarity, very large changes in source water fraction would be
29 necessary to effect a relatively small change in trace metal concentration at a particular Delta
30 location. Moreover, average and 95th percentile trace metal concentrations for these primary source
31 waters are all below their respective water quality criteria, including those that are hardness-based
32 without a WER adjustment. No mixing of these three source waters could result in a metal
33 concentration greater than the highest source water concentration, and given that trace metals do
34 not already exceed water quality criteria, more frequent exceedances of criteria in the Delta would
35 not be expected to occur under the Alternative 3.

36 The assessment of the Alternative 3 effects on trace metals in the SWP/CVP Export Service Areas is
37 based on assessment of changes in trace metal concentrations at Banks and Jones pumping plants.
38 As just discussed regarding similarities in Delta source water trace metal concentrations, the
39 Alternative 3 is not expected to result in substantial changes in trace metal concentrations in Delta
40 waters, including Banks and Jones pumping plants, therefore effects on trace metal concentrations
41 in the SWP/CVP Export Service Area are expected to be negligible.

42 Based on the above, there would be no substantial long-term increase in trace metal concentrations
43 in the rivers and reservoirs upstream of the Delta, in the Delta Region, or the SWP/CVP export

1 service area waters under Alternative 3 relative to Existing Conditions. As such, this alternative is
2 not expected to cause additional exceedance of applicable water quality objectives by frequency,
3 magnitude, and geographic extent that would cause adverse effects on any beneficial uses of waters
4 in the affected environment. Because trace metal concentrations are not expected to increase
5 substantially, no long-term water quality degradation for trace metals is expected to occur and, thus,
6 no adverse effects to beneficial uses would occur. Furthermore, any negligible changes in long-term
7 trace metal concentrations that may occur in water bodies of the affected environment would not be
8 expected to make any existing beneficial use impairments measurably worse. The trace metals
9 discussed in this assessment are not considered bioaccumulative, and thus would not directly cause
10 bioaccumulative problems in aquatic life or humans. This impact is considered to be less than
11 significant. No mitigation is required.

12 **Impact WQ-28: Effects on Trace Metal Concentrations Resulting from Implementation of** 13 **CM2–CM22**

14 **NEPA Effects:** Conservation Measures 2–22 proposed under Alternative 3 would be the same as
15 those proposed under Alternative 1A. As such, effects on trace metals resulting from the
16 implementation of CM2–CM22 would be similar to that previously discussed for Alternative 1A. As
17 they pertain to trace metals, implementation of CM2–CM22 would not be expected to adversely
18 affect beneficial uses of the affected environment or substantially degrade water quality with
19 respect to trace metals.

20 In summary, implementation of CM2–CM22 under Alternative 3, relative to the No Action
21 Alternative, would have negligible, if any, effect on trace metals concentrations. The effect on trace
22 metals from implementing CM2–CM22 is determined not to be adverse.

23 **CEQA Conclusion:** Implementation of CM2–CM22 under Alternative 3 would not cause substantial
24 long-term increase in trace metal concentrations in the rivers and reservoirs upstream of the Delta,
25 in the Delta Region, or the SWP/CVP export service area. As such, this alternative is not expected to
26 cause additional exceedance of applicable water quality objectives by frequency, magnitude, and
27 geographic extent that would cause adverse effects on any beneficial uses of waters in the affected
28 environment. Because trace metal concentrations are not expected to increase substantially, no
29 long-term water quality degradation for trace metals is expected to occur and, thus, no adverse
30 effects to beneficial uses would occur. Furthermore, any negligible changes in long-term trace metal
31 concentrations that may occur throughout the affected environment would not be expected to make
32 any existing beneficial use impairments measurably worse. The trace metals discussed in this
33 assessment are not considered bioaccumulative, and thus would not directly cause bioaccumulative
34 problems in aquatic life or humans. This impact is considered to be less than significant. No
35 mitigation is required.

36 **Impact WQ-29: Effects on TSS and Turbidity Resulting from Facilities Operations and** 37 **Maintenance (CM1)**

38 **NEPA Effects:** Effects of CM1 on TSS and turbidity under Alternative 3 are the same as those
39 discussed for Alternative 1A. The effects on TSS and turbidity from implementing CM1 is determined
40 to not be adverse.

41 **CEQA Conclusion:** Effects of CM1 on TSS and turbidity under Alternative 3 would be similar to those
42 discussed for Alternative 1A, and are summarized here, then compared to the CEQA thresholds of
43 significance (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for

1 this constituent. For additional details on the effects assessment findings that support this CEQA
2 impact determination, see the effects assessment discussion under Alternative 1A.

3 Changes river flow rate and reservoir storage that would occur under Alternative 3, relative to
4 Existing Conditions, would not be expected to result in a substantial adverse change in TSS
5 concentrations and turbidity levels in the reservoirs and rivers upstream of the Delta, given that
6 suspended sediment concentrations are more affected by season than flow. Site-specific and
7 temporal exceptions may occur due to localized temporary construction activities, dredging
8 activities, development, or other land use changes would be site-specific and temporal, which would
9 be regulated to limit both their short-term and long-term effects on TSS and turbidity levels to less
10 than substantial levels.

11 Within the Delta, geomorphic changes associated with sediment transport and deposition are
12 usually gradual, occurring over years, and high storm event inflows would not be substantially
13 affected. Thus, it is expected that the TSS concentrations and turbidity levels in the affected channels
14 would not be substantially different from the levels under Existing Conditions. Consequently, this
15 alternative is expected to have minimal effect on TSS concentrations and turbidity levels in the Delta
16 region, relative to Existing Conditions.

17 There is not expected to be substantial, if even measurable, changes in TSS concentrations and
18 turbidity levels in the SWP/CVP Export Service Areas waters under Alternative 3, relative to Existing
19 Conditions, because this alternative is not expected to result in substantial changes in TSS
20 concentrations and turbidity levels at the south Delta export pumps, relative to Existing Conditions.

21 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
22 objectives where such objectives are not exceeded under Existing Conditions. Because TSS
23 concentrations and turbidity levels are not expected to be substantially different, long-term water
24 quality degradation is not expected, and, thus, beneficial uses are not expected to be adversely
25 affected. Finally, TSS and turbidity are neither bioaccumulative nor Clean Water Act section 303(d)
26 listed constituents. This impact is considered to be less than significant. No mitigation is required.

27 **Impact WQ-30: Effects on TSS and Turbidity Resulting from Implementation of CM2–CM22**

28 **NEPA Effects:** Effects of CM2–CM22 on TSS and turbidity under Alternative 3 are the same as those
29 discussed for Alternative 1A. The effects on TSS and turbidity from implementing CM2–CM22 is
30 determined to not be adverse.

31 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 3 would be similar to
32 those proposed under Alternative 1A. As such, effects on TSS and turbidity resulting from the
33 implementation of CM2–CM22 would be similar to that previously discussed for Alternative 1A. This
34 impact is considered to be less than significant. No mitigation is required.

35 **Impact WQ-31: Water Quality Effects Resulting from Construction-Related Activities (CM1– 36 CM22)**

37 **NEPA Effects:** The conveyance features for CM1 under Alternative 3 would be very similar to those
38 discussed for Alternative 1A. The primary difference between Alternative 3 and Alternative 1A is
39 that under Alternative 3, there would be three fewer intakes and three fewer pumping plants
40 constructed, which would result reduce the level of construction activity. However, construction
41 techniques and locations of major features of the conveyance system within the Delta would be

1 similar. The remainder of the facilities constructed under Alternative 3, including CM2–CM22, would
2 be very similar to, or the same as, those to be constructed for Alternative 1A.

3 The types and magnitude of potential construction-related water quality effects associated with
4 implementation of CM1 under Alternative 3 would be very similar to the effects discussed for
5 Alternative 1A, and the effects anticipated with implementation of CM2–CM22 would be essentially
6 identical. Nevertheless, the construction of CM1, and any individual components necessitated by
7 CM2, and CM4–CM10, with the implementation of the BMPs specified in Appendix 3B, *Environmental*
8 *Commitments* and other agency permitted construction requirements would result in the potential
9 water quality effects being largely avoided and minimized. The specific environmental commitments
10 that would be implemented under Alternative 3 would be similar to those described for Alternative
11 1A. Consequently, relative to the No Action Alternative, Alternative 3 would not be expected to cause
12 exceedance of applicable water quality objectives/criteria or substantial water quality degradation
13 with respect to constituents of concern, and thus would not adversely affect any beneficial uses
14 upstream of the Delta, in the Delta, or in the SWP and CVP service area.

15 In summary, with implementation of environmental commitments in Appendix 3B, the potential
16 construction-related water quality effects are considered to be not adverse.

17 **CEQA Conclusion:** Because environmental commitments would be implemented under Alternative 3
18 for construction-related activities along with agency-issued permits that also contain construction
19 requirements to protect water quality, the construction-related effects, relative to Existing
20 Conditions, would not be expected to cause or contribute to substantial alteration of existing
21 drainage patterns which would result in substantial erosion or siltation on- or off-site, substantial
22 increased frequency of exceedances of water quality objectives/criteria, or substantially degrade
23 water quality with respect to the constituents of concern on a long-term average basis, and thus
24 would not adversely affect any beneficial uses in water bodies upstream of the Delta, within the
25 Delta, or in the SWP and CVP service area. Moreover, because the construction-related activities
26 would be temporary and intermittent in nature, the construction would involve negligible
27 discharges, if any, of bioaccumulative or 303(d) listed constituents to water bodies of the affected
28 environment. As such, construction activities would not contribute measurably to bioaccumulation
29 of contaminants in organisms or humans or cause 303(d) impairments to be discernibly worse.
30 Based on these findings, this impact is determined to be less than significant. No mitigation is
31 required.

32 **8.4.3.9 Alternative 4—Dual Conveyance with Modified Pipeline/Tunnel** 33 **and Intakes 2, 3, and 5 (9,000 cfs; Operational Scenario H)**

34 Alternative 4 would comprise physical/structural components similar to those under Alternative
35 1A, however, there are notable differences. Alternative 4 would convey up to 9,000 cfs of water from
36 the north Delta to the south Delta and that Alternative 4 would include an operable barrier at the
37 head of Old River. Diverted water would be conveyed through pipelines/tunnels from three
38 screened intakes (i.e., Intakes 2, 3 and 5) located on the east bank of the Sacramento River between
39 Clarksburg and Courtland. Alternative 4 would include a 245 acre intermediate forebay at Glannvale
40 Tract. Clifton Court Forebay would be dredged and expanded by approximately 690 acres to the
41 southeast of the existing forebay. Water supply and conveyance operations would follow the
42 guidelines described as Scenario H1, H2, H3, or H4, which variously include or exclude
43 implementation of fall X2 and/or enhanced spring outflow. Conservation Measures 2–22 would be

1 implemented under this alternative, and would be the same as those under Alternative 1A. See
2 Chapter 3, *Description of Alternatives*, Section 3.5.9, for additional details on Alternative 4.

3 **Effects of the Alternative on Delta Hydrodynamics**

4 Under the No Action Alternative and Alternatives 1–9, the following two primary factors can
5 substantially affect water quality within the Delta:

- 6 • Within the south, west, and interior Delta, a decrease in the percentage of Sacramento River-
7 sourced water and a concurrent increase in San Joaquin River-sourced water can increase the
8 concentrations of numerous constituents (e.g., boron, bromide, chloride, electrical conductivity,
9 nitrate, organic carbon, some pesticides, selenium). This source water replacement is caused by
10 decreased exports of San Joaquin River water (due to increased Sacramento River water
11 exports), or effects of climate change on timing of flows in the rivers. Changes in channel flows
12 also can affect water residence time and many related physical, chemical, and biological
13 variables.
- 14 • Particularly in the west Delta, sea water intrusion as a result of sea level rise or decreased Delta
15 outflow can increase the concentration of salts (bromide, chloride) and levels of electrical
16 conductivity. Conversely, increased Delta outflow (e.g., as a result of Fall X2 operations in wet
17 and above normal water years) will decrease levels of these constituents, particularly in the
18 west Delta.

19 Under Alternative 4, over the long term, average annual delta exports are anticipated to range from
20 an increase of 112 TAF under scenario H1 to a decrease by 730 TAF under scenario H4 relative to
21 Existing Conditions, and an increase by 815 TAF under scenario H1 to a decrease of 27 TAF under
22 scenario H4 relative to the No Action Alternative. Since, over the long-term, between 47 (scenario
23 H1) and 49% (scenario H4) of the exported water will be from the new north Delta intakes, average
24 monthly diversions at the south Delta intakes would be decreased because of the shift in diversions
25 to the north Delta intakes (see Chapter 5, *Water Supply*, for more information). The result of this is
26 increased San Joaquin River water influence throughout the south, west, and interior Delta, and a
27 corresponding decrease in Sacramento River water influence. This can be seen, for example, in
28 Appendix 8D, ALT 4, H3–Old River at Rock Slough for ALL years (1976–1991), which shows
29 increased San Joaquin River (SJR) percentage and decreased Sacramento River (SAC) percentage
30 under the alternative, relative to Existing Conditions and the No Action Alternative.

31 Under Alternative 4, long-term average annual Delta outflow is anticipated to range from a decrease
32 of 114 TAF under scenario H1 to an increase 744 TAF under scenario H4 relative to Existing
33 Conditions, due to both changes in operations (including north Delta intake capacity of 9,000 cfs,
34 Fall X2, and numerous other operational components of scenarios H1 through H4) and climate
35 change/sea level rise (see Chapter 5, *Water Supply*, for more information). Long-term average
36 annual Delta outflow is anticipated to decrease under Alternative 4 by between 864 (scenario H1)
37 and 5 TAF (scenario H4) relative to the No Action Alternative, due only to changes in operations. The
38 result of this is increased sea water intrusion in the west Delta. The increase in sea water intrusion
39 (represented by an increase in San Francisco Bay (BAY) percentage) can be seen, for example, in
40 Appendix 8D, ALT 4, H3–Sacramento River at Mallard Island for ALL years (1976–1991).

1 **Impact WQ-1: Effects on Ammonia Concentrations Resulting from Facilities Operations and**
2 **Maintenance (CM1)**

3 ***Upstream of the Delta***

4 Substantial point sources of ammonia-N do not exist upstream of the SRWTP in the Sacramento
5 River watershed, in the watersheds of the eastern tributaries (Cosumnes, Mokelumne, and Calaveras
6 Rivers), or upstream of the Delta in the San Joaquin River watershed. Nonpoint sources of ammonia-
7 N within the watersheds are also relatively low, thus resulting in generally low ammonia-N
8 concentrations in the reservoirs and rivers of the watersheds. Consequently, any modified reservoir
9 operations and subsequent changes in river flows under Alternative 4 (including the different
10 operational components of Scenarios H1-H4) would have negligible, if any, effect on ammonia
11 concentrations in the rivers and reservoirs upstream of the Delta relative to Existing Conditions and
12 the No Action Alternative. Any negligible increases in ammonia-N concentrations that could occur in
13 the water bodies of the affected environment located upstream of the Delta would not be of
14 frequency, magnitude and geographic extent that would adversely affect any beneficial uses or
15 substantially degrade the quality of these water bodies, with regard to ammonia.

16 ***Delta***

17 As summarized in Table 8-40, it is assumed that SRWTP effluent ammonia concentrations would be
18 substantially lower under Alternative 4 than under Existing Conditions, and would be the same as
19 would occur under the No Action Alternative. Relative to Existing Conditions, ammonia-N
20 concentrations downstream of the SRWTP would be substantially lower under Alternative 4
21 (including the different operational components of Scenarios H1-H4) because it is assumed that
22 SRWTP upgrades would be in place, and thus that the average monthly effluent ammonia-N
23 concentration would not exceed 1.5 mg/L-N in April through October or 2.4 mg/L-N in November
24 through March. Consequently, a substantial decrease in Sacramento River ammonia-N
25 concentrations is expected to decrease ammonia concentrations for all areas of the Delta that are
26 influenced by Sacramento River water. Concentrations of ammonia-N at locations not influenced
27 notably by Sacramento River water will change little relative to Existing Conditions, due to the
28 similarity in SJR and BAY concentrations and the lack of expected changes in either of these
29 concentrations. Thus, Alternative 4 would not result in substantial increases in ammonia
30 concentrations in the Plan Area, relative to Existing Conditions.

31 Because the SRWTP discharge ammonia concentrations are assumed to be the same under
32 Alternative 4 as would occur under the No Action Alternative, the primary mechanism that could
33 potentially increase ammonia concentrations in the Delta under Alternative 4, relative to the No
34 Action Alternative, is decreased flows in the Sacramento River, which would lower dilution available
35 to the SRWTP discharge. This change would be attributable only to operations of Alternative 4, since
36 the same assumptions regarding water demands, climate change, and sea level rise are included in
37 both Alternative 1A and the No Action Alternative.

38 To address this possibility, a simple mixing calculation was performed to assess concentrations of
39 ammonia downstream of the SRWTP discharge (i.e., downstream of Freeport) under Alternative 4
40 and the No Action Alternative. Monthly average CALSIM II flows at Freeport and the upstream
41 ammonia concentration (0.04 mg/L-N; Central Valley Water Board 2010a:5) were used, together
42 with the SRWTP permitted average dry weather flow (181 mgd) and seasonal ammonia
43 concentration (1.5 mg/L-N in Apr-Oct, 2.4 mg/L-N in Nov-Mar), to estimate the average change in

1 ammonia concentrations downstream of the SRWTP. Table 8-67 shows monthly average and long
2 term annual average predicted concentrations under the two scenarios.

3 As Table 8-67 shows, average monthly ammonia-N concentrations in the Sacramento River
4 downstream of Freeport (upon full mixing of the SRWTP discharge with river water) under the four
5 different operational scenarios of Alternative 4 and under the No Action Alternative are expected to
6 be similar (Table 8-67). In comparison to the No Action Alternative, minor increases in monthly
7 average ammonia-N concentrations would occur during February, July through September, and
8 during November for all operational scenarios (H1 through H4). Under operational scenario H2 and
9 H4, minor increases in ammonia-N concentrations also would occur in the months of January and
10 March. In the month of December, average ammonia-N concentrations would increase slightly for
11 scenario H4. Minor decreases in ammonia-N concentrations are expected for all scenarios (H1
12 through H4) in May and June, while minor decreases would also occur in October under scenario H1.

13 A minor increase in the annual average concentration would occur under the different operational
14 components of scenarios H1 through H4 of Alternative 4, compared to the No Action Alternative.
15 Moreover, the estimated concentrations downstream of Freeport under Alternative 4 would be
16 similar to existing source water concentrations for the San Francisco Bay and San Joaquin River.
17 Consequently, changes in source water fraction anticipated under Alternative 4, relative to the No
18 Action Alternative, are not expected to substantially increase ammonia concentrations at any Delta
19 locations.

20 Any negligible increases in ammonia-N concentrations that could occur at certain locations in the
21 Delta would not be of frequency, magnitude and geographic extent that would adversely affect any
22 beneficial uses or substantially degrade the water quality at these locations, with regards to
23 ammonia.

24 **Table 8-67. Estimated Ammonia-N (mg-L as N) Concentrations in the Sacramento River Downstream of**
25 **the Sacramento Regional Wastewater Treatment Plant for the No Action Alternative and Alternative 4**
26 **Operational Scenarios H1, H2, H3, and H4.**

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual Average
No Action Alternative	0.074	0.084	0.069	0.060	0.057	0.060	0.058	0.064	0.067	0.060	0.067	0.064	0.065
Scenario H1	0.073	0.090	0.068	0.060	0.058	0.060	0.058	0.063	0.062	0.062	0.070	0.076	0.067
Scenario H2	0.074	0.088	0.069	0.061	0.058	0.061	0.058	0.063	0.062	0.062	0.070	0.065	0.066
Scenario H3	0.074	0.090	0.069	0.060	0.058	0.060	0.057	0.062	0.066	0.064	0.071	0.075	0.067
Scenario H4	0.074	0.088	0.070	0.061	0.058	0.061	0.057	0.062	0.066	0.064	0.071	0.065	0.066

28 *SWP/CVP Export Service Areas*

29 The assessment of effects on ammonia in the SWP and CVP Export Service Area is based on
30 assessment of ammonia-N concentrations at Banks and Jones pumping plants. The dominant source
31 waters influencing the Banks and Jones pumping plants are the Sacramento and San Joaquin Rivers
32 (see Appendix 8D). As discussed above for the Plan Area, for areas of the Delta that are influenced by
33 Sacramento River water, including Banks and Jones pumping plants, ammonia-N concentrations are
34 expected to decrease under Alternative 4, relative to Existing Conditions (in association with less
35 diversion of water influenced by the SRWTP). This decrease in ammonia-N concentrations for water

1 exported via the south Delta pumps is not expected to result in an adverse effect on beneficial uses
2 or substantially degrade water quality of exported water, with regards to ammonia.

3 Furthermore, as discussed above for the Plan Area, for all areas of the Delta, including Banks and
4 Jones pumping plants, ammonia-N concentrations are not expected to be substantially different
5 under the four different operational scenarios of Alternative 4, relative to No Action Alternative. Any
6 negligible increases in ammonia-N concentrations that could occur at Banks and Jones pumping
7 plants would not be of frequency, magnitude and geographic extent that would adversely affect any
8 beneficial uses or substantially degrade the water quality at these locations, with regards to
9 ammonia.

10 **NEPA Effects:** In summary, based on the discussion above, effects on ammonia from implementation
11 of CM1 are considered to be not adverse.

12 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
13 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
14 purpose of making the CEQA impact determination for this constituent. For additional details on the
15 effects assessment findings that support this CEQA impact determination, see the effects assessment
16 discussion that immediately precedes this conclusion.

17 Ammonia-N concentrations are generally low in the reservoirs and rivers of the watersheds, owing
18 to the lack of substantial point and nonpoint sources of ammonia-N upstream of the SRWTP in the
19 Sacramento River watershed, in the watersheds of the eastern tributaries (Cosumnes, Mokelumne,
20 and Calaveras Rivers), or upstream of the Delta in the San Joaquin River watershed. Consequently,
21 any modified reservoir operations and subsequent changes in river flows under Alternative 4,
22 relative to Existing Conditions, are expected to have negligible, if any, effects on reservoir and river
23 ammonia-N concentrations upstream of Freeport in the Sacramento River watershed and upstream
24 of the Delta in the San Joaquin River watershed.

25 Ammonia-N concentrations in the Sacramento River downstream of the SRWTP would be
26 substantially lower under Alternative 4 (regardless of operational scenario), relative to Existing
27 Conditions, due to upgrades to the SRWTP that are assumed to be in place, and thus, ammonia
28 concentrations for all areas of the Delta that are influenced by Sacramento River water are expected
29 to decrease. At locations which are not influenced notably by Sacramento River water,
30 concentrations are expected to remain relatively unchanged compared to Existing Conditions, due to
31 the similarity in SJR and BAY concentrations and the lack of expected changes in either of these
32 concentrations.

33 The assessment of effects on ammonia in the SWP/CVP Export Service Areas is based on assessment
34 of ammonia-N concentrations at Banks and Jones pumping plants. As discussed above for the Plan
35 Area, for areas of the Delta that are influenced by Sacramento River water, including Banks and
36 Jones pumping plants, ammonia-N concentrations are expected to decrease under Alternative 4,
37 relative to Existing Conditions.

38 Based on the above, there would be no substantial, long-term increase in ammonia-N concentrations
39 in the rivers and reservoirs upstream of the Delta, in the Plan Area, or the waters exported to the
40 CVP and SWP service areas under Alternative 4 relative to Existing Conditions. As such, this
41 alternative is not expected to cause additional exceedance of applicable water quality
42 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
43 on any beneficial uses of waters in the affected environment. Because ammonia concentrations are

1 not expected to increase substantially, no long-term water quality degradation is expected to occur
2 and, thus, no adverse effects on beneficial uses would occur. Ammonia is not 303(d) listed within the
3 affected environment and thus any minor increases that could occur in some areas would not make
4 any existing ammonia-related impairment measurably worse because no such impairments
5 currently exist. Because ammonia-N is not bioaccumulative, minor increases that could occur in
6 some areas would not bioaccumulate to greater levels in aquatic organisms that would, in turn, pose
7 substantial health risks to fish, wildlife, or humans. This impact is considered to be less than
8 significant. No mitigation is required.

9 **Impact WQ-2: Effects on Ammonia Concentrations Resulting from Implementation of CM2–**
10 **CM22**

11 **NEPA Effects:** Some habitat restoration activities would occur on lands in the Delta formerly used
12 for irrigated agriculture. Although this may decrease ammonia loading to the Delta from agriculture,
13 increased biota in those areas as a result of restored habitat may increase ammonia loading
14 originating from flora and fauna. Ammonia loaded from organisms is expected to be converted
15 rapidly to nitrate by established microbial communities. Thus, these land use changes would not be
16 expected to substantially increase ammonia concentrations in the Delta. In general, with the
17 exception of changes in Delta hydrodynamics resulting from habitat restoration, CM2–CM11 would
18 not substantially increase ammonia concentrations in the water bodies of the affected environment.
19 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
20 and CM4) would affect Delta hydrodynamics, and thus such effects of these restoration measures
21 were included in the assessment of CM1 facilities operations and maintenance (see Impact WQ-1).
22 Additionally, implementation of CM12–CM22 would not be expected to substantially alter ammonia
23 concentrations in the affected environment.

24 The effects of ammonia from implementation of CM2–22 are considered to be not adverse.

25 **CEQA Conclusion:** There would be no substantial, long-term increase in ammonia-N concentrations
26 in the rivers and reservoirs upstream of the Delta, in the Plan Area, or the waters exported to the
27 CVP and SWP service areas due to implementation of CM2–CM22 relative to Existing Conditions. As
28 such, implementation of these conservation measures would not be expected to cause additional
29 exceedance of applicable water quality objectives/criteria by frequency, magnitude, and geographic
30 extent that would cause significant impacts on any beneficial uses of waters in the affected
31 environment. Because ammonia concentrations would not be expected to increase substantially
32 from implementation of these conservation measures, no long-term water quality degradation
33 would be expected to occur and, thus, no significant impact on beneficial uses would occur.
34 Ammonia is not 303(d) listed within the affected environment and thus any minor increases that
35 could occur in some areas would not make any existing ammonia-related impairment measurably
36 worse because no such impairments currently exist. Because ammonia-N is not bioaccumulative,
37 minor increases that could occur in some areas would not bioaccumulate to greater levels in aquatic
38 organisms that would, in turn, pose substantial health risks to fish, wildlife, or humans. This impact
39 is considered less than significant. No mitigation is required.

1 **Impact WQ-3: Effects on Boron Concentrations Resulting from Facilities Operations and**
2 **Maintenance (CM1)**

3 ***Upstream of the Delta***

4 Under Alternative 4 Scenarios H1–H4, there would be no expected change to the sources of boron in
5 the Sacramento and east-side tributary watersheds, and resultant changes in flows from altered
6 system-wide operations would have negligible, if any, effects on the concentration of boron in the
7 rivers and reservoirs of these watersheds. The modeled long-term annual average lower San Joaquin
8 River flow at Vernalis would decrease by an estimated 6%, relative to Existing Conditions (in
9 association with the different operational components of Scenarios H1–H4 for Alternative 4, climate
10 change, and increased water demands) and would remain virtually the same relative to the No
11 Action Alternative considering only changes due only to the different operational components of
12 Scenarios H1–H4 under Alternative 4. The reduced flow would result in possible increases in long-
13 term average boron concentrations of up to about 3% relative to the Existing Conditions, which
14 would be nearly identical under each of the H1–H4 scenarios (Appendix 8F, Table Bo-24). The
15 increased boron concentrations would not increase the frequency of exceedances of any applicable
16 objectives or criteria and would not be expected to cause further degradation at measurable levels
17 in the lower San Joaquin River, and thus would not cause the existing impairment there to be
18 discernibly worse. Consequently, Alternative 4 would not be expected to cause exceedance of boron
19 objectives/criteria or substantially degrade water quality with respect to boron, and thus would not
20 adversely affect any beneficial uses of the Sacramento River, the east-side tributaries, associated
21 reservoirs upstream of the Delta, or the San Joaquin River.

22 ***Delta***

23 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
24 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
25 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
26 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
27 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
28 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

29 The effects relative to Existing Conditions and the No Action Alternative are discussed together
30 because the direction and magnitude of predicted change are so similar. Relative to Existing
31 Conditions, the following changes reflect the range of effects that would result from the four
32 potential outcomes under the Alternative 4 H1–H4 Scenarios. There would be generally similar
33 increased long-term average boron concentrations for the 16-year period modeled at interior Delta
34 locations (by as much as 8% at the SF Mokelumne River at Staten Island for all H1–H4 Scenarios,
35 from 12% for H1 to 15% for H4 at Franks Tract, and from 11% for H1 to 18% for H4 at Old River at
36 Rock Slough) (Appendix 8F, Tables Bo-12A/12D). The comparisons to Existing Conditions reflects
37 changes due to the different operational components of Scenarios H1–H4 for Alternative 4 and
38 climate change/sea level rise. Comparison to the No Action Alternative reflects changes due only to
39 the different operational components of Scenarios H1–H4 for Alternative 4.

40 Implementation of tidal habitat restoration under CM4 also may contribute to increased boron
41 concentrations at western Delta assessment locations (more discussion of this phenomenon is
42 included in Section 8.3.1.3), and thus would not be anticipated to substantially affect agricultural
43 diversions which occur primarily at interior Delta locations. The long-term annual average and
44 monthly average boron concentrations, for either the 16-year period or drought period modeled,

1 would never exceed the 2,000 µg/L human health advisory objective (i.e., for children) or 500 µg/L
2 agricultural objective at any of the eleven Delta assessment locations, which represents no change
3 from the Existing Conditions and No Action Alternative (Appendix 8F, Table Bo-3B). Additionally,
4 relative to the Existing Conditions, reductions in long-term average assimilative capacity would be
5 small with respect to the 500 µg/L agricultural objective at interior Delta locations and reductions
6 would be similar for all of the Alternative 4 H1–H4 Scenarios (i.e., range of maximum monthly
7 reductions of 12% (H1) to 13% (H4) at Franks Tract and up to 13% (H1) to 18% (H4) at Old River at
8 Rock Slough (Appendix 8F, Tables Bo-13A/13D), and the reductions in assimilative capacity relative
9 to the No Action Alternative also would be comparable. However, because the absolute boron
10 concentrations would still be well below the lowest 500 µg/L objective for the protection of the
11 agricultural beneficial use under Alternative 4, the levels of boron degradation would not be of
12 sufficient magnitude to substantially increase the risk of exceeding objectives or cause adverse
13 effects to municipal and agricultural water supply beneficial uses, or any other beneficial uses, in the
14 Delta (Appendix 8F, Figure Bo-3).

15 ***SWP/CVP Export Service Areas***

16 Under all of the Alternative 4 H1–H4 Scenarios, long-term average boron concentrations would
17 decrease at the Banks Pumping Plant (ranging from as much as 21% [H1]) to a 9% [H2]) and at
18 Jones Pumping Plant (ranging from 23% [H4] to 19% [H1]) relative to Existing Conditions and the
19 reductions would be similar compared to No Action Alternative (Appendix 8F, Table Bo-12A/12D)
20 as a result of export of a greater proportion of low-boron Sacramento River water. Commensurate
21 with the decrease in exported boron concentrations, boron concentrations in the lower San Joaquin
22 River may be reduced and would likely alleviate or lessen any expected increase in boron
23 concentrations at Vernalis associated with flow reductions (see discussion of Upstream of the Delta),
24 as well as locations in the Delta receiving a large fraction of San Joaquin River water. Reduced export
25 boron concentrations also may contribute to reducing the existing 303(d) impairment in the lower
26 San Joaquin River and associated TMDL actions for reducing boron loading.

27 Maintenance of SWP and CVP facilities under Alternative 4 would not be expected to create new
28 sources of boron or contribute towards a substantial change in existing sources of boron in the
29 affected environment. Maintenance activities would not be expected to cause any substantial
30 increases in boron concentrations or degradation with respect to boron such that objectives would
31 be exceeded more frequently, or any beneficial uses would be adversely affected anywhere in the
32 affected environment.

33 ***NEPA Effects:*** In summary, relative to the No Action Alternative conditions, Alternative 4 would
34 result in relatively small increases in long-term average boron concentrations in the Delta and not
35 appreciably change boron levels in the lower San Joaquin River. However, the predicted changes
36 would not be expected to cause exceedances of applicable objectives or further measurable water
37 quality degradation, and thus would not constitute an adverse effect on water quality.

38 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
39 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
40 purpose of making the CEQA impact determination for this constituent. For additional details on the
41 effects assessment findings that support this CEQA impact determination, see the effects assessment
42 discussion that immediately precedes this conclusion.

43 Boron is not a constituent of concern in the Sacramento River watershed upstream of the Delta, thus
44 river flow rate and reservoir storage reductions that would occur under the Alternative 4, relative to

1 Existing Conditions, would not be expected to result in a substantial adverse change in boron levels.
 2 Additionally, relative to Existing Conditions, Alternative 4 would not result in reductions in river
 3 flow rates (i.e., less dilution) or increased boron loading such that there would be any substantial
 4 increases in boron concentration upstream of the Delta in the San Joaquin River watershed.

5 Small increased boron levels predicted for interior and western Delta locations in response (i.e., up
 6 to 15% increase) to a shift in the Delta source water percentages and tidal habitat restoration under
 7 this alternative would not be expected to cause exceedances of objectives, or substantial
 8 degradation of these water bodies. Alternative 4 maintenance also would not result in any
 9 substantial increases in boron concentrations in the affected environment. Boron concentrations
 10 would be reduced in water exported from the Delta to the CVP/SWP Export Service Areas, thus
 11 reflecting a potential improvement to boron loading in the lower San Joaquin River.

12 Boron is not a bioaccumulative constituent, thus any increased concentrations under Alternative 4
 13 would not result in adverse boron bioaccumulation effects to aquatic life or humans. Relative to
 14 Existing Conditions, Alternative 4 would not result in substantially increased boron concentrations
 15 such that frequency of exceedances of municipal and agricultural water supply objectives would
 16 increase. The levels of boron degradation that may occur under Alternative 4 would not be of
 17 sufficient magnitude to cause substantially increased risk for adverse effects to municipal or
 18 agricultural beneficial uses within the affected environment. Long-term average boron
 19 concentrations would decrease in Delta water exports to the SWP and CVP service area, which may
 20 contribute to reducing the existing 303(d) impairment of agricultural beneficial uses in the lower
 21 San Joaquin River. Based on these findings, this impact is determined to be less than significant. No
 22 mitigation is required.

23 **Impact WQ-4: Effects on Boron Concentrations Resulting from Implementation of CM2–CM22**

24 **NEPA Effects:** The implementation of the other conservation measures (i.e., CM2–CM22), of which
 25 most do not involve land disturbance, present no new direct sources of boron to the affected
 26 environment, including areas Upstream of the Delta, within the Plan Area, and the SWP/CVP Export
 27 Service Area, nor would they affect channel flows or Delta hydrodynamic conditions. As noted
 28 above, the potential effects of implementation of tidal habitat restoration (i.e., CM4) on Delta
 29 hydrodynamic conditions is addressed above in the discussion of Impact WQ-3. The potential
 30 channel flow effects of CM2 for actions in the Yolo Bypass also were accounted for in the CALSIM II
 31 and DSM2 modeling, and thus were addressed in the discussion for Impact WQ-3. Habitat
 32 restoration activities in the Delta (i.e., CM4-10), including restored tidal wetlands, floodplain, and
 33 related channel margin and off-channel habitats, while involving increased land and water
 34 interaction within these habitats, would not be anticipated to contribute boron which is primarily
 35 associated with source water inflows to the Delta (i.e., San Joaquin River, agricultural drainage, and
 36 Bay source water). Moreover, some habitat restoration conservation measures (CM4–CM10) would
 37 occur on lands within the Delta currently used for irrigated agriculture, thus replacing agricultural
 38 land uses with restored habitats. The potential reduction in irrigated lands within the Delta may
 39 result in reduced discharges of agricultural field drainage with elevated boron concentrations,
 40 which would be considered an improvement compared to the No Action Alternative. CM3 and CM11
 41 provide the mechanism, guidance, and planning for the land acquisition and thus would not,
 42 themselves, affect boron levels in the Delta. CM12–CM22 involve actions that target reduction in
 43 other stressors at the species level involving actions such as methylmercury reduction management
 44 (CM12), improving DO in the Stockton Deep Water Ship Channel (CM14), and urban stormwater
 45 treatment (CM19). None of the CM12–CM22 actions would contribute to substantially increasing

1 boron levels in the Delta. Consequently, as they pertain to boron, implementation of CM2–CM22
2 would not be expected to adversely affect any of the beneficial uses of the affected environment.

3 The impact on boron of implementing CM2–CM22 is determined to be not adverse.

4 **CEQA Conclusion:** Implementation of the CM2–CM22 for Alternative 4 would not present new or
5 substantially changed sources of boron to the affected environment upstream of the Delta, within
6 Delta, or in the SWP and CVP service area. As such, the their implementation would not be expected
7 to substantially increase the frequency with which applicable Basin Plan objectives or other criteria
8 would be exceeded in water bodies of the affected environment located upstream of the Delta,
9 within the Delta, or in the SWP and CVP Service Area or substantially degrade the quality of these
10 water bodies, with regard to boron. Based on these findings, this impact is considered to be less than
11 significant. No mitigation is required.

12 **Impact WQ-5: Effects on Bromide Concentrations Resulting from Facilities Operations and** 13 **Maintenance (CM1)**

14 ***Upstream of the Delta***

15 Under Alternative 4, regardless of operational scenario (i.e., Scenarios H1–H4), there would be no
16 expected change to the sources of bromide in the Sacramento and eastside tributary watersheds.
17 Bromide loading in these watersheds would remain unchanged and resultant changes in flows from
18 altered system-wide operations under Alternative 4 would have negligible, if any, effects on the
19 concentration of bromide in the rivers and reservoirs of these watersheds. Consequently, no
20 individual operational scenario of Alternative 4 would be expected to adversely affect the MUN
21 beneficial use, or any other beneficial uses, of the Sacramento River, the eastside tributaries, or their
22 associated reservoirs upstream of the Delta.

23 Under the four operational scenarios of Alternative 4, modeling indicates that long-term annual
24 average flows on the San Joaquin River would decrease by 6% relative to Existing Conditions and
25 would remain virtually the same relative to the No Action Alternative (Appendix 5A). These similar
26 decreases in flow, regardless of operational scenario, would result in possible increases in long-term
27 average bromide concentrations of about 3%, relative to Existing Conditions and less than <1%
28 relative to the No Action Alternative (Appendix 8E, Bromide Table 22). The small predicted
29 increases in lower San Joaquin River bromide levels that could occur under Scenarios H1–H4 of
30 Alternative 4, relative to existing and No Action Alternative conditions, would not be expected to
31 adversely affect the MUN beneficial use, or any other beneficial uses, of the lower San Joaquin River.

32 ***Delta***

33 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
34 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
35 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
36 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
37 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
38 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

39 Under operational scenarios H1–H4 of Alternative 4, the geographic extent of effects pertaining to
40 long-term average bromide concentrations in the Delta would be similar to that previously
41 described for Alternative 1A, although the magnitude of predicted long-term change and relative
42 frequency of concentration threshold exceedances would be different. Using the mass-balance

1 modeling approach for bromide (see Section 8.3.1.3), relative to Existing Conditions, Scenario H1–
2 H4 modeled long-term average bromide concentrations would increase at Staten Island, Emmaton,
3 and Barker Slough, while Scenario H1–H4 modeled long-term average bromide concentrations
4 would decrease at the other assessment locations (Appendix 8E, *Bromide*, Table 10). Overall effects
5 would be greatest at Barker Slough, with the smallest model predicted increases occurring under
6 Scenario H3, and the largest model predicted increases occurring under Scenario H2. Under
7 Scenario H3, predicted long-term average bromide concentrations would increase from 51 µg/L to
8 62 µg/L (21% relative increase) for the modeled 16-year hydrologic period and would increase
9 from 54 µg/L to 92 µg/L (72% relative increase) for the modeled drought period. Under Scenario
10 H2, predicted long-term average bromide concentrations would increase from 51 µg/L to 72 µg/L
11 (40% relative increase) for the modeled 16-year hydrologic period and would increase from 54
12 µg/L to 106 µg/L (98% relative increase) for the modeled drought period. At Barker Slough, changes
13 in exceedance frequency would follow a similar pattern, with the greatest increase in exceedance
14 frequency occurring under Scenario H2. Under Scenario H2, the predicted 50 µg/L exceedance
15 frequency would increase from 49% under Existing Conditions to 56% under Alternative 4, and
16 would increase from 55% to 83% during the drought period. Similarly at Barker Slough, the
17 predicted 100 µg/L exceedance frequency would increase from 0% under Existing Conditions to
18 20% under Scenario H2, and would increase from 0% to 47% during the drought period. In contrast,
19 increases in bromide at Staten Island would result in a 50 µg/L bromide threshold exceedance
20 increase from 47% under Existing Conditions to 76% under Scenario H2 (52% to 83% during the
21 modeled drought period). However, unlike Barker Slough, modeling shows that long-term average
22 bromide concentration at Staten Island would exceed the 100 µg/L assessment threshold
23 concentration 1% under Existing Conditions and 3% under all operational scenarios (0% to 2%
24 during the modeled drought period for all operational scenarios). The highest long-term average
25 bromide concentrations would occur under Scenario H2, and would be 76 µg/L (83 µg/L for the
26 modeled drought period) at Staten Island. Changes in exceedance frequency of the 50 µg/L and 100
27 µg/L concentration thresholds, as well as relative change in long-term average concentration, at
28 other assessment locations would be less substantial for all operational scenarios. This comparison
29 to Existing Conditions reflects changes in bromide due to both Alternative 4 operations (including
30 north Delta intake capacity of 9,000 cfs and the different operational components of Scenarios H1–
31 H4) and climate change/sea level rise.

32 Due to the relatively small differences between modeled Existing Conditions and No Action baseline,
33 changes in long-term average bromide concentrations and changes in exceedance frequencies
34 relative to the No Action Alternative are generally of similar magnitude to those previously
35 described for the existing condition comparison (Appendix 8E, *Bromide* Table 10). Relative to the
36 No Action Alternative, modeled long-term average bromide concentration increases would similarly
37 be greatest at Barker Slough under Scenario H2, where long-term average concentrations are
38 predicted to increase by 44% (97% for the modeled drought period). However, unlike the Existing
39 Conditions comparison, under the No Action Alternative long-term average bromide concentrations
40 at Buckley Cove would increase for all operational scenarios, although the increases would be
41 relatively small ($\leq 4\%$). Unlike the comparison to Existing Conditions, this comparison to the No
42 Action Alternative reflects changes in bromide due only to the different operational components of
43 Scenarios H1–H4 of Alternative 4.

44 At Barker Slough, modeled long-term average bromide concentrations for the two baseline
45 conditions are very similar (Appendix 8E, *Bromide* Table 10-11). Such similarity demonstrates that
46 the modeled Alternative 4 change in bromide is almost entirely due to Alternative 4 operations, and

1 not climate change/sea level rise, regardless of the specific different operational components of
2 Scenarios H1–H4. Therefore, operations are the primary driver of effects on bromide at Barker
3 Slough, regardless of whether and particular operational scenario of Alternative 4 is compared to
4 Existing Conditions, or compared to the No Action Alternative.

5 Results of the modeling approach which used relationships between EC and chloride and between
6 chloride and bromide (see Section 8.3.1.3) differed somewhat from what is presented above for the
7 mass-balance approach (see Appendix 8E, Table 11). For most locations, the frequency of
8 exceedance of the 50 µg/L and 100 µg/L were similar. The greatest difference between the methods
9 was predicted for Barker Slough. Under all of the operational scenarios, the increases in frequency
10 of exceedance of the 100 µg/L threshold, relative to Existing Conditions and the No Action
11 Alternative, were not as great using this alternative EC to chloride and chloride to bromide
12 relationship modeling approach as compared to that presented above from the mass-balance
13 modeling approach. Model predicted increases under Scenario H2 were still the greatest, and
14 increases under the other operational scenarios were still substantial. At Barker Slough, the
15 predicted 100 µg/L exceedance frequency for the 16-year hydrologic period would increase from
16 1% under Existing Conditions and 2% under the No Action Alternative to as much as 11% under the
17 Scenario H2. For the modeled drought period, the predicted 100 µg/L exceedance frequency would
18 increase from 0% under Existing Conditions and the No Action Alternative to as much as 25% under
19 Scenario H2. Because the mass-balance approach predicts a greater level of impact at Barker Slough,
20 determination of impacts was based on the mass-balance results.

21 Although Scenario H2 would result in the greatest relative increase in long-term average bromide
22 concentrations and greatest relative increase in exceedance frequency at Barker Slough, the
23 difference between operational scenarios is very small. Regardless of particular Alternative 4
24 operational scenario, the increase in long-term average bromide concentrations predicted at Barker
25 Slough, principally the relative increase in 100 µg/L exceedance frequency, would result in a
26 substantial change in source water quality for existing drinking water treatment plants drawing
27 water from the North Bay Aqueduct. As discussed for Alternative 1A, drinking water treatment
28 plants obtaining water via the North Bay Aqueduct utilize a variety of conventional and enhanced
29 treatment technologies in order to achieve DBP drinking water criteria. While the implications of
30 such a modeled change in bromide at Barker Slough are difficult to predict, the substantial modeled
31 increases could lead to adverse changes in the formation of disinfection byproducts such that
32 considerable treatment plant upgrades may be necessary in order to achieve equivalent levels of
33 health protection. Because many of the other modeled locations already frequently exceed the 100
34 µg/L threshold under Existing Conditions and the No Action Alternative, these locations likely
35 already require treatment plant technologies to achieve equivalent levels of health protection, and
36 thus no additional treatment technologies would be triggered by the small increases in the
37 frequency of exceeding the 100 µg/L threshold. Hence, no further impact on the drinking water
38 beneficial use would be expected at these locations.

39 The seasonal intakes at Mallard Slough and City of Antioch are infrequently used due to water
40 quality constraints related to sea water intrusion. On a long-term average basis, bromide at these
41 locations is in excess of 3,000 µg/L, but during seasonal periods of high Delta outflow can be <300
42 µg/L. Based on modeling using the mass-balance approach, use of the seasonal intakes at Mallard
43 Slough and City of Antioch under Scenarios H1–H4 of Alternative 4 would experience a period
44 average increase in bromide during the months when these intakes would most likely be utilized.
45 For those wet and above normal water year types where mass balance modeling would predict
46 water quality typically suitable for diversion, change would be greatest for Scenario H1 and H3,

1 where predicted long-term average bromide concentrations would increase from 103 µg/L to 155
 2 µg/L (51% increase) at City of Antioch and would increase from 150 µg/L to 201 µg/L (41%
 3 increase) at Mallard Slough relative to Existing Conditions (Appendix 8E, *Bromide*, Table 23). Under
 4 Scenarios H2 and H4, predicted increases would also occur, but would be somewhat less, with
 5 approximate 40% increases at the City of Antioch and approximate 34% increases at Mallard
 6 Slough. Increases would be similar for the No Action Alternative comparison, with slightly lower
 7 relative increases at City of Antioch (i.e., 33–44% depending on operational scenario), and slightly
 8 higher relative increases at Mallard Slough (i.e., 36–47% depending on operational scenario).
 9 Modeling results using the EC to chloride and chloride to bromide relationships show increases
 10 during these months, but the relative magnitude of the increases is much lower (Appendix 8E,
 11 *Bromide*, Table 24). Regardless of the differences in the data between the two modeling approaches,
 12 the decisions surrounding the use of these seasonal intakes is largely driven by acceptable water
 13 quality, and thus have historically been opportunistic. Opportunity to use these intakes would
 14 remain, and the predicted increases in bromide concentrations at the City of Antioch and Mallard
 15 Slough intake would not be expected to adversely affect MUN beneficial uses, or any other beneficial
 16 use, at these locations.

17 ***SWP/CVP Export Service Areas***

18 Under the various operational scenarios of Alternative 4, improvement in long-term average
 19 bromide concentrations would occur at the Banks and Jones pumping plants, with the largest
 20 improvement predicted to occur under Scenario H4 and the smallest improvement predicted to
 21 occur under Scenario H1. Under Scenario H4, long-term average bromide concentrations for the
 22 modeled 16-year hydrologic period at Banks and Jones pumping plants would decrease by as much
 23 as 46% relative to Existing Conditions and 38% relative to the No Action Alternative. Relative
 24 change in long-term average bromide concentration under Scenario H4 would be less during
 25 drought conditions ($\leq 36\%$), but would still represent considerable improvement (Appendix 8E,
 26 *Bromide*, Table 10). Decreased long-term average bromide concentrations under the other
 27 operational scenarios would also be predicted, but would be slightly less. Under Scenario H1, long-
 28 term average bromide concentrations for the modeled 16-year hydrologic period at Banks and Jones
 29 pumping plants would decrease by as much as 37% relative to Existing Conditions and 28% relative
 30 to the No Action Alternative. Relative change in long-term average bromide concentration under
 31 Scenario H1 would be less during drought conditions ($\leq 28\%$) (Appendix 8E, *Bromide*, Table 10). As
 32 a result, and regardless of operational scenario, less frequent bromide concentration exceedances of
 33 the 50 µg/L and 100 µg/L assessment thresholds would be predicted and an overall improvement in
 34 Export Service Areas water quality would be experienced respective to bromide. Commensurate
 35 with the decrease in exported bromide, an improvement in lower San Joaquin River bromide would
 36 also be observed since bromide in the lower San Joaquin River is principally related to irrigation
 37 water deliveries from the Delta. While the magnitude of this expected lower San Joaquin River
 38 improvement in bromide is difficult to predict, the relative decrease in overall loading of bromide to
 39 the Export Service Areas would likely alleviate or lessen any expected increase in bromide
 40 concentrations at Vernalis (see discussion of Upstream of the Delta) as well as locations in the Delta
 41 receiving a large fraction of San Joaquin River water, such as much of the south Delta.

42 The discussion above is based on results of the mass-balance modeling approach. Results of the
 43 modeling approach which used relationships between EC and chloride and between chloride and
 44 bromide (see Section 8.3.1.3) were consistent with the discussion above, and assessment of bromide
 45 using these data results in the same conclusions as are presented above for the mass-balance
 46 approach (see Appendix 8E, Table 11).

1 Similar to the discussion pertaining to the No Action Alternative, maintenance of SWP and CVP
2 facilities under Scenarios H1–H4 of Alternative 4 would not be expected to create new sources of
3 bromide or contribute towards a substantial change in existing sources of bromide in the affected
4 environment. Maintenance activities would not be expected to cause any substantial change in
5 bromide such that MUN beneficial uses, or any other beneficial use, would be adversely affected
6 anywhere in the affected environment.

7 **NEPA Effects:** In summary, the operations and maintenance activities under Scenarios H1–H4 of
8 Alternative 4, relative to the No Action Alternative, would result in small increases (i.e., <1%) in
9 long-term average bromide concentrations at Vernalis related to relatively small declines in long-
10 term average flow on the San Joaquin River. However, the operations and maintenance activities
11 under Scenarios H1–H4 of Alternative 4 would cause substantial degradation to water quality with
12 respect to bromide at Barker Slough, source of the North Bay Aqueduct. This substantial
13 degradation would be predicted to occur regardless of operational scenario, but would be greatest
14 under Scenario H2. Resultant substantial change in long-term average bromide at Barker Slough
15 could necessitate changes in water treatment plant operations or require treatment plant upgrades
16 in order to maintain DBP compliance, and thus would constitute an adverse effect on water quality.
17 Mitigation Measure WQ-5 is available to reduce these effects (implementation of this measure along
18 with a separate, non-environmental commitment as set forth in EIR/EIS Appendix 3B,
19 *Environmental Commitments*, relating to the potential increased treatment costs associated with
20 bromide-related changes would reduce these effects).

21 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
22 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
23 purpose of making the CEQA impact determination for this constituent. For additional details on the
24 effects assessment findings that support this CEQA impact determination, see the effects assessment
25 discussion that immediately precedes this conclusion.

26 Under operational Scenarios H1–H4 of Alternative 4 there would be no expected change to the
27 sources of bromide in the Sacramento and eastside tributary watersheds. Bromide loading in these
28 watersheds would remain unchanged and resultant changes in flows from altered system-wide
29 operations under any operational scenario of Alternative 4 would have negligible, if any, effects on
30 the concentration of bromide in the rivers and reservoirs of these watersheds. However, south of the
31 Delta, the San Joaquin River is a substantial source of bromide, primarily due to the use of irrigation
32 water imported from the southern Delta. Concentrations of bromide at Vernalis are inversely
33 correlated to net river flow. Under all operational scenarios of Alternative 4, long-term average
34 flows at Vernalis would decrease only slightly, resulting in less than substantial predicted increases
35 in long-term average bromide of about 3% relative to Existing Conditions.

36 Relative to Existing Conditions, all operational scenarios of Alternative 4 would result in small
37 decreases in long-term average bromide concentration at most Delta assessment locations, with
38 principal exceptions being the North Bay Aqueduct at Barker Slough, Staten Island, and Emmaton on
39 the Sacramento River. Overall effects would be greatest at Barker Slough, where substantial
40 increases in long-term average bromide concentrations under all operational scenarios would be
41 predicted, but would be greatest for Scenario H2. While the predicted increase in long-term average
42 bromide concentrations at Barker Slough would be greatest for Scenario H2, the relative increases
43 regardless of particular operational scenario would result in a substantial change in source water
44 quality to existing drinking water treatment plants drawing water from the North Bay Aqueduct.
45 These modeled increases in bromide at Barker Slough could lead to adverse changes in the

1 formation of disinfection byproducts at drinking water treatment plants such that considerable
2 water treatment plant upgrades could be necessary in order to achieve equivalent levels of drinking
3 water health protection.

4 The assessment of effects on bromide in the SWP/CVP Export Service Areas is based on assessment
5 of changes in bromide concentrations at Banks and Jones pumping plants. Under all of the
6 operational scenarios of Alternative 4, substantial improvement would occur at the Banks and Jones
7 pumping plants, where long-term average bromide concentrations are predicted to decrease by as
8 much as 44% relative to Existing Conditions. As a result, an overall improvement in bromide-related
9 water quality would be predicted in the SWP/CVP Export Service Areas.

10 Based on the above, the operations and maintenance activities under Scenarios H1–H4 of
11 Alternative 4 would not result in any substantial change in long-term average bromide
12 concentration upstream of the Delta. Furthermore, under all of the operational scenarios of
13 Alternative 4, water exported from the Delta to the SWP/CVP service area would be substantially
14 improved relative to bromide. Bromide is not bioaccumulative, therefore change in long-term
15 average bromide concentrations would not directly cause bioaccumulative problems in aquatic life
16 or humans. Additionally, bromide is not a constituent related to any 303(d) listings. The operations
17 and maintenance activities under Scenarios H1–H4 of Alternative 4 would not cause substantial
18 long-term degradation to water quality respective to bromide with the exception of water quality at
19 Barker Slough, source of the North Bay Aqueduct. At Barker Slough, modeled long-term annual
20 average concentrations of bromide would increase by as much as 40%, and 98% during the modeled
21 drought period. For the modeled 16-year hydrologic period the frequency of predicted bromide
22 concentrations exceeding 100 µg/L would increase from 0% under Existing Conditions to as much
23 as 20% under Alternative 4, while for the modeled drought period, the frequency would increase
24 from 0% to as much as 47%. The substantial changes in long-term average bromide predicted for
25 Barker Slough under all operational scenarios of Alternative 4 could necessitate changes in
26 treatment plant operation or require treatment plant upgrades in order to maintain DBP
27 compliance. The model predicted change at Barker Slough is substantial and, therefore, would
28 represent a substantially increased risk for adverse effects on existing MUN beneficial uses should
29 treatment upgrades not be undertaken. The impact is considered significant.

30 Implementation of Mitigation Measure WQ-5 along with a separate, non-environmental
31 commitment relating to the potential increased treatment costs associated with bromide-related
32 changes would reduce these effects. While mitigation measures to reduce these water quality effects
33 in affected water bodies to less than significant levels are not available, implementation of
34 Mitigation Measure WQ-5 is recommended to attempt to reduce the effect that increased bromide
35 concentrations may have on Delta beneficial uses. However, because the effectiveness of this
36 mitigation measure to result in feasible measures for reducing water quality effects is uncertain, this
37 impact is considered to remain significant and unavoidable.

38 In addition to and to supplement Mitigation Measure WQ-5, the BDCP proponents have incorporated
39 into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*, a separate, non-
40 environmental commitment to address the potential increased water treatment costs that could
41 result from bromide-related concentration effects on municipal water purveyor operations.
42 Potential options for making use of this financial commitment include funding or providing other
43 assistance towards implementation of the North Bay Aqueduct AIP, acquiring alternative water
44 supplies, or other actions to indirectly reduce the effects of elevated bromide and DOC in existing
45 water supply diversion facilities. Please refer to Appendix 3B, *Environmental Commitments*, for the

1 full list of potential actions that could be taken pursuant to this commitment in order to reduce the
 2 water quality treatment costs associated with water quality effects relating to chloride, electrical
 3 conductivity, and bromide.

4 **Mitigation Measure WQ-5: Avoid, Minimize, or Offset, as Feasible, Adverse Water Quality**
 5 **Conditions**

6 It remains to be determined whether, or to what degree, the available and existing salinity
 7 response and countermeasure actions of SWP and CVP facilities or municipal water purveyors
 8 would be capable of offsetting the actual level of changes in bromide that may occur from
 9 implementation of Alternative 4. Therefore, in order to determine the feasibility of reducing the
 10 effects of increased bromide levels, and potential adverse effects on beneficial uses associated
 11 with CM1 operations (and hydrodynamic effects of tidal restoration under CM4), the proposed
 12 mitigation requires a series of phased actions to identify and evaluate existing and possible
 13 feasible actions, followed by development and implementation of the actions, if determined to
 14 be necessary. The development and implementation of any mitigation actions shall be focused
 15 on those incremental effects attributable to implementation of Alternative 4 operations only.
 16 Development of mitigation actions for the incremental bromide effects attributable to climate
 17 change/sea level rise are not required because these changed conditions would occur with or
 18 without implementation of Alternative 4. The goal of specific actions would be to reduce/avoid
 19 additional degradation of Barker Slough water quality conditions with respect to the CALFED
 20 bromide goal.

21 Following commencement of initial operations of CM1, the BDCP proponents will conduct
 22 additional evaluations described herein, and develop additional modeling (as necessary), to
 23 define the extent to which modified operations could reduce or eliminate the increased bromide
 24 concentrations currently modeled to occur under Alternative 4. The additional evaluations
 25 should also consider specifically the changes in Delta hydrodynamic conditions associated with
 26 tidal habitat restoration under CM4 (in particular the potential for increased bromide
 27 concentrations that could result from increased tidal exchange) once the specific restoration
 28 locations are identified and designed. If sufficient operational flexibility to offset bromide
 29 increases is not practicable/feasible under Alternative 4 operations, achieving bromide
 30 reduction pursuant to this mitigation measure would not be feasible under this alternative.

31 **Impact WQ-6: Effects on Bromide Concentrations Resulting from Implementation of CM2–**
 32 **CM22**

33 **NEPA Effects:** CM12–CM22 would present no new sources of bromide to the affected environment,
 34 including areas Upstream of the Delta, within the Plan Area, and the SWP/CVP Export Service Areas.
 35 As they pertain to bromide, implementation of these conservation measures would not be expected
 36 to adversely affect MUN beneficial use, or any other beneficial uses, of the affected environment.

37 With exception to habitat restoration areas that would effectively alter Delta hydrodynamics, habitat
 38 restoration and the various land-disturbing conservation measures proposed for Alternative 4
 39 would not present new or substantially changed sources of bromide to the study area. Modeling
 40 scenarios included assumptions regarding how certain habitat restoration activities would affect
 41 Delta hydrodynamics (CM2 and CM4), and thus such hydrodynamic effects of these restoration
 42 measures were included in the assessment of CM1 facilities operations and maintenance (see Impact
 43 WQ-1).

1 Some habitat restoration activities would occur on lands in the Delta formerly used for irrigated
 2 agriculture. Such replacement or substitution of land use activity would not be expected to result in
 3 new or increased sources of bromide to the Delta. Implementation of CM2–CM11 would not be
 4 expected to adversely affect MUN beneficial use, or any other beneficial uses, within the affected
 5 environment.

6 In summary, implementation of CM2–CM22 under Alternative 4, relative to the No Action
 7 Alternative, would have negligible, if any, effects on bromide concentrations. The effects on bromide
 8 from implementing CM2–CM22 are determined to not be adverse.

9 **CEQA Conclusion:** Implementation of CM2–CM22 under Alternative 4 would not present new or
 10 substantially changed sources of bromide to the study area. Some conservation measures may
 11 replace or substitute for existing irrigated agriculture in the Delta. This replacement or substitution
 12 would not be expected to substantially increase or present new sources of bromide. Implementation
 13 of CM2–CM22 would have negligible, if any, effects on bromide concentrations throughout the
 14 affected environment, would not cause exceedance of applicable state or federal numeric or
 15 narrative water quality objectives/criteria because none exist for bromide, and would not cause
 16 changes in bromide concentrations that would result in significant impacts on any beneficial uses
 17 within affected water bodies. Implementation of CM2–CM22 would not cause significant long-term
 18 water quality degradation such that there would be greater risk of significant impacts on beneficial
 19 uses, would not cause greater bioaccumulation of bromide, and would not further impair any
 20 beneficial uses due to bromide concentrations because no uses are currently impaired due to
 21 bromide levels. This impact is therefore considered less than significant. No mitigation is required.

22 **Impact WQ-7: Effects on Chloride Concentrations Resulting from Facilities Operations and** 23 **Maintenance (CM1)**

24 ***Upstream of the Delta***

25 Under Alternative 4, Scenarios H1–H4, there would be no expected change to the sources of chloride
 26 in the Sacramento and eastside tributary watersheds. Chloride loading in these watersheds would
 27 remain unchanged and resultant changes in flows from altered system-wide operations would have
 28 negligible, if any, effects on the concentration of chloride in the rivers and reservoirs of these
 29 watersheds. The modeled long-term annual average flows on the lower San Joaquin River at Vernalis
 30 would decrease slightly compared to Existing Conditions (in association with the different
 31 operational components of Scenarios H1–H4 for Alternative 4, climate change, and increased water
 32 demands) and be similar compared to the No Action Alternative (considering only changes due only
 33 to the different operational components of Scenarios H1–H4 under Alternative 4). The reduced flow
 34 would result in possible increases in long-term average chloride concentrations of about 2%,
 35 relative to the Existing Conditions, which would be nearly identical under each of the H1–H4
 36 scenarios, and no change relative to No Action Alternative (Appendix 8G, Table CI-62).
 37 Consequently, the Alternative 4 H1–H4 Scenarios would not be expected to cause exceedances of
 38 chloride objectives/criteria or substantially degrade water quality with respect to chloride, and thus
 39 would not adversely affect any beneficial uses of the Sacramento River, the eastside tributaries,
 40 associated reservoirs upstream of the Delta, or the San Joaquin River.

41 ***Delta***

42 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 43 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter

1 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
2 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
3 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
4 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

5 Relative to Existing Conditions, modeling predicts that the Alternative 4 H1–H4 Scenarios would
6 result in similar or reduced long-term average chloride concentrations for the 16-year period
7 modeled at most of the assessment locations. The mass-balance modeling results indicate similar,
8 but slightly larger increases in chloride concentrations compared to estimates generated using EC-
9 chloride relationships and DSM2 EC output (see Section 8.3.1.3). Increased long-term average
10 chloride concentrations would occur at the North Bay Aqueduct at Barker Slough (i.e., range from up
11 to 33% [H2] to 16% [H3]) and San Joaquin River at Staten Island (i.e., similar increase of 22–23% for
12 all H1–H4 Scenarios) (Appendix 8G, *Chloride*, Tables Cl-25A/25D [mass balance model results] and
13 Tables Cl-26A/26D [EC-chloride relationship results]). Changes in long-term average concentrations
14 in the western Sacramento River at Emmaton would range from an increase for Scenarios H1 and
15 H2 (14 to 16%) to no measureable change for Scenarios H3 and H4 (i.e., -1%). Long-term average
16 chloride concentration would decrease at other assessment locations, with the largest reductions
17 occurring under Scenarios H3 and H4 (i.e., up to -24% at Franks Tract) and less reduction under
18 Scenarios H1 and H2 (i.e., up to -12% at Franks Tract). Additionally, implementation of tidal habitat
19 restoration under CM4 would increase the tidal exchange volume in the Delta, and thus may
20 contribute to increased chloride concentrations in the Bay source water as a result of increased
21 salinity intrusion. More discussion of this phenomenon is included in Section 8.3.1.3. Consequently,
22 while uncertain, the magnitude of chloride increases may be greater than indicated herein and
23 would affect the western Delta assessment locations the most which are influenced to the greatest
24 extent by the Bay source water. This comparison to Existing Conditions reflects changes in chloride
25 due to both the different operational components of Scenarios H1–H4 for Alternative 4 and climate
26 change/sea level rise.

27 Relative to the No Action Alternative conditions, the mass balance analysis of modeling results
28 indicated that the Alternative 4 Scenarios H1–H4 would result in similar increases in long-term
29 average chloride concentrations for the 16-year period as described above compared to Existing
30 Conditions: SF Mokelumne River at Staten Island (i.e., up to 25 to 27% for all H1–H4 Scenarios),
31 North Bay Aqueduct at Barker Slough (i.e., range of 20% [H3] up to 37% [H2]), and for the
32 Sacramento River at Emmaton (i.e., ranging from an increase for Scenarios H1-H2 of up to 17% to
33 reduction under Scenarios H3-H4 [-1%]) (Appendix 8G, Table Cl-25A/25D [mass balance model
34 results] and Tables Cl-26A/26D [EC-chloride relationship results]). Relative to the No Action
35 Alternative, the long-term average chloride concentrations based on EC to chloride relationships
36 indicate that most of the other interior and western Delta assessment locations under Scenarios H1
37 and H2 would exhibit similar increases ranging from up to 3% at San Joaquin River at Buckley Cove
38 to 9% at the Sacramento River at Mallard Island. The comparison to the No Action Alternative
39 reflects chloride changes due only to the different operational components of Scenarios H1–H4 for
40 Alternative 4.

41 The following outlines the modeled chloride changes relative to the applicable objectives and
42 beneficial uses of Delta waters.

1 *Municipal Beneficial Uses—Relative to Existing Conditions*

2 Estimates of chloride concentrations generated using EC-chloride relationships and DSM2 EC output
3 (see Section 8.3.1.3) were used to evaluate the 150 mg/L Bay-Delta WQCP objective for municipal
4 and industrial beneficial uses on a basis of the percent of years the chloride objective is exceeded for
5 the modeled 16-year period. The objective is exceeded if chloride concentrations exceed 150 mg/L
6 for a specified number of days in a given water year at both the Antioch and Contra Costa Pumping
7 Plant #1 locations. For the Alternative 4 Scenarios H1–H4, the modeled frequency of objective
8 exceedance would approximately double at the Contra Costa Pumping Plant #1 from 6% of years
9 under Existing Conditions, to 13% of years under all of the Alternative 4 scenarios (Appendix 8G,
10 Table Cl-64).

11 Similarly, estimates of chloride concentrations generated using EC-chloride relationships and DSM2
12 EC output (see Section 8.3.1.3) were also used to evaluate the 250 mg/L Bay-Delta WQCP objective
13 for chloride at Contra Costa Pumping Plant #1 where daily average objectives apply. The basis for
14 the evaluation was the predicted number of days the objective was exceeded for the modeled 16-
15 year period. For Alternative 4, the modeled frequency of objective exceedance would decrease
16 similarly for the H1–H4 Scenarios by approximately one half, from 6% of modeled days under
17 Existing Conditions, to 3–4% of modeled days under the Alternative 4 operational scenarios
18 (Appendix 8G, Table Cl-63).

19 Given the limitations inherent to estimating future chloride concentrations (see Section 8.3.1.3),
20 estimation of chloride concentrations through both a mass balance approach and an EC-chloride
21 relationship approach was used to evaluate the 250 mg/L Bay-Delta WQCP objectives in terms of
22 both frequency of exceedance and use of assimilative capacity. When utilizing the mass balance
23 approach to model monthly average chloride concentrations for the 16-year period, the predicted
24 frequency of exceeding the 250 mg/L objective would decrease at the Contra Costa Canal at
25 Pumping Plant #1 from an exceedance frequency of 24% under Existing Conditions to a range of
26 18% (for H1) to 12–13% (for H3 and H4) (Appendix 8G, Table Cl-27 and Figure Cl-5). However, the
27 frequency of exceedances would increase slightly for the 16-year period modeled at the San Joaquin
28 River at Antioch (i.e., from 66% under Existing Conditions to 68% to 70% for the H1–H4 Scenarios)
29 and Sacramento River at Mallard Island (i.e., from 85% under Existing Conditions to 86% to 88% for
30 the H1–H4 Scenarios) (Appendix 8G, Table Cl-27). The mass balance results also indicate that the
31 increased concentrations would reduce assimilative capacity with respect to the 250 mg/L
32 objective, thus causing further degradation at Antioch in March and April, with similar maximum
33 reductions under H1 and H3 of up to 54% to maximum reductions of up to 42% for H3 and H4 for
34 the 16-year period modeled, and 100% reduction, or elimination of assimilative capacity, for all of
35 the H1–H4 Scenarios during the drought period modeled) (Appendix 8G, Tables Cl-29A/29D and
36 Figure Cl-5). Assimilative capacity at the Contra Costa Canal at Pumping Plant #1 also would be
37 similarly reduced in September and October under the H1 and H2 scenarios (i.e., up to 100%, or
38 elimination) when chloride concentrations would be near, or exceed, the objectives, thus increasing
39 the risk of exceeding objectives (Appendix 8G, Figure Cl-5), but would not be substantially reduced
40 under the H3 or H4 scenarios.

41 In comparison, when utilizing the chloride-EC relationship to model monthly average chloride
42 concentrations for the 16-year period, trends in frequency of exceedance and use of assimilative
43 capacity would be similar to that discussed when utilizing the mass balance modeling approach
44 (Appendix 8G, Table Cl-28 and Tables Cl-30A/30D). However, as with Alternative 1A the modeling
45 approach utilizing the chloride-EC relationships predicted changes of lesser magnitude, where

1 predictions of change utilizing the mass balance approach were generally of greater magnitude, and
2 thus more conservative. As discussed in Section 8.3.1.3, in cases of such disagreement, the approach
3 that yielded the more conservative predictions was used as the basis for determining adverse
4 impacts.

5 Based on the additional predicted annual and seasonal exceedances of one or both Bay Delta WQCP
6 objectives for chloride, and the associated long-term average water quality degradation in the
7 western Delta, the potential exists for substantial adverse effects under all of the Alternative 4 H1–
8 H4 Scenarios on the municipal and industrial beneficial uses through reduced opportunity for
9 diversion of water with acceptable chloride levels.

10 *303(d) Listed Water Bodies—Relative to Existing Conditions*

11 With respect to the 303(d) listing for chloride in Tom Paine Slough, the monthly average chloride
12 concentrations for the 16-year period modeled at Old River at Tracy Road would generally be
13 similar under all of the Alternative 4 H1–H4 Scenarios compared to Existing Conditions, and thus,
14 would not be further degraded on a long-term basis (Appendix 8G, Figure Cl-6). With respect to
15 Suisun Marsh, the monthly average chloride concentrations for the 16-year period modeled would
16 generally increase under all of the Alternative 4 H1–H4 Scenarios compared to Existing Conditions
17 in the months of March through May at the Sacramento River at Collinsville (Appendix 8G, Figure Cl-
18 7), Mallard Island (Appendix 8G, Figure Cl-5), and increase substantially at Montezuma Slough at
19 Beldon’s Landing (i.e., over a doubling of concentration in December through February) (Appendix
20 8G, Figure Cl-8), thereby contributing to additional, measureable long-term degradation that
21 potentially would adversely affect the necessary actions to reduce chloride loading for any TMDL
22 that is developed.

23 *Municipal Beneficial Uses—Relative to No Action Alternative*

24 Similar to the assessment conducted for Existing Conditions, estimates of chloride concentrations
25 generated using EC-chloride relationships and DSM2 EC output (see Section 8.3.1.3) were used to
26 evaluate the 150 mg/L Bay-Delta WQCP objective for municipal and industrial beneficial uses. For
27 Alternative 4, the modeled frequency of objective exceedance would increase at the Contra Costa
28 Pumping Plant #1 from 6% under the No Action Alternative to 13% of years under all of the
29 Alternative 4 H1–H4 Scenarios (Appendix 8G, Table Cl-64).

30 Similarly, estimates of chloride concentrations generated using EC-chloride relationships and DSM2
31 EC output (see Section 8.3.1.3) were also used to evaluate the 250 mg/L Bay-Delta WQCP objective
32 for chloride at Contra Costa Pumping Plant #1 where daily average objectives apply. For Alternative
33 4, the modeled frequency of objective exceedance would decrease minimally under all the H1–H4
34 Scenarios, from 5% of modeled days under the No Action Alternative to 4–3% of modeled days
35 under the Alternative 4 scenarios (Appendix 8G, Table Cl-64).

36 Similar to Existing Conditions, a comparative assessment of modeling approaches was utilized to
37 evaluate the 250 mg/L Bay-Delta WQCP objectives in terms of both frequency of exceedance and use
38 of assimilative capacity on a monthly average basis. When utilizing the mass balance approach to
39 model monthly average chloride concentrations for the 16-year period, a small increase in
40 exceedance frequency would be predicted at the Sacramento River at Mallard Island (i.e., from 86%
41 for the No Action Alternative to a slight 2% increase [up to 88%] for H1 and H3), with no change in
42 exceedances under H2 or H4 (Appendix 8G, Table Cl-27). The frequency of exceedances would
43 decrease slightly at the San Joaquin River at Antioch (i.e., from 73% for the No Action Alternative to

1 a range of 68% [H2 and H4] to 70% [H1]), and the frequency of exceedances at the Contra Costa
 2 Canal at Pumping Plant #1 would depend on the scenario from 14% under the No Action Alternative
 3 increasing by 2–4% for H1 and H2 (i.e., up to 18%) and decreasing at H3 and H4 [to
 4 12%]](Appendix 8G, Table Cl-27). Substantial reductions in available assimilative capacity
 5 compared to the No Action Alternative condition would occur at Antioch under H1 and H3 (i.e., 24%
 6 in April) and no substantial reduction under H2/H4 for the 16-year period modeled, and up to 100%
 7 in April [i.e., eliminated] for the drought period for all H1–H4 scenarios). Assimilative capacity also
 8 would be reduced substantially at the Contra Costa Canal at Pumping Plant #1 at similar levels for
 9 H1 and H2 in August through November (i.e., up to 100% elimination in October) to only in August
 10 and September under H3 and H4 (i.e., up to 29%) for the 16-year period modeled, with 100%
 11 elimination in at least one month under all of the H1–H4 scenarios for the drought period)
 12 (Appendix 8G, Tables Cl-29A/29D), reflecting substantial degradation during months when average
 13 concentrations would be near, or exceed, the objective.

14 In comparison, when utilizing the chloride-EC relationship to model monthly average chloride
 15 concentrations for the 16-year period, trends in frequency of exceedance and use of assimilative
 16 capacity would be similar to that discussed when utilizing the mass balance modeling approach
 17 (Appendix 8G, Tables Cl-30A/30D). However, as with Alternative 1A the modeling approach
 18 utilizing the chloride-EC relationships predicted changes of lesser magnitude, where predictions of
 19 change utilizing the mass balance approach were generally of greater magnitude, and thus more
 20 conservative. As discussed in Section 8.3.1.3, in cases of such disagreement, the approach that
 21 yielded the more conservative predictions was used as the basis for determining adverse impacts.

22 Based on the additional predicted annual and seasonal exceedances of one or both Bay Delta WQCP
 23 objectives for chloride, and the associated long-term average water quality degradation in the
 24 western Delta, the potential exists for substantial adverse effects under all of the Alternative 4 H1–
 25 H4 Scenarios on the municipal and industrial beneficial uses through reduced opportunity for
 26 diversion of water with acceptable chloride levels.

27 *303(d) Listed Water Bodies—Relative to No Action Alternative*

28 With respect to the 303(d) listing for chloride, Alternative 4 would generally result in similar
 29 changes for all of the Alternative 4 H1–H4 Scenarios to those discussed for the comparison to
 30 Existing Conditions. Monthly average chloride concentrations at Tom Paine Slough would not be
 31 further degraded on a long-term basis (Appendix 8G, Figure Cl-6). Monthly average chloride
 32 concentrations at source water channel locations for the Suisun Marsh (Appendix 8G, Figures Cl-5,
 33 Cl-7 and Cl-8) would increase substantially in some months during October through May compared
 34 to the No Action Alternative conditions. Therefore, additional, measureable long-term degradation
 35 would occur in Suisun Marsh that potentially would adversely affect the necessary actions to reduce
 36 chloride loading for any TMDL that is developed.

37 **SWP/CVP Export Service Areas**

38 Under the Alternative 4 H1–H4 Scenarios, long-term average chloride concentrations based on the
 39 mass balance analysis of modeling results for the 16-year period modeled at the Banks and Jones
 40 pumping plants would decrease compared to Existing Conditions. Reductions at Banks would be
 41 slightly larger than at Jones, ranging from 37% (H1) to 45% (H4) (Appendix 8G, *Chloride*, Table Cl-
 42 25A/25D). Compared to No Action Alternative, the pattern of reductions would be similar with
 43 Banks ranging from 32% (H1) to 38% (H4). The modeled frequency of exceedances of applicable
 44 water quality objectives/criteria would decrease relative to Existing Conditions and No Action

1 Alternative, for both the 16-year period and the drought period modeled (Appendix 8G, *Chloride*,
2 Table Cl-27). Consequently, water exported into the SWP/CVP service area would generally be of
3 similar or better quality with regards to chloride relative to Existing Conditions and the No Action
4 Alternative conditions.

5 Results of the modeling approach which used relationships between EC and chloride (see Section
6 8.3.1.3) were consistent with the discussion above, and assessment of chloride using these data
7 results in the same conclusions as are presented above for the mass-balance approach (Appendix
8 8G, Tables Cl-26A/26D [for concentration changes] and Table Cl-28 [for frequency of exceedances]).

9 Commensurate with the reduced chloride concentrations in water exported to the service area,
10 reduced chloride loading in the lower San Joaquin River would be anticipated which would likely
11 alleviate or lessen any expected increase in chloride at Vernalis related to decreased annual average
12 San Joaquin River flows (see discussion of Upstream of the Delta).

13 Maintenance of SWP and CVP facilities would not be expected to create new sources of chloride or
14 contribute towards a substantial change in existing sources of chloride in the affected environment.
15 Maintenance activities would not be expected to cause any substantial change in chloride such that
16 any long-term water quality degradation would occur, thus, beneficial uses would not be adversely
17 affected anywhere in the affected environment.

18 **NEPA Effects:** In summary, relative to the No Action Alternative conditions, all of the Alternative 4
19 H1–H4 Scenarios would result in increased water quality degradation and frequency of exceedance
20 of the 150 mg/L objective at Contra Costa Pumping Plant #1 and Antioch, increased water quality
21 degradation with respect to the 250 mg/L municipal and industrial objective at interior and western
22 Delta locations on a monthly average basis, and measureable water quality degradation relative to
23 the 303(d) impairment in Suisun Marsh (see Mitigation Measure WQ-7 below; implementation of
24 this measure along with a separate, non-environmental commitment relating to the potential
25 increased chloride treatment costs would reduce these effects). The predicted chloride increases
26 constitute an adverse effect on water quality. Additionally, the predicted changes relative to the No
27 Action Alternative conditions indicate that in addition to the effects of climate change/sea level rise,
28 implementation of CM1 and CM4 under the Alternative 4 H1–H4 Scenarios would contribute
29 substantially to the adverse water quality effects.

30 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
31 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
32 purpose of making the CEQA impact determination for this constituent. For additional details on the
33 effects assessment findings that support this CEQA impact determination, see the effects assessment
34 discussion that immediately precedes this conclusion.

35 Chloride is not a constituent of concern in the Sacramento River watershed upstream of the Delta,
36 thus river flow rate and reservoir storage reductions that would occur under any of the Alternative
37 4 H1–H4 Scenarios, relative to Existing Conditions, would not be expected to result in a substantial
38 adverse change in chloride levels. Additionally, relative to Existing Conditions, the Alternative 4 H1–
39 H4 Scenarios would not result in reductions in river flow rates (i.e., less dilution) or increased
40 chloride loading such that there would be any substantial increase in chloride concentrations
41 upstream of the Delta in the San Joaquin River watershed.

42 Relative to Existing Conditions, all of the Alternative 4 H1–H4 Scenarios would result in
43 substantially increased chloride concentrations in the Delta such that frequency of exceeding the

1 150 mg/L Bay-Delta WQCP objective would approximately double. Moreover, the frequency of
 2 exceedance of the 250 mg/L Bay-Delta WQCP objective would increase at the San Joaquin River at
 3 Antioch and at Mallard Slough (ranging by up to 2 to 4% for the H1–H4 Scenarios). Substantial long-
 4 term degradation also may occur at Antioch under all of the H1–H4 Scenarios, and at the Contra
 5 Costa Canal at Pumping Plant #1 under the H1-H2 Scenarios, that may result in adverse effects on
 6 the municipal and industrial water supply beneficial use (see Mitigation Measure WQ-7 below;
 7 implementation of this measure along with a separate, non-environmental commitment relating to
 8 the potential increased chloride treatment costs would reduce these effects). Relative to the Existing
 9 Conditions, the modeled increased chloride concentrations and degradation in the western Delta
 10 under all of the H1–H4 Scenarios could further contribute, at measurable levels (i.e., over a doubling
 11 of concentration), to the existing 303(d) listed impairment due to chloride in Suisun Marsh for the
 12 protection of fish and wildlife.

13 Chloride concentrations would be reduced under all of the H1–H4 Scenarios in water exported from
 14 the Delta to the CVP/SWP Export Service Areas, thus reflecting a potential improvement to chloride
 15 loading in the lower San Joaquin River.

16 Chloride is not a bioaccumulative constituent, thus any increased concentrations under the
 17 Alternative 4 H1–H4 Scenarios would not result in substantial chloride bioaccumulation impacts on
 18 aquatic life or humans. Alternative 4 maintenance would not result in any substantial changes in
 19 chloride concentration upstream of the Delta or in the SWP/CVP Export Service Areas. However,
 20 based on these findings, this impact is determined to be significant due to increased chloride
 21 concentrations and degradation at western Delta locations and its potential effects on municipal and
 22 industrial water supply and fish and wildlife beneficial uses.

23 While mitigation measures to reduce these water quality effects in affected water bodies to less than
 24 significant levels are not available, implementation of Mitigation Measure WQ-7 is recommended to
 25 attempt to reduce the effect that increased chloride concentrations may have on Delta beneficial
 26 uses. However, because the effectiveness of this mitigation measure to result in feasible measures
 27 for reducing water quality effects is uncertain, this impact is considered to remain significant and
 28 unavoidable.

29 In addition to and to supplement Mitigation Measure WQ-7, the BDCP proponents have incorporated
 30 into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*, a separate, non-
 31 environmental commitment to address the potential increased water treatment costs that could
 32 result from chloride concentration effects on municipal, industrial and agricultural water purveyor
 33 operations. Potential options for making use of this financial commitment include funding or
 34 providing other assistance towards acquiring alternative water supplies or towards modifying
 35 existing operations when chloride concentrations at a particular location reduce opportunities to
 36 operate existing water supply diversion facilities. Please refer to Appendix 3B, *Environmental*
 37 *Commitments*, for the full list of potential actions that could be taken pursuant to this commitment in
 38 order to reduce the water quality treatment costs associated with water quality effects relating to
 39 chloride, electrical conductivity, and bromide.

40 **Mitigation Measure WQ-7: Conduct Additional Evaluation and Modeling of Increased** 41 **Chloride Levels and Develop and Implement Phased Mitigation Actions**

42 It is currently unknown whether the effects of increased chloride levels, and potential adverse
 43 effects on municipal and industrial water supply and fish and wildlife beneficial uses associated
 44 with CM1 operations (and hydrodynamic effects of tidal restoration under CM4), can be

1 mitigated through modifications to initial operations. Specifically, it remains to be determined
2 whether, or to what degree, the available and existing salinity response and countermeasure
3 actions of SWP and CVP facilities, municipal water purveyors, or Suisun Marsh salinity control
4 facilities would be capable of offsetting the actual level of changes in chloride that may occur
5 from implementation of Alternative 4. Therefore, the proposed mitigation measures require a
6 series of actions to identify and evaluate potentially feasible actions, to achieve reduced chloride
7 levels in order to reduce or avoid impacts to beneficial uses.

8 The development and implementation of any mitigation actions shall be focused on those
9 incremental effects attributable to implementation of Alternative 4 operations only.
10 Development of mitigation actions for the incremental chloride effects attributable to climate
11 change/sea level rise are not required because these changed conditions would occur with or
12 without implementation of Alternative 4.

13 **Mitigation Measure WQ-7a: Conduct Additional Evaluation and Modeling of Increased**
14 **Chloride Levels Following Initial Operations of CM1**

15 Following commencement of initial operations of CM1, the BDCP proponents will conduct
16 additional evaluations described herein, and develop additional modeling (as necessary), to
17 define the extent to which modified operations could reduce or eliminate the additional
18 exceedances of the 250 mg/L Bay-Delta WQCP objective for chloride currently modeled to occur
19 under Alternative 4. The additional evaluations should also consider specifically the changes in
20 Delta hydrodynamic conditions associated with tidal habitat restoration under CM4 (in
21 particular the potential for increased chloride concentrations that could result from increased
22 tidal exchange) once the specific restoration locations are identified and designed. If sufficient
23 operational flexibility to offset chloride increases is not feasible under Alternative 4 operations,
24 achieving chloride reduction pursuant to this mitigation measure would not be feasible under
25 this alternative.

26 **Mitigation Measure WQ-7b: Consult with Delta Water Purveyors to Identify Means to**
27 **Avoid, Minimize, or Offset for Reduced Seasonal Availability of Water That Meets**
28 **Applicable Water Quality Objectives**

29 To determine the feasibility of reducing the effects of CM1/CM4 operations on increased
30 chloride concentrations as shown in modeling estimates to occur to municipal and industrial
31 water purveyors at the Antioch, Mallard Slough, and Contra Costa Canal at Pumping Plant #1
32 locations, the BDCP proponents will consult with the purveyors to identify any feasible
33 operational means to either avoid, minimize, or offset for reduced seasonal availability of water
34 that meets applicable water quality objectives and that results in levels of degradation that do
35 not substantially increase the risk of adversely affecting the municipal and industrial beneficial
36 use. Any such action will be developed following, and in conjunction with, the completion of the
37 evaluation and development of any potentially feasible actions described in Mitigation Measure
38 WQ-7a.

39 **Mitigation Measure WQ-7c: Consult with DFW/USFWS, and Suisun Marsh Stakeholders, to**
40 **Identify Potential Actions to Avoid or Minimize Chloride Level Increases in the Marsh**

41 To determine the feasibility of reducing the effects of CM1/CM4 operations on increased
42 chloride concentrations as shown in modeling estimates to occur in the Suisun Marsh, the BDCP

1 proponents will consult with DFW/USFWS, and Suisun Marsh stakeholders, to identify potential
2 actions to avoid or minimize the chloride level increases in the marsh, with the goal of
3 maintaining chloride at levels that would not further impair fish and wildlife beneficial uses in
4 Suisun Marsh. Potential actions may include modifications of the existing Suisun Marsh Salinity
5 Control Gates for effective salinity control and evaluation of the efficacy of additional physical
6 salinity control facilities or operations for the marsh to reduce the effects of increased chloride
7 levels. Based on the modeled conditions, the emphasis would be identification of potentially
8 feasible actions to reduce adverse chloride-related effects during the seasonal period of January
9 through May. Any such action will be developed following, and in conjunction with, the
10 completion of the evaluation and development of any feasible actions described in Mitigation
11 Measure WQ-7a.

12 **Impact WQ-8: Effects on Chloride Concentrations Resulting from Implementation of CM2-
13 CM22**

14 **NEPA Effects:** The implementation of the other conservation measures (i.e., CM2–CM22), of which
15 most do not involve land disturbance, present no new direct sources of chloride to the affected
16 environment, including areas Upstream of the Delta, within the Plan Area, and the SWP/CVP Export
17 Service Area, nor would they affect channel flows or Delta hydrodynamic conditions. As noted
18 above, the potential effects of implementation of tidal habitat restoration (i.e., CM4) on Delta
19 hydrodynamic conditions is addressed above in the discussion of Impact WQ-8. The potential
20 channel flow effects of CM2 for actions in the Yolo Bypass also were accounted for in the CALSIM II
21 and DSM2 modeling, and thus were addressed in the discussion for Impact WQ-8. CM3 and CM11
22 provide the mechanism, guidance, and planning for the land acquisition and thus would not,
23 themselves, affect chloride levels in the Delta. CM12–CM22 involve actions that target reduction in
24 other stressors at the species level involving actions such as methylmercury reduction management
25 (CM12), improving DO in the Stockton Deep Water Ship Channel (CM14), and urban stormwater
26 treatment (CM19). None of CM12–CM22 would contribute to substantially increasing chloride levels
27 in the Delta. Consequently, as they pertain to chloride, implementation of CM2–CM22 would not be
28 expected to adversely affect any of the beneficial uses of the affected environment. Moreover, some
29 habitat restoration conservation measures (CM4–CM10) would occur on lands within the Delta
30 currently used for irrigated agriculture, thus replacing agricultural land uses with restored tidal
31 wetlands, floodplain, and related channel margin and off-channel habitats. The potential reduction
32 in irrigated lands within the Delta may result in reduced discharges of agricultural field drainage
33 with elevated chloride concentrations, which would be considered an improvement compared to the
34 No Action Alternative.

35 In summary, based on the discussion above, the effects on chloride from implementing CM2-CM22
36 are considered to be not adverse.

37 **CEQA Conclusion:** Implementation of the CM2–CM22 for Alternative 4 would not present new or
38 substantially changed sources of chloride to the affected environment upstream of the Delta, within
39 Delta, or in the SWP/CVP service area. Replacement of irrigated agricultural land uses in the Delta
40 with habitat restoration conservation measures may result in some reduction in discharge of
41 agricultural field drainage with elevated chloride concentrations, thus resulting in improved water
42 quality conditions. Based on these findings, this impact is considered to be less than significant. No
43 mitigation is required.

1 **Impact WQ-9: Effects on Dissolved Oxygen Resulting from Facilities Operations and**
2 **Maintenance (CM1)**

3 ***Upstream of the Delta***

4 DO levels in the reservoirs and rivers are primarily affected by water temperature, flow velocity,
5 turbulence, amounts of oxygen demanding substances present (e.g., ammonia, organics), and rates
6 of photosynthesis (which is influenced by nutrient levels), respiration, and decomposition. Water
7 temperature and salinity affect the maximum DO saturation level (i.e., the highest amount of oxygen
8 the water can dissolve). Flow velocity affects the turbulence and re-aeration of the water (i.e., the
9 rate at which oxygen from the atmosphere can be dissolved in water). High nutrient content can
10 support aquatic plant and algae growth, which in turn generates oxygen through photosynthesis and
11 consumes oxygen through respiration and decomposition.

12 The four operational scenarios of Alternative 4 would alter the magnitude and timing of water
13 releases from reservoirs upstream of the Delta relative to Existing Conditions and the No Action
14 Alternative, which would consequently alter downstream river flows. There would be some
15 increases and decreases in the mean monthly river flows, depending on month and year. Mean
16 monthly flows would remain within the range historically seen under Existing Conditions and the
17 No Action Alternative. Moreover, these are large, turbulent rivers with flow velocities typically in the
18 range of 0.5 fps to 2.0 fps or higher. Consequently, flow changes that would occur under any
19 operational scenario of Alternative 4 would not be expected to have substantial effects on river DO
20 levels; likely, the changes would be immeasurable. This is because sufficient turbulence and
21 interaction of river water with the atmosphere would continue to occur under this alternative to
22 maintain water saturation levels (due to these factors) at levels similar to that of Existing Conditions
23 and the No Action Alternative.

24 The changes in the magnitude and timing of water releases from reservoirs upstream of the Delta,
25 relative to Existing Conditions and the No Action Alternative, could affect downstream river
26 temperatures, depending on month and year. Water temperature affects the maximum DO
27 saturation level; as temperature increases, the DO saturation level decreases. When holding
28 constant for barometric pressure (e.g., 760 mm mercury), the DO saturation level ranges from 7.5
29 mg/L at 30°C (86°F) to 11 mg/L at 10°C (50°F) (Tchobanoglous and Schroeder 1987:735). As
30 described in the affected environment section, DO in the Sacramento River at Keswick, Feather River
31 at Oroville, and lower American River ranged from 7.3 to 15.6 mg/L, 7.4 to 12.5 mg/L, and 6.5 to
32 13.0 mg/L, respectively. Thus, these rivers are well oxygenated and experience periods of
33 supersaturation (i.e., when DO level exceeds the saturation concentration). Because these are large,
34 turbulent rivers, any reduced DO saturation level that would be caused by an increase in
35 temperature under any operational scenario of Alternative 4 would not be expected to cause DO
36 levels to be outside of the range seen historically. This is because sufficient turbulence and
37 interaction of river water with the atmosphere would continue to occur under this alternative to
38 maintain saturation levels.

39 Amounts of oxygen demanding substances present (e.g., ammonia, organics) in the reservoirs and
40 rivers upstream of the Delta, rates of photosynthesis (which is influenced by nutrient
41 levels/loading), and respiration and decomposition of aquatic life is not expected to change
42 sufficiently under Alternative 4 to substantially alter DO levels relative to Existing Conditions or the
43 No Action Alternative. Any minor reductions in DO levels that may occur under this alternative

1 would not be expected to be of sufficient frequency, magnitude and geographic extent to adversely
2 affect beneficial uses, or substantially degrade the quality of these water bodies, with regard to DO.

3 An effect on salinity (expressed as EC) would not be expected in the rivers and reservoirs upstream
4 of the Delta. Thus, these parameters would not be expected to measurably change DO levels under
5 any of the operational scenarios of Alternative 4, relative to Existing Conditions or the No Action
6 Alternative.

7 **Delta**

8 Similar to the reservoirs and rivers upstream of the Delta, DO levels in the Delta are primarily
9 affected by water temperature, salinity, Delta channel flow velocities, nutrients (i.e., phosphorus and
10 nitrogen) and aquatic organisms (i.e., photosynthesis, respiration, and decomposition). Sediment
11 oxygen demand of organic material deposited in the low velocity channels also affects Plan Area DO
12 levels.

13 Under all operational scenarios of Alternative 4, minor DO level changes could occur due to nutrient
14 loading to the Delta relative to Existing Conditions and the No Action Alternative (see WQ-1, WQ-15,
15 WQ-23). The state has begun to aggressively regulate point-source discharge effects on Delta
16 nutrients, and is expected to further regulate nutrients upstream of and in the Delta in the future.
17 Although population increased in the affected environment between 1983 and 2001, average
18 monthly DO levels during this period of record show no trend in decline in the presence of
19 presumed increases in anthropogenic sources of nutrients (see Table 4.4-15 in the ES/AE section).
20 Based on these considerations, excessive nutrients that would cause low DO levels would not be
21 expected to occur under any operational scenario of Alternative 4.

22 Various areas of the Delta could experience salinity increases due to change in quantity of Delta
23 inflows (see WQ-11) For a 5 ppt salinity increase at 68° Fahrenheit, the saturation level of oxygen
24 dissolved in the water is reduced by only about 0.25 mg/L. Thus, increased salinity under
25 Alternative 4 would generally have relatively minor effects on Delta DO levels where salinity is
26 increased on the order of 5 ppt or less.

27 The relative degree of tidal exchange of flows and turbulence, which contributes to exposure of
28 Delta waters to the atmosphere for reaeration, would not be expected to substantially change
29 relative to Existing Conditions or the No Action Alternative, such that these factors would reduce
30 Delta DO levels below objectives or levels that protect beneficial uses.

31 As discussed in the section on DO in section 8.3.1.7 Effects of climate change on air and Delta water
32 temperatures are discussed in Appendix 29C. In general, waters of the Delta would be expected to
33 warm less than 5 degrees F under Alternative 4, relative to Existing Conditions, due to climate
34 change, which translates into a < 0.5 mg/L decrease in DO saturation. Thus, increased temperature
35 under Alternative 4 would generally have relatively minor effects on Delta DO levels, relative to
36 Existing Conditions.

37 Some waterways in the eastern, southern, and western Delta are listed on the state's Clean Water
38 Act section 303(d) list as impaired due to low oxygen levels. A TMDL for the Deep Water Ship
39 channel in the eastern Delta has been approved and identifies the factors contributing to low DO in
40 the Deep Water Ship Channel as oxygen demanding substances from upstream sources, Deep Water
41 Ship Channel geometry, and reduced flow through the Deep Water Ship Channel (Central Valley
42 Water Board 2005:28). The TMDL takes a phased approach to allow more time to gather additional
43 informational on sources and linkages to the DO impairment, while at the same time moving

1 forward on making improvements to DO conditions. One component of the TMDL implementation
2 activities is an aeration device demonstration project. It is expected that under Alternative 4 that DO
3 levels in the Deep Water Ship Channel would remain similar to those under Existing Conditions and
4 the No Action Alternative or improve as the TMDL-required studies are completed and actions are
5 implemented to improve DO levels. DO levels in other Clean Water Act section 303(d)-listed
6 waterways would not be expected to change relative to Existing Conditions or the No Action
7 Alternative, as the circulation of flows, tidal flow exchange, and re-aeration would continue to occur.

8 ***SWP/CVP Export Service Areas***

9 The primary factor that would affect DO in the conveyance channels and ultimately the receiving
10 reservoirs in the SWP/CVP Export Service Areas would be changes in the levels of nutrients and
11 oxygen-demanding substances and DO levels in the exported water. For reasons provided above, the
12 Delta waters exported to the SWP/CVP Export Service Areas would not be expected to be
13 substantially lower in DO compared to Existing Conditions or the No Action Alternative. Exported
14 water could potentially be warmer and have higher salinity relative to Existing Conditions and the
15 No Action Alternative. Nevertheless, because the biochemical oxygen demand of the exported water
16 would not be expected to substantially differ from that under Existing Conditions or the No Action
17 Alternative (due to ever increasing water quality regulations), canal turbulence and exposure of the
18 water to the atmosphere and the algal communities that exist within the canals would establish an
19 equilibrium for DO levels within the canals. The same would occur in downstream reservoirs.
20 Consequently, substantial adverse effects on DO levels in the SWP/CVP Export Service Areas would
21 not be expected to occur.

22 ***NEPA Effects:*** The effects on dissolved oxygen from implementing any operational scenario of
23 Alternative 4 is determined to not be adverse.

24 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
25 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
26 purpose of making the CEQA impact determination for this constituent. For additional details on the
27 effects assessment findings that support this CEQA impact determination, see the effects assessment
28 discussion that immediately precedes this conclusion.

29 River flow rate and reservoir storage reductions that would occur under any operational scenario of
30 Alternative 4, relative to Existing Conditions, would not be expected to result in a substantial
31 adverse change in DO levels in the reservoirs and rivers upstream of the Delta, given that mean
32 monthly flows would remain within the ranges historically seen under Existing Conditions and the
33 affected river are large and turbulent. Any reduced DO saturation level that may be caused by
34 increased water temperature would not be expected to cause DO levels to be outside of the range
35 seen historically. Finally, amounts of oxygen demanding substances and salinity would not be
36 expected to change sufficiently to affect DO levels.

37 It is expected there would be no substantial change in Delta DO levels in response to a shift in the
38 Delta source water percentages under this alternative or substantial degradation of these water
39 bodies, with regard to DO. DO levels would be affected by nutrient loading, which the state has
40 begun to aggressively regulate the discharges of, and this loading would not be expected to lower DO
41 levels relative to Existing Conditions based on historical DO levels. Further, the anticipated changes
42 in salinity would have relatively minor effects on DO levels, and tidal exchange, which contribute to
43 the reaeration of Delta waters would not be expected to change substantially.

1 There is not expected to be substantial, if even measurable, changes in DO levels in the SWP/CVP
2 Export Service Areas waters under any operational scenario of Alternative 4, relative to Existing
3 Conditions, because the biochemical oxygen demand of the exported water would not be expected to
4 substantially differ from that under Existing Conditions (due to ever increasing water quality
5 regulations), canal turbulence and exposure of the water to the atmosphere and the algal
6 communities that exist within the canals would establish an equilibrium for DO levels within the
7 canals. The same would occur in downstream reservoirs.

8 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
9 objectives by frequency, magnitude, and geographic extent that would result in significant impacts
10 on any beneficial uses within affected water bodies. Because no substantial changes in DO levels are
11 expected, long-term water quality degradation would not be expected to occur, and, thus, beneficial
12 uses would not be adversely affected. Various Delta waterways are 303(d)-listed for low DO, but
13 because no substantial decreases in DO levels would be expected, greater degradation and DO-
14 related impairment of these areas would not be expected. This impact would be less than significant.
15 No mitigation is required.

16 **Impact WQ-10: Effects on Dissolved Oxygen Resulting from Implementation of CM2–CM22**

17 **NEPA Effects:** CM2–CM22 would not be expected to contribute to adverse DO levels in the Delta. The
18 increased habitat provided by CM2–CM11 could contribute to an increased biochemical or sediment
19 demand, through contribution of organic carbon and plants decaying. However, similar habitat
20 exists currently in the Delta and is not identified as contributing to adverse DO conditions. Although
21 additional DOC loading to the Delta may occur (see impact WQ-18), only a fraction of the DOC is
22 available to microorganisms that would consume oxygen as part of the decay and mineralization
23 process. Since decreases in dissolved organic carbon are not typically observed in Delta waterways
24 due to these processes, any increase in DOC is unlikely to contribute to adverse DO levels in the
25 Delta. CM14, an oxygen aeration facility in the Stockton Deep Water Ship Channel to meet TMDL
26 objectives established by the Central Valley Water Board, would maintain DO levels above those that
27 impair fish species when covered species are present. CM19, which would fund projects to
28 contribute to reducing pollutant discharges in stormwater, would be expected to reduce biochemical
29 oxygen demand load and, thus, would not adversely affect DO levels. The remaining conservation
30 measures would not be expected to affect DO levels because they are actions that do not affect the
31 presence of oxygen-demanding substances.

32 The effects on dissolved oxygen from implementing CM2–CM22 is determined to not be adverse.

33 **CEQA Conclusion:** It is expected that DO levels in the Upstream of the Delta Region, in the Plan Area,
34 or in the SWP/CVP Export Service Areas following implementation of CM2–CM22 under Alternative
35 4 would not be substantially different from existing DO conditions. Therefore, this alternative is not
36 expected to cause additional exceedance of applicable water quality objectives by frequency,
37 magnitude, and geographic extent that would result in significant impacts on any beneficial uses
38 within affected water bodies. Because no substantial changes in DO levels would be expected, long-
39 term water quality degradation would not be expected, and, thus, beneficial uses would not be
40 adversely affected. Various Delta waterways are 303(d)-listed for low DO, but because no
41 substantial decreases in DO levels would be expected, greater degradation and impairment of these
42 areas would not be expected. Implementation of CM14 would have a net beneficial effect on DO
43 conditions in the Stockton Deep Water Ship Channel. This impact would be less than significant. No
44 mitigation is required.

1 **Impact WQ-11: Effects on Electrical Conductivity Concentrations Resulting from Facilities**
2 **Operations and Maintenance (CM1)**

3 ***Upstream of the Delta***

4 Alternative 4, Scenarios H1–H4, would alter the magnitude and timing of water releases from
5 reservoirs upstream of the Delta relative to Existing Conditions and the No Action Alternative. With
6 respect to EC, an increase or decrease in river flow alone is not of concern. Measureable changes in
7 the quality of the watershed runoff and reservoir inflows would not be expected to occur in the
8 future; therefore, the EC levels in these reservoirs would not be expected to change relative to
9 Existing Conditions or the No Action Alternative. There could be increased discharges of EC-
10 elevating parameters in the future in water bodies upstream of the Delta as a result of urban growth
11 and increased runoff and wastewater discharges. The state has begun to aggressively regulate point-
12 source discharge effects on Delta salinity-elevating parameters, capping dischargers at existing
13 levels, and is expected to further regulate EC and related parameters upstream of and within the
14 Delta in the future as salt management plans are developed. Based on these considerations, EC levels
15 (highs, lows, typical conditions) in the Sacramento River and its tributaries, the eastside tributaries,
16 or their associated reservoirs upstream of the Delta would not be expected to be outside the ranges
17 occurring under Existing Conditions or the No Action Alternative.

18 The effects on lower San Joaquin River EC would be somewhat different. Elevated EC in the San
19 Joaquin River can be sourced to agricultural use of irrigation water imported from the southern
20 Delta and applied on soils high in salts. This accumulation of salts is a primary contributor of
21 elevated EC on the lower San Joaquin River. Tributary flows generally provide dilution of the high
22 EC agricultural drainage waters. Depending on operational scenario, long-term average flows at
23 Vernalis would decrease about 6% (as a result of climate change and increased water demands)
24 relative to Existing Conditions, and would increase about 0.1% relative to the No Action Alternative
25 (Appendix 5A). These decreases in flow, alone, would correspond to a possible increase in long-term
26 average EC levels. The level of EC increase cannot be readily quantified but, based on estimated
27 increase in bromide and chloride concentrations, to which EC is correlated, would be relatively
28 small and on the order of about 3% relative to Existing Conditions, and less than 0.1% relative to the
29 No Action Alternative. However, with the implementation of the adopted TMDL for the San Joaquin
30 River at Vernalis and the ongoing development of the TMDL for the San Joaquin River upstream of
31 Vernalis and its implementation, it is expected that long-term EC levels will improve. Based on these
32 considerations, substantial changes in EC levels in the San Joaquin River relative to Existing
33 Conditions or the No Action Alternative would not be expected of sufficient magnitude and
34 geographic extent that would result in adverse effects on any beneficial uses, or substantially
35 degrade the quality of these water bodies, with regard to EC.

36 ***Delta***

37 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
38 and CM4) would affect Delta hydrodynamics. To the extent that restoration actions alter
39 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
40 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
41 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
42 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

43 Relative to Existing Conditions, Alternative 4, Scenarios H1–H4, would result in an increase in the
44 number of days the Bay-Delta WQCP EC objectives would be exceeded in the Sacramento River at

1 Emmaton, San Joaquin River at San Andreas Landing and Prisoners Point, and Old River near Middle
 2 River and at Tracy Bridge (Appendix 8H, Table EC-4). The percent of days the Emmaton EC objective
 3 would be exceeded for the entire period modeled (1976–1991) would increase from 6% under
 4 Existing Conditions to 23–25%, depending on the operations scenario, and the percent of days out of
 5 compliance would increase from 11% under Existing Conditions to 35–38%, depending on the
 6 operations scenario. The percent of days the San Andreas Landing EC objective would be exceeded
 7 would increase from 1% to 3–4%, depending on the operations scenario. The percent of days out of
 8 compliance with the EC objective for San Andreas Landing would increase from 1% to 5–7%,
 9 depending on the operations scenario. The percent of days the Prisoners Point EC objective would
 10 be exceeded for the entire period modeled would increase from 6% to 20–31% and the percent of
 11 days out of compliance with the EC objective would increase from 10% to 22–31%, depending on
 12 the operations scenario. The increase in percent of days exceeding the EC objectives and days out of
 13 compliance at the Old River locations would be 1–2% at Tracy Bridge and less than 1% at Middle
 14 River for all operations scenarios. Average EC levels at the western and southern Delta compliance
 15 locations would decrease, except at Emmaton, from 1–36% for the entire period modeled and 2–
 16 33% during the drought period modeled (1987–1991) (Appendix 8H, Tables EC-15A through EC-
 17 15D). At Emmaton, there would be an increase in average EC under all operational scenarios, though
 18 the increase would be less for scenarios H3 and H4 (0% for entire period; 8% for drought period)
 19 than for scenarios H1 and H2 (13–14% for entire period; 12–13% for drought period). There would
 20 be increases in average EC at two interior Delta locations under all operational scenarios: the S. Fork
 21 Mokelumne River at Terminous average EC would increase 5% for the entire period modeled and
 22 4% during the drought period modeled; and San Joaquin River at San Andreas Landing average EC
 23 would increase 0–9% for the entire period modeled and 7–13% during the drought period modeled.
 24 In addition, under Scenarios H1 and H2, there would be slight increase (<1–2%) in drought period
 25 average EC in the San Joaquin River at Prisoners Point. On average, EC would increase at San
 26 Andreas Landing from March through September under all operations scenarios; Scenarios H1, H2,
 27 and H4 also would increase EC at this location in February and Scenarios H1 and H2 would increase
 28 EC in October. Average EC in the S. Fork Mokelumne River at Terminous would increase during all
 29 months (Appendix 8H, Tables EC-15A through EC-15D). The comparison to Existing Conditions
 30 reflects changes in EC due to both Alternative 4 operations (including north Delta intake capacity of
 31 9,000 cfs and numerous other operational components of Scenarios H1–H4) and climate change/sea
 32 level rise.

33 Relative to the No Action Alternative, the percent of days exceeding EC objectives and percent of
 34 days out of compliance would increase at: Sacramento River at Emmaton, San Joaquin River at
 35 Jersey Point, San Andreas Landing, and Prisoners Point; and Old River near Middle River and at
 36 Tracy Bridge (Appendix 8H, Table EC-4). The increase in percent of days exceeding the EC objective
 37 would be 19–30% at Prisoners Point, depending on the operations scenario, and 13% or less at the
 38 remaining locations. The increase in percent of days out of compliance would be 21–30% at
 39 Prisoners Point, depending on the operations scenario, and 16% or less at the remaining locations.
 40 For the entire period modeled, average EC levels would increase at western (scenarios H1 and H2
 41 only), interior, and southern Delta locations; the average EC increase would be 12–13% at Emmaton
 42 (western Delta; for scenarios H1 and H2 only), 5–15% at interior Delta locations and 2% or less at
 43 southern Delta locations, depending on the operations scenario (Appendix 8H, Tables EC-15A
 44 through EC-15D). During the drought period modeled, average EC would increase at western
 45 (scenarios H1 and H2 only), interior, and southern Delta locations. The greatest average EC increase
 46 during the drought period modeled would occur in the interior Delta in the San Joaquin River at San
 47 Andreas Landing (7–13% depending on the operations scenario); the increase at the other locations

1 would be <1–9% (Appendix 8H, Tables EC-15A through EC-15D). The comparison to the No Action
 2 Alternative reflects changes in EC due only to the different operational components of Scenarios H1–
 3 H4 of Alternative 4.

4 For Suisun Marsh, October–May is the period when Bay-Delta WQCP EC objectives for protection of
 5 fish and wildlife apply. Average EC for the entire period modeled would increase in the Sacramento
 6 River at Collinsville during the months of March through May under all operations scenarios of
 7 Alternative 4, relative to Existing Conditions, by 0.3–0.9 mS/cm (Appendix 8H, Table EC-21). Long-
 8 term average EC would decrease under all operations scenarios, relative to Existing Conditions, in
 9 Montezuma Slough at National Steel during October–May (Appendix 8H, Table EC-22). The most
 10 substantial EC increase would occur near Beldon Landing, with long-term average EC levels
 11 increasing by 1.3–6.0 mS/cm, depending on the month and operations scenario, at least doubling
 12 during some months the long-term average EC relative to Existing Conditions (Appendix 8H, Table
 13 EC-23). Sunrise Duck Club and Volanti Slough also would have long-term average EC increases
 14 during all months ranging 0.5–3.9 mS/cm (Appendix 8H, Tables EC-24 and EC-25). The degree to
 15 which the long-term average EC increases would cause exceedance of Bay-Delta WQCP objectives is
 16 unknown, because objectives are expressed as a monthly average of daily high tide EC, which does
 17 not have to be met if it can be demonstrated “equivalent or better protection will be provided at the
 18 location” (State Water Resources Control Board 2006:14). The described long-term average EC
 19 increase may, or may not, contribute to adverse effects on beneficial uses, depending on how and
 20 when wetlands are flooded, soil leaching cycles, and how agricultural use of water is managed, and
 21 future actions taken with respect to the marsh. However, the EC increases at certain locations would
 22 be substantial and it is uncertain the degree to which current management plans for the Suisun
 23 Marsh would be able to address these substantially higher EC levels and protect beneficial uses.
 24 Thus, these increased EC levels in Suisun Marsh are considered to have a potentially adverse effect
 25 on marsh beneficial uses. Long-term average EC increases in Suisun Marsh under Alternative 4,
 26 Scenarios H1–H4, relative to the No Action Alternative would be similar to the increases relative to
 27 Existing Conditions.

28 ***SWP/CVP Export Service Area***

29 At the Banks and Jones pumping plants, Alternative 4, Scenarios H1–H4, would result in no
 30 exceedances of the Bay-Delta WQCP’s 1,000 µmhos/cm EC objective for the entire period modeled
 31 (Appendix 8H, Table EC-10). Thus, there would be no adverse effect on the beneficial uses in the
 32 SWP/CVP Export Service Areas using water pumped at this location under the Alternative 4.

33 At the Banks pumping plant, relative to Existing Conditions, average EC levels under Alternative 4,
 34 Scenarios H1–H4, would decrease 23–27% for the entire period modeled and 21–27% during the
 35 drought period modeled, depending on the operations scenario. Relative to the No Action
 36 Alternative, average EC levels would similarly decrease, by 17–22% for the entire period modeled
 37 and 16–22% during the drought period modeled. (Appendix 8H, Tables EC-15A through EC-15D)

38 At the Jones pumping plant, relative to Existing Conditions, average EC levels under Alternative 4,
 39 Scenarios H1–H4, would decrease 21–26% for the entire period modeled and 17–23% during the
 40 drought period modeled, depending on the operations scenario. Relative to the No Action
 41 Alternative, average EC levels would similarly decrease by 17–22% for the entire period modeled
 42 and 14–20% during the drought period modeled. (Appendix 8H, Table EC-13)

43 Based on the decreases in long-term average EC levels that would occur at the Banks and Jones
 44 pumping plants, Alternative 4, Scenarios H1–H4, would not cause degradation of water quality with

1 respect to EC in the SWP/CVP Export Service Areas; rather, Alternative 4, Scenarios H1–H4, would
2 improve long-term average EC conditions in the SWP/CVP Export Service Areas.

3 Commensurate with the EC decrease in exported waters, an improvement in lower San Joaquin
4 River average EC levels would be expected since EC in the lower San Joaquin River is, in part, related
5 to irrigation water deliveries from the Delta. While the magnitude of this expected lower San
6 Joaquin River improvement in EC is difficult to predict, the relative decrease in overall loading of EC-
7 elevating constituents to the Export Service Areas would likely alleviate or lessen any expected
8 increase in EC at Vernalis related to decreased annual average San Joaquin River flows.

9 The export area of the Delta is listed on the state’s CWA Section 303(d) list as impaired due to
10 elevated EC. Alternative 4, Scenarios H1–H4, would result in lower average EC levels relative to
11 Existing Conditions and the No Action Alternative and, thus, would not contribute to additional
12 beneficial use impairment related to elevated EC in the SWP/CVP Export Service Areas waters.

13 **NEPA Effects:** In summary, the increased frequency of exceedance of EC objectives and increased
14 long-term and drought period average EC levels that would occur at western, interior, and southern
15 Delta compliance locations under Alternative 4, Scenarios H1–H4, relative to the No Action
16 Alternative, would contribute to adverse effects on the agricultural beneficial uses. In addition, the
17 increased frequency of exceedance of the San Joaquin River at Prisoners Point EC objective and long-
18 term and drought period average EC could contribute to adverse effects on fish and wildlife
19 beneficial uses. Given that the western and southern Delta are CWA section 303(d) listed as
20 impaired due to elevated EC, the increase in the incidence of exceedance of EC objectives and long-
21 term average and drought period average EC in this portion of the Delta has the potential to
22 contribute to additional beneficial use impairment. The increases in long-term average EC levels that
23 would occur in Suisun Marsh would further degrade existing EC levels and could contribute
24 additional to adverse effects on the fish and wildlife beneficial uses. Suisun Marsh is CWA section
25 303(d) listed as impaired due to elevated EC, and the potential increases in long-term average EC
26 levels could contribute to additional beneficial use impairment. These increases in EC constitute an
27 adverse effect on water quality. Mitigation Measure WQ-11 would be available to reduce these
28 effects (implementation of this measure along with a separate, non-environmental commitment as
29 set forth in EIR/EIS Appendix 3B, *Environmental Commitments*, relating to the potential EC-related
30 changes would reduce these effects).

31 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
32 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
33 purpose of making the CEQA impact determination for this constituent. For additional details on the
34 effects assessment findings that support this CEQA impact determination, see the effects assessment
35 discussion that immediately precedes this conclusion.

36 River flow rate and reservoir storage reductions that would occur under Alternative 4, Scenarios
37 H1–H4, relative to Existing Conditions, would not be expected to result in a substantial adverse
38 change in EC levels in the reservoirs and rivers upstream of the Delta, given that: changes in the
39 quality of watershed runoff and reservoir inflows would not be expected to occur in the future; the
40 state’s aggressive regulation of point-source discharge effects on Delta salinity-elevating parameters
41 and the expected further regulation as salt management plans are developed; the salt-related
42 TMDLs adopted and being developed for the San Joaquin River; and the expected improvement in
43 lower San Joaquin River average EC levels commensurate with the lower EC of the irrigation water
44 deliveries from the Delta.

1 Relative to Existing Conditions, Alternative 4, Scenarios H1–H4, would not result in any substantial
2 increases in long-term average EC levels in the SWP/CVP Export Service Areas. There would be no
3 exceedance of the EC objective at the Jones and Banks pumping plants. Average EC levels for the
4 entire period modeled would decrease at both plants and, thus, this alternative would not contribute
5 to additional beneficial use impairment related to elevated EC in the SWP/CVP Export Service Areas
6 waters. Rather, this alternative would improve long-term EC levels in the SWP/CVP Export Service
7 Areas, relative to Existing Conditions.

8 In the Plan Area, Alternative 4, Scenarios H1–H4, would result in an increase in the frequency with
9 which Bay-Delta WQCP EC objectives are exceeded for the entire period modeled (1976–1991): in
10 the Sacramento River at Emmaton (agricultural objective; 17–19% increase) in the western Delta,
11 and in the San Joaquin River at San Andreas Landing (agricultural objective; 2–3% increase) and
12 Prisoners Point (fish and wildlife objective; 14–25% increase), both in the interior Delta; and in Old
13 River near Middle River and at Tracy Bridge (agricultural objectives; up to 2% increase), both in the
14 southern Delta. Average EC levels at Emmaton would increase by <1–14% for the entire period
15 modeled and 8–13% during the drought period modeled. Average EC levels at San Andreas Landing
16 would increase by 0–9% during for the entire period modeled and 7–13% during the drought period
17 modeled. The increases in long-term and drought period average EC levels and increased frequency
18 of exceedance of EC objectives that would occur in the Sacramento River at Emmaton and San
19 Joaquin River at San Andreas Landing would potentially contribute to adverse effects on the
20 agricultural beneficial uses in the western and interior Delta. Further, the increased frequency of
21 exceedance of the fish and wildlife objective at Prisoners Point could contribute to adverse effects on
22 aquatic life. Because EC is not bioaccumulative, the increases in long-term average EC levels would
23 not directly cause bioaccumulative problems in aquatic life or humans. The western and southern
24 Delta are CWA section 303(d) listed for elevated EC and the increased frequency of exceedance of EC
25 objectives that would occur in these portions of the Delta could make beneficial use impairment
26 measurably worse. This impact is considered to be significant.

27 Further, relative to Existing Conditions, Alternative 4, Scenarios H1–H4, would result in substantial
28 increases in long-term average EC during the months of October through May in Suisun Marsh, such
29 that EC levels would be double that relative to Existing Conditions. The increases in long-term
30 average EC levels that would occur in Suisun Marsh could further degrade existing EC levels and
31 thus contribute additionally to adverse effects on the fish and wildlife beneficial uses. Because EC is
32 not bioaccumulative, the increases in long-term average EC levels would not directly cause
33 bioaccumulative problems in fish and wildlife. Suisun Marsh is CWA section 303(d) listed for
34 elevated EC and the increases in long-term average EC that would occur in the marsh could make
35 beneficial use impairment measurably worse. This impact is considered to be significant.

36 Implementation of Mitigation Measure WQ-11 along with a separate, non-environmental
37 commitment relating to the potential increased costs associated with EC-related changes would
38 reduce these effects. While mitigation measures to reduce these water quality effects in affected
39 water bodies to less than significant levels are not available, implementation of Mitigation Measure
40 WQ-11 is recommended to attempt to reduce the effect that increased EC concentrations may have
41 on Delta beneficial uses. However, because the effectiveness of this mitigation measure to result in
42 feasible measures for reducing water quality effects is uncertain, this impact is considered to remain
43 significant and unavoidable.

44 In addition to and to supplement Mitigation Measure WQ-11, the BDCP proponents have
45 incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*, a

1 separate, non-environmental commitment to address the potential increased water treatment costs
2 that could result from EC concentration effects on municipal, industrial and agricultural water
3 purveyor operations. Potential options for making use of this financial commitment include funding
4 or providing other assistance towards acquiring alternative water supplies or towards modifying
5 existing operations when EC concentrations at a particular location reduce opportunities to operate
6 existing water supply diversion facilities. Please refer to Appendix 3B, *Environmental Commitments*,
7 for the full list of potential actions that could be taken pursuant to this commitment in order to
8 reduce the water quality treatment costs associated with water quality effects relating to chloride,
9 electrical conductivity, and bromide.

10 **Mitigation Measure WQ-11: Avoid, Minimize, or Offset, as Feasible, Reduced Water**
11 **Quality Conditions**

12 It remains to be determined whether, or to what degree, the available and existing salinity
13 response and countermeasure actions of SWP and CVP facilities, municipal water purveyors, or
14 Suisun Marsh salinity control facilities would be capable of offsetting the actual level of changes
15 in EC that may occur from implementation of Alternative 4. Therefore, in order to determine the
16 feasibility of reducing the effects of increased EC levels, and potential adverse effects on
17 beneficial uses associated with CM1 operations (and hydrodynamic effects of tidal restoration
18 under CM4), the proposed mitigation requires a series of phased actions to identify and evaluate
19 existing and possible feasible actions, followed by development and implementation of the
20 actions, if determined to be necessary. The phased actions for reducing EC levels and associated
21 adverse effects on agricultural water supply also could mitigate adverse effects on fish and
22 wildlife life. The emphasis and mitigation actions would be limited to those identified as
23 necessary to avoid, reduce, or offset adverse EC effects at Delta compliance locations and the
24 Suisun Marsh. The development and implementation of any mitigation actions shall be focused
25 on those incremental effects attributable to implementation of Alternative 4 operations only.
26 Development of mitigation actions for the incremental EC effects attributable to climate
27 change/sea level rise are not required because these changed conditions would occur with or
28 without implementation of Alternative 4. The goal of specific actions would be to reduce/avoid
29 additional exceedances of Delta EC objectives and reduce long-term average concentration
30 increases to levels that would not adversely affect beneficial uses within the Delta and Suisun
31 Marsh.

32 **Mitigation Measure WQ-11a: Conduct Additional Evaluation and Modeling of Increased EC**
33 **Levels Following Initial Operations of CM1**

34 Following commencement of initial operations of CM1, the BDCP proponents will conduct
35 additional evaluations described herein, and develop additional modeling (as necessary), to
36 define the extent to which modified operations could reduce or eliminate the additional
37 exceedances of the Bay-Delta WQCP objectives for EC currently modeled to occur under
38 Alternative 4. The additional evaluations should also consider specifically the changes in Delta
39 hydrodynamic conditions associated with tidal habitat restoration under CM4 (in particular the
40 potential for increased EC concentrations that could result from increased tidal exchange) once
41 the specific restoration locations are identified and designed. If sufficient operational flexibility
42 to offset EC increases is not feasible under Alternative 4 operations, achieving EC reduction
43 pursuant to this mitigation measure would not be feasible under this Alternative.

1 **Mitigation Measure WQ-11b: Consult with CDFW/USFWS, and Suisun Marsh Stakeholders,**
 2 **to Identify Potential Actions to Avoid or Minimize EC Level Increases in the Marsh**

3 In order to determine the feasibility of reducing the effects of CM1/CM4 operations on increased
 4 EC concentrations as shown in modeling estimates to occur in the Suisun Marsh, the BDCP
 5 proponents will consult with CDFW/USFWS, and Suisun Marsh stakeholders, to identify
 6 potential actions to avoid or minimize the EC increases in the marsh, with the goal of
 7 maintaining EC at levels that would not further impair fish and wildlife beneficial uses in Suisun
 8 Marsh. Potential actions may include modifications of the existing Suisun Marsh Salinity Control
 9 Gates for effective salinity control and evaluation of the efficacy of additional physical salinity
 10 control facilities or operations for the marsh to reduce the effects of increased EC levels. Based
 11 on the modeled conditions, the emphasis would be identification of potentially feasible actions
 12 to reduce adverse EC-related effects. Any such action will be developed following, and in
 13 conjunction with, the completion of the evaluation and development of any feasible actions
 14 described in Mitigation Measure WQ-11a.

15 **Impact WQ-12: Effects on Electrical Conductivity Resulting from Implementation of CM2–**
 16 **CM22**

17 **NEPA Effects:** The implementation of the other conservation measures (i.e., CM2–CM22) present no
 18 new direct sources of EC to the affected environment, including areas upstream of the Delta, within
 19 the Delta region, and in the SWP/CVP Export Service Areas. As they pertain to EC, implementation of
 20 these conservation measures would not be expected to adversely affect any of the beneficial uses of
 21 the affected environment. Moreover, some habitat restoration conservation measures would occur
 22 on lands within the Delta currently used for irrigated agriculture. Such replacement or substitution
 23 of land use activity is not expected to result in new or increased sources of EC to the Delta and, in
 24 fact, could decrease EC through elimination of high EC agricultural runoff.

25 CM4 would result in substantial tidal habitat restoration that would increase the magnitude of daily
 26 tidal water exchange at the restoration areas, and alter other hydrodynamic conditions in adjacent
 27 Delta channels. The DSM2 modeling included assumptions regarding possible locations of tidal
 28 habitat restoration areas, and how restoration would affect Delta hydrodynamic conditions, and
 29 thus the effects of this restoration measure on Delta EC were included in the assessment of CM1
 30 facilities operations and maintenance.

31 Implementation of CM2–CM22 would not be expected to adversely affect EC levels in the affected
 32 environment and thus would not adversely affect beneficial uses or substantially degrade water
 33 quality with regard to EC within the affected environment.

34 The effects on EC from implementing CM2–CM22 is determined to not be adverse.

35 **CEQA Conclusion:** Implementation of CM2–CM22 under Alternative 4 would not present new or
 36 substantially changed sources of EC to the affected environment. Some conservation measures may
 37 replace or substitute for existing irrigated agriculture in the Delta. This replacement or substitution
 38 is not expected to substantially increase or present new sources of EC, and could actually decrease
 39 EC loads to Delta waters. Thus, implementation of CM2–CM22 would have negligible, if any, adverse
 40 effects on EC levels throughout the affected environment and would not cause exceedance of
 41 applicable state or federal numeric or narrative water quality objectives/criteria that would result
 42 in adverse effects on any beneficial uses within affected water bodies. Further, implementation of
 43 CM2–CM22 would not cause significant long-term water quality degradation such that there would

1 be greater risk of adverse effects on beneficial uses. Based on these findings, this impact is
2 considered to be less than significant. No mitigation is required.

3 **Impact WQ-13: Effects on Mercury Concentrations Resulting from Facilities Operations and** 4 **Maintenance (CM1)**

5 *Upstream of the Delta*

6 Under the various Alternative 4 scenarios (H1–H4), greater water demands and climate change
7 would alter the magnitude and timing of reservoir releases and river flows upstream of the Delta in
8 the Sacramento River watershed and east-side tributaries, relative to Existing Conditions.

9 The Sacramento River at Freeport and San Joaquin River at Vernalis (as summarized for water
10 quality average concentrations in Tables 8-48 and 8-49) were examined for flow/concentration
11 relationships for mercury and methylmercury. No significant, predictive regression relationships
12 were discovered for mercury or methylmercury, except for total mercury with flow at Freeport
13 (monthly or annual) (Appendix 8I, Figure 8I-10 through 8I-13). Such a positive relationship between
14 total mercury and flow is to be expected based on the association of mercury with suspended
15 sediment and the mobilization of sediments during storm flows. However, the changes in flow in the
16 Sacramento River under the operational scenarios of Alternative 4 relative to Existing Conditions
17 and No Action Alternative are not of the magnitude of storm flows, in which substantial sediment-
18 associated mercury is mobilized. Therefore mercury loading should not be substantially different
19 due to changes in flow. In addition, even though it may be flow-affected, total mercury
20 concentrations remain well below criteria at upstream locations. Any negligible changes in mercury
21 concentrations that may occur in the water bodies of the affected environment located upstream of
22 the Delta would not be of frequency, magnitude, and geographic extent that would adversely affect
23 any beneficial uses or substantially degrade the quality of these water bodies as related to mercury.
24 Both waterborne methylmercury concentrations and largemouth bass fillet mercury concentrations
25 are expected to remain above guidance levels at upstream of Delta locations, but will not change
26 substantially relative to Existing Conditions or No Action Alternative due to changes in flows under
27 the operational scenarios of Alternative 4.

28 The upstream of Delta areas in the north will benefit from the implementation of the Cache Creek,
29 Sulfur Creek, Harley Gulch, and Clear Lake Mercury TMDLs and the American River methylmercury
30 TMDL. These projects will target specific sources of mercury and methylation upstream of the Delta
31 and could result in net improvement to Delta mercury loading in the future. The implementation of
32 these projects could help to ensure that upstream of Delta environments will not be substantially
33 degraded for water quality with respect to mercury or methylmercury.

34 *Delta*

35 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
36 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
37 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
38 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
39 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
40 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

1 The water quality impacts of waterborne concentrations of mercury (Appendix 8I, Table I-5) and
2 methylmercury (Appendix 8I, Table I-6) and fish tissue mercury concentrations (Appendix 8I,
3 Tables I-11A through I-11D) were evaluated for 9 Delta locations.

4 The analysis of percentage change in assimilative capacity of waterborne total mercury of
5 Alternative 4 scenarios as compared to Existing Conditions showed the greatest decrease to be of -
6 2.4% in the Old River at Rock Slough and the Contra Costa Pumping Plant for scenario. These are
7 bounded by Alternative 4 H1 estimates of -1.4% and -1.5% at these two locations, respectively. In
8 contrast the greatest increase in assimilative capacity relative to Existing Conditions was 4.4% for
9 H4 at the Jones Pumping Plant (Figures 8-53 through 8-54). Scenarios H2 and H3 range in changes
10 in assimilative capacity in relation to Existing Conditions from -2.1% (H3 at Contra Costa Pumping
11 Plant to 4.1 (H2 at Banks). These small changes in assimilative capacity are not expected to result in
12 adverse (or positive) effects to beneficial uses.

13 As compared to the No Action Alternative, Alternative 4 H4 showed the greatest range in changes in
14 assimilative capacity for total mercury; ranging from 5.0% at the Jones Pumping Plant to -2.3% at
15 the Old River site. These same sites show the smallest range of effects for Alternative 4 H1; with
16 4.3% and -1.4% for these same two stations, respectively. Scenarios H2 and H3 fall between these
17 extremes. However, these small ranges of changes are not expected to result in adverse effects to
18 beneficial uses.

19 All methylmercury concentrations in water were estimated to exceed TMDL guidelines and no
20 assimilative capacity exists. Changes in methylmercury concentration are expected to be very small.
21 The greatest annual average methylmercury concentration for drought conditions was 0.163 ng/L
22 for the San Joaquin River at Buckley Cove (all scenarios) which was slightly higher than Existing
23 Conditions (0.161 ng/L) and slightly lower than the No Action Alternative (0.167 ng/L)(Appendix 8I
24 Table I-6). In general, the Alternative 4 H4 conditions were highest in concentration and Alternative
25 4 H1 was lowest, as compared among scenarios for modeled methylmercury concentrations in
26 water. All modeled concentrations exceeded the methylmercury TMDL guidance objective of 0.06
27 ng/L, therefore percentage change in assimilative capacity was not evaluated for methylmercury.

28 Similar to waterborne methylmercury, fish tissue mercury concentration estimates all exceed TMDL
29 guidelines. Percentage changes were somewhat larger than for waterborne concentrations, but not
30 expected to result in changes to beneficial use. Fish tissue estimates show only small or no increases
31 in EQs based on long-term annual average concentrations for mercury at the Delta locations
32 (Appendix 8I, Table I-11Aa through I-11Db). The greatest increase over Existing Conditions was for
33 scenario H4 and was 15% at Old River at Rock Slough and 13% for Franks Tract as compared to H1
34 estimates for both of those locations of 9% (Table 1-11 Ab – Db). In comparison to the No Action
35 Alternative, the greatest increases in concentrations mirrored the Existing Condition comparisons
36 and were estimated to be 12% for Old River at Rock Slough, and 12% for Franks Tract. Scenario H1
37 provided the lowest set of percent changes in bass mercury for those locations (Figure 8-55,
38 Appendix 8I Tables I-11Aa through I-11Db).

39 ***SWP/CVP Export Service Areas***

40 The analysis of mercury and methylmercury in the SWP/CVP Export Service Areas was based on
41 concentrations estimated at the Banks and Jones pumping plants. Both waterborne total and
42 methylmercury concentrations for Alternative 4, all scenarios, at the Jones and Banks pumping
43 plants, were lower than Existing Conditions and the No Action Alternative (Appendix 8I, Figures 8I-4
44 and 8I-5). Therefore, mercury shows an increased assimilative capacity at these locations (Figures

1 8-53 and 8-54). The greatest increase was 5% for scenario H4 for Jones Plant (compared to No
2 Action); the least was H2 at Banks of 2.9% (compared to Existing Conditions).

3 The largest improvements in bass tissue mercury concentrations and EQs for Alternative 4, relative
4 to Existing Conditions and the No Action Alternative at any location within the Delta are expected
5 for the export pump locations. The greatest improvement in bass tissue mercury concentration are
6 expected for scenario H4 at the Banks and Jones pumping plants (-14% and -16%, respectively)
7 (Figure 8-55, Appendix 8I Table I-11Aa through I-11Db).

8 **NEPA Effects:** Based on the above discussion, the effects of mercury and methylmercury in
9 comparison of Scenarios H1–H4 of Alternative 4 to the No Action Alternative (as waterborne and
10 bioaccumulated forms) are not considered to be adverse.

11 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
12 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
13 purpose of making the CEQA impact determination for this constituent. For additional details on the
14 effects assessment findings that support this CEQA impact determination, see the effects assessment
15 discussion that immediately precedes this conclusion.

16 Under Alternative 4, greater water demands and climate change would alter the magnitude and
17 timing of reservoir releases and river flows upstream of the Delta in the Sacramento River
18 watershed and east-side tributaries, relative to Existing Conditions. Concentrations of mercury and
19 methylmercury upstream of the Delta will not be substantially different relative to Existing
20 Conditions due to the lack of important relationships between mercury/methylmercury
21 concentrations and flow for the major rivers.

22 Methylmercury concentrations exceed criteria at all locations in the Delta and no assimilative
23 capacity exists. However, monthly average waterborne concentrations of total and methylmercury,
24 over the period of record, are very similar to Existing Conditions. Similarly, estimates of fish tissue
25 mercury concentrations show almost no differences would occur among sites for Alternative 4
26 scenarios as compared to Existing Conditions for Delta sites. The greatest changes in assimilative
27 capacity and tissue mercury estimates were for scenario H4; these least for scenario H1.

28 Assessment of effects of mercury in the SWP and CVP Export Service Areas were based on effects on
29 mercury concentrations and fish tissue mercury concentrations at the Banks and Jones pumping
30 plants. The Banks and Jones pumping plants are expected to show increased assimilative capacity
31 for waterborne mercury and decreased fish tissue concentrations of mercury for Alternative 4, all
32 scenarios, as compared to Existing Conditions.

33 As such, none of the H1–H4 scenarios for this alternative are expected to cause additional
34 exceedance of applicable water quality objectives/criteria by frequency, magnitude, and geographic
35 extent that would cause adverse effects on any beneficial uses of waters in the affected environment.
36 Because mercury concentrations are not expected to increase substantially, no long-term water
37 quality degradation is expected to occur and, thus, no adverse effects to beneficial uses would occur.
38 Because any increases in mercury or methylmercury concentrations are not likely to be measurable,
39 changes in mercury concentrations or fish tissue mercury concentrations would not make any
40 existing mercury-related impairment measurably worse. In comparison to Existing Conditions,
41 Alternative 4 would not increase levels of mercury by frequency, magnitude, and geographic extent
42 such that the affected environment would be expected to have measurably higher body burdens of
43 mercury in aquatic organisms, thereby substantially increasing the health risks to wildlife (including

1 fish) or humans consuming those organisms. This impact is considered to be less than significant. No
 2 mitigation is required.

3 **Impact WQ-14: Effects on Mercury Concentrations Resulting from Implementation of CM2-22**

4 **NEPA Effects:** Some habitat restoration activities under Alternative 4 would occur on lands in the
 5 Delta formerly used for irrigated agriculture. Tidal and other restoration proposed under
 6 Alternative 4 have the potential to increase water residence times and increase accumulation of
 7 organic sediments that are known to enhance methylmercury bioaccumulation in biota in the
 8 restored habitat. Therefore, increases in mercury methylation in the habitat restoration areas is
 9 possible but uncertain depending on the specific restoration design implemented at a particular
 10 Delta location. Models to estimate the potential for methylmercury formation in restored areas are
 11 not currently available. However, DSM2 modeling for Alternative 4 operations does incorporate
 12 assumptions for certain habitat restoration activities proposed under CM2 and CM4 (see Section
 13 8.3.1.3) that result in changes to Delta hydrodynamics compared to the No Action Alternative. These
 14 modeled restoration assumptions provide some insight into potential hydrodynamic changes that
 15 could be expected related to implementing CM2 and CM4 and are considered in the evaluation of the
 16 potential for increased mercury and methylmercury concentrations under Alternative 4.

17 BDCP Conservation Measure 12 (CM12) addresses the potential for methylmercury bioaccumulation
 18 associated with restoration activities and acknowledges the uncertainties associated with mitigating
 19 or minimizing this potential effect. CM12 proposes project-specific mercury management plans for
 20 restoration actions that will incorporate relevant approaches recommended in Phase 1
 21 Methylmercury TMDL control studies. Specific approaches recommended under CM12 that are
 22 intended to minimize or mitigate for potential increases in methylmercury bioaccumulation at
 23 future restoration sites include:

- 24 • Characterizing mercury, methylmercury, organic carbon, iron, and sulfate concentrations to
 25 better inform restoration design,
- 26 • Sequestering methylmercury at restoration sites using low intensity chemical dosing
 27 techniques,
- 28 • Minimizing microbial methylation associated with anoxic conditions by reducing the amount of
 29 organic material at a restoration site (this approach could limit the benefit of restoration areas
 30 by limiting the amount of carbon supplied by these areas to the Delta as a whole. In some cases,
 31 this would run directly counter to the goals and objectives of the BDCP. This approach should
 32 not be implemented in such a way that it reduces the benefits to the Delta ecosystem provided
 33 by restoration areas),
- 34 • Designing restoration sites to enhance photo degeneration that converts methylmercury into a
 35 biologically unavailable, inorganic form of mercury,
- 36 • Remediating restoration site soils with iron to reduce methylation in sulfide rich soils, and
- 37 • Considering capping mercury laden sediments, where feasible, to reduce methylation potential
 38 at a site.

39 Because of the uncertainties associated with site-specific estimates of methylmercury
 40 concentrations and the uncertainties in source modeling and tissue modeling, the effectiveness of
 41 methylmercury management proposed under CM12 to reduce methylmercury concentrations would
 42 need to be evaluated separately for each restoration effort, as part of design and implementation.

1 Because of this uncertainty and the known potential for methylmercury creation in the Delta this
 2 potential effect of implementing CM2–CM22 is considered adverse.

3 **CEQA Conclusion:** There would be no substantial, long-term increase in mercury or methylmercury
 4 concentrations or loads in the rivers and reservoirs upstream of the Delta or the waters exported to
 5 the CVP and SWP service areas due to implementation of CM2–CM22 relative to Existing Conditions.
 6 However, in the Delta, uptake of mercury from water and/or methylation of inorganic mercury may
 7 increase to an unquantified degree as part of the creation of new, marshy, shallow, or organic-rich
 8 restoration areas. Methylmercury is 303(d)-listed within the affected environment, and therefore
 9 any potential measurable increase in methylmercury concentrations would make existing mercury-
 10 related impairment measurably worse. Because mercury is bioaccumulative, increases in water-
 11 borne mercury or methylmercury that could occur in some areas could bioaccumulate to somewhat
 12 greater levels in aquatic organisms and would, in turn, pose health risks to fish, wildlife, or humans.
 13 Design of restoration sites under Alternative 4 would be guided by CM12 which requires
 14 development of site specific mercury management plans as restoration actions are implemented.
 15 The effectiveness of minimization and mitigation actions implemented according to the mercury
 16 management plans is not known at this time, although the potential to reduce methylmercury
 17 concentrations exists based on current research. Although the BDCP will implement CM12 with the
 18 goal to reduce this potential effect, the uncertainties related to site specific restoration conditions
 19 and the potential for increases in methylmercury concentrations in the Delta result in this potential
 20 impact being considered significant. No mitigation measures would be available until specific
 21 restoration actions are proposed. Therefore this programmatic impact is considered significant and
 22 unavoidable.

23 **Impact WQ-15: Effects on Nitrate Concentrations Resulting from Facilities Operations and** 24 **Maintenance (CM1)**

25 *Upstream of the Delta*

26 Although point sources of nitrate do exist upstream of the Delta in the Sacramento River watershed,
 27 nitrate levels in the major rivers (Sacramento, Feather, American) are low, generally due to ample
 28 dilution available in the rivers relative to the magnitude of the discharges. Furthermore, while many
 29 dischargers have already improved facilities to remove more nitrate, many others are likely to do so
 30 over the next few decades. Non-point sources of nitrate within the Sacramento watersheds are also
 31 relatively low, thus resulting in generally low nitrate-N concentrations in the reservoirs and rivers
 32 of the watershed. Furthermore, there is no correlation between historical water year average nitrate
 33 concentrations and water year average flow in the Sacramento River at Freeport (Nitrate Appendix
 34 8J, Figure 1). Consequently, any modified reservoir operations and subsequent changes in river
 35 flows under various operational scenarios of Alternative 4, relative to Existing Conditions or the No
 36 Action Alternative, are expected to have negligible, if any, effects on average reservoir and river
 37 nitrate-N concentrations in the Sacramento River watershed upstream of the Delta.

38 In the San Joaquin River watershed, nitrate concentrations are higher than in the Sacramento
 39 watershed, owing to use of nitrate based fertilizers throughout the lower watershed. The correlation
 40 between historical water year average nitrate concentrations and water year average flow in the San
 41 Joaquin River at Vernalis is a weak inverse relationship—that is, generally higher flows result in
 42 lower nitrate concentrations, while low flows result in higher nitrate concentrations (linear
 43 regression $r^2=0.49$, Nitrate Appendix 8J, Figure 2). Under Alternative 4, Scenarios H1–H4, modeling
 44 indicates that long-term annual average flows on the San Joaquin River would decrease by an

1 estimated 6% relative to Existing Conditions, and would remain virtually the same relative to the No
 2 Action Alternative (Appendix 5A). Given these relatively small decreases in flows and the weak
 3 correlation between nitrate and flows in the San Joaquin River (see Nitrate Appendix 8J, Figure 2), it
 4 is expected that nitrate concentrations in the San Joaquin River would be minimally affected, if at all,
 5 by changes in flow rates under any operational scenario of Alternative 4.

6 Any negligible changes in nitrate-N concentrations that may occur in the water bodies of the affected
 7 environment located upstream of the Delta would not be of frequency, magnitude and geographic
 8 extent that would adversely affect any beneficial uses or substantially degrade the quality of these
 9 water bodies, with regards to nitrate.

10 **Delta**

11 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 12 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 13 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 14 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 15 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
 16 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

17 Mixing calculations indicate that under Alternative 4 (including the different operational
 18 components of Scenarios H1–H4), relative to Existing Conditions and the No Action Alternative,
 19 nitrate concentrations throughout the Delta are anticipated to remain low (<1.4 mg/L-N) relative to
 20 adopted objectives (Nitrate Appendix 8J, Table 16, 17A/17D). Although changes at specific Delta
 21 locations and for specific months may be substantial on a relative basis, the absolute concentration
 22 of nitrate in Delta waters would remain low (<1.4 mg/L-N) in relation to the drinking water MCL of
 23 10 mg/L-N, as well as all other thresholds identified in Table 8-50. Long-term average nitrate
 24 concentrations are anticipated to remain below 1 mg/L-N at all 11 assessment locations except the
 25 San Joaquin River at Buckley Cove, where long-term average concentrations would be somewhat
 26 above 1 mg/L-N. Nevertheless, at this location, long-term average nitrate concentration would be
 27 somewhat reduced under Alternative 4 relative to Existing Conditions, and slightly increased
 28 relative to the No Action Alternative. Regardless of operational scenario, no additional exceedances
 29 of the MCL are anticipated at any location under Alternative 4 (Nitrate Appendix 8J, Table 16).

30 Use of assimilative capacity relative to the drinking water MCL of 10 mg/L-N under the four
 31 operational scenarios of Alternative 4 is low or negligible (i.e., <5%) in comparison to both Existing
 32 Conditions and the No Action Alternative, for all locations and months, for all modeled years, and for
 33 the drought period (Nitrate Appendix 8J, Table 18A/18D). One exception is for Buckley Cove on the
 34 San Joaquin River in August, where use of assimilative capacity available during the drought period
 35 (1987–1991) relative to the No Action Alternative for the four operational scenarios of Alternative 4
 36 ranged from 6.3% to 6.5%.

37 Nitrate concentrations will likely be higher than the modeling results indicate in certain locations.
 38 This includes in the Sacramento River between Freeport and Mallard Island and other areas in the
 39 Delta downstream of Freeport that are influenced by Sacramento River water. These increases are
 40 associated with ammonia and nitrate that are discharged from the SRWTP, which are not included in
 41 the modeling.

- 42 • Under Existing Conditions, most of the ammonia discharged from the SRWTP is converted to
 43 nitrate downstream of the facility's discharge at Freeport, and thus, nitrate concentrations

1 under Existing Conditions in these areas are expected to be higher than the modeling
 2 predicts, the increase becoming greater with increasing distance downstream. However, the
 3 increase in nitrate concentrations downstream of the SRWTP is expected to be small—the
 4 existing increase appears to be from approximately 0.1 mg/L-N to approximately 0.4–0.5
 5 mg/L-N over this reach, due to approximately a 1:1 conversion of ammonia-N to nitrate-N
 6 (Central Valley Water Board 2010a:32).

- 7 • Under the four operational scenarios of Alternative 4, the planned upgrades to the SRWTP,
 8 which include nitrification/partial denitrification, would substantially decrease ammonia
 9 concentrations in the discharge, but would increase nitrate concentrations in the discharge
 10 up to 10 mg/L-N, which is substantially higher than under Existing Conditions.
- 11 • Overall, under the four operational scenarios of Alternative 4, the nitrogen load from the
 12 SRWTP discharge is expected to decrease (by up to 50%), relative to Existing Conditions,
 13 due to nitrification/partial denitrification upgrades at the SRWTP facility. Thus, while
 14 concentrations of nitrate downstream of the facility are expected to be higher than modeling
 15 results indicate for both Existing Conditions and the four operational scenarios of
 16 Alternative 4, the increase is expected to be greater under Existing Conditions than for the
 17 four operational scenarios of Alternative 4 due to the upgrades that are assumed under the
 18 four operational scenarios of Alternative 4.

19 The other areas in which nitrate concentrations will be higher than the modeling results indicate are
 20 immediately downstream of other wastewater treatment plants that practice nitrification, but not
 21 denitrification (e.g., City of Rio Vista Beach WWTF, Town of Discovery Bay WWTF, City of Stockton
 22 RWCF). For all such facilities in the Delta, the Regional Water Boards have issued NPDES permits
 23 that allow discharge of wastewater containing nitrate into the Delta, and under these permits, the
 24 State has determined that no beneficial uses are adversely affected by the discharge, and that the
 25 discharger's use of available assimilative capacity of the water body is acceptable. When dilution is
 26 necessary in order for the discharge to be in compliance with the Basin Plans (which incorporate the
 27 10 mg/L-N MCL by reference), not all of the assimilative capacity of the receiving water is granted to
 28 the discharger. Thus, limited decreases in flows are not anticipated to result in systemic
 29 exceedances of the MCLs by these POTWs. Furthermore, NPDES permits are renewed on a 5-year
 30 basis, and thus, if under changes in flows, dilution was no longer sufficient to maintain nitrate below
 31 the MCL in the receiving water, the NPDES permit renewal process would address such cases.

32 In summary, any increases in nitrate-N concentrations that may occur at certain locations within the
 33 Delta would not be of frequency, magnitude and geographic extent that would adversely affect any
 34 beneficial uses or substantially degrade the water quality at these locations, with regards to nitrate.

35 ***SWP/CVP Export Service Areas***

36 Assessment of effects of nitrate in the SWP and CVP Export Service Areas is based on effects on
 37 nitrate-N at the Banks and Jones pumping plants.

38 Results of the mixing calculations indicate that the change in nitrate concentrations and use of
 39 assimilative capacity are similar for the four operational scenarios of Alternative 4 (Nitrate
 40 Appendix 8J, Tables 16, 17A/17D, 18A/18D). Relative to Existing Conditions and the No Action
 41 Alternative, nitrate concentrations at Banks and Jones pumping plants under Alternative 4 are
 42 anticipated to decrease on a long-term average annual basis (Nitrate Appendix 8J, Table 17A/17D).
 43 During the late summer, particularly in the drought period assessed, concentrations are expected to

1 increase substantially on a relative basis (i.e., >50%), but the absolute value of these changes (i.e., in
2 mg/L-N) is small. Additionally, given the many factors that contribute to potential algal blooms in
3 the SWP and CVP canals within the Export Service Area, and the lack of studies that have shown a
4 direct relationship between nutrient concentrations in the canals and reservoirs and problematic
5 algal blooms in these water bodies, there is no basis to conclude that these small (i.e., generally <0.3
6 mg/L-N), seasonal increases in nitrate concentrations would increase the potential for problem algal
7 blooms in the SWP and CVP Export Service Area. No additional exceedances of the MCL are
8 anticipated (Nitrate Appendix 8J, Table 16). On a monthly average basis and on a long term annual
9 average basis, for all modeled years and for the drought period (1987–1991) only, use of
10 assimilative capacity available under Existing Conditions and the No Action Alternative, relative to
11 the 10 mg/L-N MCL, was negligible (<5%) for both Banks and Jones pumping plants (Nitrate
12 Appendix 8J, Table 18A/18D).

13 Any increases in nitrate-N concentrations that may occur in water exported via Banks and Jones
14 pumping plants are not expected to result in adverse effects to beneficial uses or substantially
15 degrade the quality of exported water, with regards to nitrate.

16 **NEPA Effects:** In summary, based on the discussion above, the effects on nitrate from implementing
17 CM1 are considered to be not adverse.

18 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
19 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
20 purpose of making the CEQA impact determination for this constituent. For additional details on the
21 effects assessment findings that support this CEQA impact determination, see the effects assessment
22 discussion that immediately precedes this conclusion.

23 Nitrate-N concentrations are generally low in the reservoirs and rivers of the watersheds, owing to
24 substantial dilution available for point sources and the lack of substantial nonpoint sources of
25 nitrate-N upstream of the SRWTP in the Sacramento River watershed, and in the watersheds of the
26 eastern tributaries (Cosumnes, Mokelumne, and Calaveras Rivers). Although higher in the San
27 Joaquin River watershed, nitrate-N concentrations are not well-correlated with flow rates.
28 Consequently, any modified reservoir operations and subsequent changes in river flows under
29 Alternative 4, relative to Existing Conditions, are expected to have negligible, if any, effects on
30 reservoir and river nitrate-N concentrations upstream of Freeport in the Sacramento River
31 watershed and upstream of the Delta in the San Joaquin River watershed.

32 In the Delta, results of the mixing calculations indicate that under the four operational scenarios of
33 Alternative 4 (H1 through H4), relative to Existing Conditions, nitrate concentrations throughout the
34 Delta are anticipated to remain low (<1.4 mg/L-N) relative to adopted objectives. No additional
35 exceedances of the MCL are anticipated at any location, and use of assimilative capacity available
36 under Existing Conditions, relative to the drinking water MCL of 10 mg/L-N, was low or negligible
37 (i.e., <5%) for all operational scenarios for virtually all locations and months.

38 Assessment of effects of nitrate in the SWP and CVP Export Service Areas is based on effects on
39 nitrate-N concentrations at the Banks and Jones pumping plants. Results of the mixing calculations
40 indicate that under Alternative 4 (including the different operational components of Scenarios H1–
41 H4), relative to Existing Conditions, long-term average nitrate concentrations at Banks and Jones
42 pumping plants are anticipated to change negligibly. No additional exceedances of the MCL are
43 anticipated, and use of assimilative capacity available under Existing Conditions, relative to the MCL
44 was negligible (i.e., <5%) for both Banks and Jones pumping plants for all months.

1 Based on the above, there would be no substantial, long-term increase in nitrate-N concentrations in
2 the rivers and reservoirs upstream of the Delta, in the Delta Region, or the waters exported to the
3 CVP and SWP service areas under Alternative 4 relative to Existing Conditions. As such, this
4 alternative is not expected to cause additional exceedance of applicable water quality
5 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
6 on any beneficial uses of waters in the affected environment. Because nitrate concentrations are not
7 expected to increase substantially, no long-term water quality degradation is expected to occur and,
8 thus, no adverse effects to beneficial uses would occur. Nitrate is not 303(d) listed within the
9 affected environment and thus any increases that may occur in some areas and months would not
10 make any existing nitrate-related impairment measurably worse because no such impairments
11 currently exist. Because nitrate is not bioaccumulative, increases that may occur in some areas and
12 months would not bioaccumulate to greater levels in aquatic organisms that would, in turn, pose
13 substantial health risks to fish, wildlife, or humans. This impact is considered to be less than
14 significant. No mitigation is required.

15 **Impact WQ-16: Effects on Nitrate Concentrations Resulting from Implementation of CM2-
16 CM22**

17 **NEPA Effects:** Some habitat restoration activities included in CM2–CM11 would occur on lands
18 within the Delta formerly used for agriculture. It is expected that this will decrease nitrate
19 concentrations in the Delta, due to less use of nitrate-based fertilizers, relative to the No Action
20 Alternative. Modeling scenarios included assumptions regarding how certain habitat restoration
21 activities (i.e., CM2 and CM4) would affect Delta hydrodynamics, and thus such effects of these
22 restoration measures were included in the assessment of CM1 facilities operations and maintenance
23 (see Impact WQ-1). In general, aside from changes in Delta hydrodynamics resulting from habitat
24 restoration discussed in Impact WQ-1, CM2–CM11 proposed for Alternative 4 are not expected to
25 increase nitrate concentrations in water bodies of the affected environment, relative to the No
26 Action Alternative.

27 Because urban stormwater is a source of nitrate in the affected environment, CM19, Urban
28 Stormwater Treatment, is expected to slightly reduce nitrate loading to the Delta, thus slightly
29 decreasing nitrate-N concentrations relative to the No Action Alternative. Implementation of CM12–
30 CM18 and CM20–CM22 is not expected to substantially alter nitrate concentrations in any of the
31 water bodies of the affected environment.

32 The effects on nitrate from implementing CM2–22 are considered to be not adverse.

33 **CEQA Conclusion:** There would be no substantial, long-term increase in nitrate-N concentrations in
34 the rivers and reservoirs upstream of the Delta, in the Delta Region, or the waters exported to the
35 CVP and SWP service areas due to implementation of CM2–CM22 under Alternative 4, Scenarios H1–
36 H4, relative to Existing Conditions. Because urban stormwater is a source of nitrate in the affected
37 environment, CM19, Urban Stormwater Treatment, is expected to slightly reduce nitrate loading to
38 the Delta. As such, implementation of these conservation measures is not expected to cause
39 additional exceedance of applicable water quality objectives/criteria by frequency, magnitude, and
40 geographic extent that would cause adverse effects on any beneficial uses of waters in the affected
41 environment. Because nitrate concentrations are not expected to increase substantially due to these
42 conservation measures, no long-term water quality degradation is expected to occur and, thus, no
43 adverse effects to beneficial uses would occur. Nitrate is not 303(d) listed within the affected
44 environment and thus any minor increases that may occur in some areas would not make any

1 existing nitrate-related impairment measurably worse because no such impairments currently exist.
 2 Because nitrate is not bioaccumulative, minor increases that may occur in some areas would not
 3 bioaccumulate to greater levels in aquatic organisms that would, in turn, pose substantial health
 4 risks to fish, wildlife, or humans. This impact is considered to be less than significant. No mitigation
 5 is required.

6 **Impact WQ-17: Effects on Dissolved Organic Carbon Concentrations Resulting from Facilities** 7 **Operations and Maintenance (CM1)**

8 ***Upstream of the Delta***

9 Under Alternative 4, Scenarios H1–H4, there would be no substantial change to the sources of DOC
 10 within the watersheds upstream of the Delta. Moreover, long-term average flow and DOC levels in
 11 the Sacramento River at Hood and San Joaquin River at Vernalis are poorly correlated. Thus changes
 12 in system operations and resulting reservoir storage levels and river flows under the various
 13 operational scenarios of Alternative 4 would not be expected to cause a substantial long-term
 14 change in DOC concentrations in the water bodies upstream of the Delta. Any negligible changes in
 15 DOC levels in water bodies upstream of the Delta under Scenarios H1–H4 of Alternative 4, relative to
 16 Existing Conditions and the No Action Alternative, would not be of sufficient frequency, magnitude
 17 and geographic extent that would adversely affect any beneficial uses or substantially degrade the
 18 quality of these water bodies, with regards to DOC.

19 ***Delta***

20 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 21 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 22 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 23 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 24 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
 25 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

26 Under the four operational scenarios of Alternative 4, the geographic extent of effects pertaining to
 27 long-term average DOC concentrations in the Delta would be similar to that previously described for
 28 Alternative 1A, although the magnitude of predicted long-term change and relative frequency of
 29 concentration threshold exceedances would be slightly greater. For all the operational scenarios
 30 relative to Existing Conditions, the modeled effects would be greatest at Franks Tract, Rock Slough,
 31 and Contra Costa PP No. 1. Increased long-term average DOC concentrations at these locations
 32 would be greatest under Scenario H4 and would be least under Scenario H1, although differences
 33 would be generally small between operational scenarios (i.e., ≤ 0.2 mg/L). Under Scenario H4, long-
 34 term average DOC concentrations for the modeled 16-year hydrologic period and the modeled
 35 drought period would be predicted to increase between 0.4–0.5 mg/L at Franks Tract, Rock Slough,
 36 and Contra Costa PP No. 1 ($\leq 14\%$ net increase) (Appendix 8K, DOC Table 5). Under Scenario H4,
 37 increases in long-term average concentrations of between 0.4–0.5 mg/L at Franks Tract, Rock
 38 Slough, and Contra Costa PP No. 1 would correspond to more frequent concentration threshold
 39 exceedances, with the greatest change occurring at Rock Slough and Contra Costa PP No. 1 locations.
 40 For Rock Slough, long-term average DOC concentrations exceeding 3 mg/L would increase from
 41 52% under Existing Conditions to 76% under Scenario H4 of Alternative 4 (an increase from 47% to
 42 67% for the drought period), and concentrations exceeding 4 mg/L would increase from 30% to
 43 38% (32% to 38% for the drought period). For Contra Costa PP No. 1, long-term average DOC

1 concentrations exceeding 3 mg/L would increase from 52% under Existing Conditions to 81% under
2 Scenario H4 of Alternative 4 (45% to 78% for the drought period), and concentrations exceeding 4
3 mg/L would increase from 32% to 45% (35% to 47% for the drought period). Relative change in
4 frequency of threshold exceedance for the other operational scenarios and at other assessment
5 locations would be similar or less. While all of the operational scenarios of Alternative 4 would
6 generally lead to slightly higher long-term average DOC concentrations (≤ 0.5 mg/L) at some
7 municipal water intakes and Delta interior locations, the predicted change would not be expected to
8 adversely affect MUN beneficial uses, or any other beneficial use. This comparison to Existing
9 Conditions reflects changes in DOC due to both Alternative 4 operations (including north Delta
10 intake capacity of 9,000 cfs and the different operational components of Scenarios H1–H4) and
11 climate change/sea level rise.

12 In comparison, relative to the No Action Alternative, the operational scenarios of Alternative 4
13 would generally result in a similar magnitude of change to that discussed for the Alternative 4
14 operational scenario comparison to Existing Conditions. Scenario H4 would generally lead to the
15 largest model predicted long-term average DOC concentration increases, and Scenario H1 would
16 generally lead to the smallest model predicted increases, although the relative difference between
17 operational scenarios would be small (i.e., ≤ 0.2 mg/L). Under Scenario H4, maximum increases of
18 0.3–0.4 mg/L DOC (i.e., $\leq 12\%$) would be predicted at Franks Tract, Rock Slough, and Contra Costa
19 PP No. 1 relative to No Action Alternative (Appendix 8K, DOC Table 5). For the operational
20 scenarios, threshold concentration exceedance frequency trends would also be similar to that
21 discussed for the existing condition comparison, with exception to the drought period predicted 4
22 mg/L exceedance frequency at Buckley Cove. In comparison to the No Action Alternative, and
23 regardless of operational scenario, the frequency which long-term average DOC concentrations
24 exceeded 4 mg/L during the modeled drought period at Buckley Cove would increase from 42% to
25 50%. While the operational scenarios of Alternative 4 would generally lead to slightly higher long-
26 term average DOC concentrations at some Delta assessment locations when compared to No Action
27 Alternative conditions, the predicted change would not be expected to adversely affect MUN
28 beneficial uses, or any other beneficial use, particularly when considering the relatively small
29 change in long-term annual average concentration. Unlike the comparison to Existing Conditions,
30 this comparison to the No Action Alternative reflects changes in DOC due only to the different
31 operational components of Scenarios H1–H4 of Alternative 4.

32 As discussed for Alternative 1A, substantial change in ambient DOC concentrations would need to
33 occur before significant changes in drinking water treatment plant design or operations are
34 triggered. The increases in long-term average DOC concentrations estimated to occur at various
35 Delta locations under the four alternative operational scenarios of Alternative 4 are of sufficiently
36 small magnitude that they would not require existing drinking water treatment plants to
37 substantially upgrade treatment for DOC removal above levels currently employed.

38 Relative to existing and No Action Alternative conditions, Alternative 4 would lead to predicted
39 improvements in long-term average DOC concentrations at Barker Slough, as well as Banks and
40 Jones pumping plants (discussed below). At Barker Slough, long-term average DOC concentrations
41 would be predicted to decrease by as much as 0.1–0.2 mg/L, depending on operational scenario,
42 baseline conditions comparison and modeling period.

1 **SWP/CVP Export Service Areas**

2 Under all operational scenarios of Alternative 4, relative to Existing Conditions and the No Action
3 Alternative, modeled long-term average DOC concentrations would decrease at Banks and Jones
4 pumping plants. Modeled decreases would be greatest under Scenarios H2 and H4. Relative to
5 Existing Conditions, long-term average DOC concentrations at Banks under Scenarios H2 and H4
6 would be predicted to decrease by 0.4 mg/L (0.4 mg/L during drought period) (Appendix 8K, DOC
7 Table 5). At Jones, long-term average DOC concentrations would be predicted to decrease by 0.4
8 mg/L (<0.1 mg/L during drought period). Under all the operational scenarios, decreases in long-
9 term average DOC would result in generally lower exceedance frequencies for concentration
10 thresholds, although the frequency of exceedance during the modeled drought period (i.e., 1987–
11 1991) in particular would be predicted to increase. For the Banks pumping plant during the drought
12 period, exceedance of the 3 mg/L threshold would increase from 57% under Existing Conditions to
13 as much as 83% under Scenario H3, and exceedance of the 4 mg/L concentration threshold would
14 increase slightly for only Scenarios H1 and H3 from 42% to as much as 45%. At the Jones pumping
15 plant, exceedance of the 3 mg/L concentration threshold during the drought period would increase
16 from 72% under Existing Conditions to as much as 93% under Scenario H1, and exceedance of the 4
17 mg/L threshold would increase slightly for all operational scenarios, from 35% to as much as 41%
18 for Scenario H4. Comparisons to the No Action Alternative yield similar trends, but with slightly
19 smaller magnitude drought period changes. Overall, modeling results for the SWP/CVP Export
20 Service Areas predict an overall improvement in Export Service Areas water quality, although more
21 frequent exports of >3 mg/L DOC water would likely occur for drought periods.

22 Similar to the discussion pertaining to the No Action Alternative, maintenance of SWP and CVP
23 facilities under Scenarios H1–H4 of Alternative 4 would not be expected to create new sources of
24 DOC or contribute towards a substantial change in existing sources of DOC in the affected area.
25 Maintenance activities would not be expected to cause any substantial change in long-term average
26 DOC concentrations such that MUN beneficial uses, or any other beneficial use, would be adversely
27 affected.

28 **NEPA Effects:** In summary, the operations and maintenance activities under Scenarios H1–H4 of
29 Alternative 4, relative to the No Action Alternative, would not cause a substantial long-term change
30 in DOC concentrations in the water bodies upstream of the Delta. Depending on operational
31 scenario, long-term average DOC concentrations at Banks and Jones pumping plants are predicted to
32 decrease by as much as 0.5 mg/L, while long-term average DOC concentrations for some Delta
33 interior locations, including Contra Costa PP #1, are predicted to increase by as much as 0.4 mg/L.
34 Regardless of operational scenario, the increase in long-term average DOC concentration that could
35 occur within the Delta interior would not be of sufficient magnitude to adversely affect the MUN
36 beneficial use, or any other beneficial uses, of Delta waters. The effect of operations and
37 maintenance activities on DOC under Scenarios H1–H4 of Alternative 4 is determined not to be
38 adverse.

39 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
40 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
41 purpose of making the CEQA impact determination for this constituent. For additional details on the
42 effects assessment findings that support this CEQA impact determination, see the effects assessment
43 discussion that immediately precedes this conclusion.

44 While greater water demands under the operational scenarios of Alternative 4 would alter the
45 magnitude and timing of reservoir releases north, south and east of the Delta, these activities would

1 have no substantial effect on the various watershed sources of DOC. Moreover, long-term average
2 flow and DOC at Sacramento River at Hood and San Joaquin River at Vernalis are poorly correlated;
3 therefore, changes in river flows would not be expected to cause a substantial long-term change in
4 DOC concentrations upstream of the Delta.

5 Relative to Existing Conditions, the operational scenarios of Alternative 4 would result in relatively
6 small increases (i.e., $\leq 14\%$) in long-term average DOC concentrations at some Delta interior
7 locations, including Franks Tract, Rock Slough, and Contra Costa PP No. 1. These increases would be
8 greatest for Scenario H4, and least for Scenarios H1, although the difference in change would be
9 relatively small. The predicted increases under the operational scenarios modeled would not
10 substantially increase the frequency with which long-term average DOC concentrations exceeds 2, 3,
11 or 4 mg/L. While Scenarios H1–H4 would generally lead to slightly higher long-term average DOC
12 concentrations (≤ 0.2 – 0.5 mg/L) within the Delta interior and some municipal water intakes, the
13 predicted change would not be expected to adversely affect MUN beneficial uses, or any other
14 beneficial use.

15 The assessment of Alternative 4 Scenario H1–H4 effects on DOC in the SWP/CVP Export Service
16 Areas is based on assessment of changes in DOC concentrations at Banks and Jones pumping plants.
17 Relative decreases in long-term average DOC concentrations would be greatest under Scenarios H2
18 and H4, where long-predicted concentrations would decrease as much as 0.4 mg/L at Banks and
19 Jones pumping plants. Regardless of operational scenario, however, slightly more frequent export of
20 >3 mg/L DOC water is predicted during the drought period. Nevertheless, under any operational
21 scenario, an overall improvement in DOC-related water quality would be predicted in the SWP/CVP
22 Export Service Areas.

23 Based on the above, the operations and maintenance activities of Scenarios H1–H4 of Alternative 4
24 would not result in any substantial change in long-term average DOC concentration upstream of the
25 Delta or result in substantial increase in the frequency with which long-term average DOC
26 concentrations exceeds 2, 3, or 4 mg/L levels at the 11 assessment locations analyzed for the Delta.
27 Increases in long-term average DOC concentrations at some Delta interior locations, including
28 Franks Tract, Rock Slough, and Contra Costa PP No. 1 would be predicted, with the greatest
29 increases occurring under Scenario H4 and the smallest increase occurring under Scenario H1.
30 Under Scenario H4, modeled long-term average DOC concentrations would increase by no more
31 than 0.5 mg/L at any single Delta assessment location (i.e., $\leq 14\%$ relative increase) while under
32 Scenario H1, modeled long-term DOC concentrations would increase by no more than 0.3 mg/L at
33 any single Delta assessment location (i.e., $\leq 9\%$ relative increase). For all operational scenarios
34 considered, the increases in long-term average DOC concentration that could occur within the Delta
35 would not be of sufficient magnitude to adversely affect the MUN beneficial use, or any other
36 beneficial uses, of Delta waters or waters of the SWP/CVP Service Area. Because DOC is not
37 bioaccumulative, the increases in long-term average DOC concentrations would not directly cause
38 bioaccumulative problems in aquatic life or humans. Finally, DOC is not causing beneficial use
39 impairments and thus is not 303(d) listed for any water body within the affected environment. Thus,
40 the increases in long-term average DOC that could occur at various locations would not make any
41 beneficial use impairment measurably worse. Because long-term average DOC concentrations are
42 not expected to increase substantially, no long-term water quality degradation with respect to DOC
43 is expected to occur and, thus, no adverse effects on beneficial uses would occur. This impact is
44 considered to be less than significant. No mitigation is required.

1 **Impact WQ-18: Effects on Dissolved Organic Carbon Concentrations Resulting from**
2 **Implementation of CM2–CM22**

3 **NEPA Effects:** The mostly non-land disturbing CM12–CM22 present no new sources of DOC to the
4 affected environment, including areas Upstream of the Delta, within the Plan Area, and the SWP/CVP
5 Export Service Area. Implementation of methylmercury control measures (CM12) and urban
6 stormwater treatment measures (CM19) may result in beneficial effects, to the extent that control
7 measures treat or reduce organic carbon loading from tidal wetlands and urban land uses. Control of
8 nonnative aquatic vegetation (CM13) may include killing mature aquatic vegetation in place, leading
9 to their decay and contribution to DOC in Delta channels. However, this measure is not expected to
10 be a significant source of long-term DOC loading as vegetation control would be sporadic and on an
11 as needed basis, with decreasing need for treatments in the long-term as nonnative vegetation is
12 eventually controlled and managed. Implementation of CM12–CM22 would not be expected to have
13 substantial, if even measurable, effect on DOC concentrations upstream of the Delta, within the
14 Delta, and in the SWP/CVP service areas. Consequently, any negligible increases in DOC levels in
15 these areas of the affected environment are not expected to be of sufficient frequency, magnitude
16 and geographic extent that they would adversely affect the MUN beneficial use, or any other
17 beneficial uses, of the affected environment, nor would potential increases substantially degrade
18 water quality with regards to DOC.

19 For CM2–CM11, effects on DOC concentrations can generally be considered in terms of: (1)
20 alternative-caused change in Delta hydrodynamics, and (2) alternative-caused change in Delta DOC
21 sources. Change in Delta hydrodynamics involves a two part process, including the conveyance
22 facilities and operational scenarios of CM1, as well as the change in Delta channel geometry and
23 open water areas that would occur as a consequence of implementing tidal wetland restoration
24 measures such as that described for CM4. Modeling scenarios included assumptions regarding how
25 these habitat restoration activities would affect Delta hydrodynamics, and thus the effects of these
26 restoration measures, via their effects on delta hydrodynamics, were included in the assessment of
27 CM1 facilities operations and maintenance (see Impact WQ-17). The potential for these same
28 conservation measures to change Delta DOC sources are addressed below.

29 CM2, CM3, CM8, CM9, and CM11 could include activities that would target increasing primary
30 production (i.e., algae growth) within the Delta. Algae currently are not estimated to be a major
31 source of DOC in the Delta (CALFED Bay-Delta Program 2008a: 4, 6), and comprise mostly the
32 particulate fraction of TOC. Conventional drinking water treatment removes much of the POC from
33 raw source water; therefore, conservation measure activities targeted at increased algae production
34 are not expected to contribute substantial amounts of new DOC, or adversely affect MUN beneficial
35 use, or any other beneficial uses, of the affected environment.

36 CM4–CM7 and CM10 include land disturbing restoration activities known to be sources of DOC.
37 Research within the Delta has focused primarily on non-tidal wetlands and flooding of Delta island
38 peat soils. The dynamics of DOC production and export from wetlands and seasonally flooded soils is
39 complex, as well as highly site and circumstance specific. Age and configuration of a wetland
40 significantly affects the amount of DOC that may be generated in a wetland. In a study of a
41 permanently flooded non-tidal constructed wetland on Twitchell Island, initial DOC loading was
42 determined to be much greater (i.e., approximately 10 times greater) than equivalent area of
43 agricultural land, but trends in annual loading led researchers to estimate that loading from the
44 wetland would be equivalent to that of agriculture within about 15 years (Fleck et. al. 2007: 18). It
45 was observed that the majority of the wetland load originated from seepage through peat soils.

1 Trends in declining load were principally associated with flushing of mobile DOC from submerged
2 soils, the origins of which were related to previous agricultural activity prior to restoration to
3 wetland. Peaks in annual loading, however, would be different, where peaks in agricultural drainage
4 occur in winter months while peaks in wetland loading occur in spring and summer months. As
5 such, age, configuration, location, operation, and season all factor into DOC loading, and long-term
6 average DOC concentrations in the Delta.

7 Available evidence suggests that restoration activities establishing new tidal and non-tidal wetlands,
8 new riparian and new seasonal floodplain habitat could potentially lead to new substantial sources
9 of localized DOC loading within the Delta. If established in areas presently used for agriculture, these
10 restoration activities could result in a substitution and temporary increase in localized DOC loading
11 for years. Presently, the specific design, operational criteria, and location of these activities are not
12 well established. Depending on localized hydrodynamics, such restoration activities could
13 contribute substantial amounts of DOC to municipal raw water if established near municipal intakes.
14 Substantially increased DOC concentrations in municipal source water may create a need for
15 existing drinking water treatment plants to upgrade treatment systems in order to achieve EPA
16 Stage 1 Disinfectants and Disinfection Byproduct Rule action thresholds. While treatment
17 technologies sufficient to achieve the necessary DOC removals exist, implementation of such
18 technologies would likely require substantial investment in new or modified infrastructure.

19 In summary, the habitat restoration elements of CM4–CM7 and CM10 under Alternative 4 would
20 present new localized sources of DOC to the study area, and in some circumstances would substitute
21 for existing sources related to replaced agriculture. Depending on localized hydrodynamics and
22 proximity to municipal drinking water intakes, such restoration activities could contribute
23 substantial amounts of DOC to municipal raw water. Substantial increases in municipal raw water
24 DOC could necessitate changes in water treatment plant operations or require treatment plant
25 upgrades in order to maintain DBP compliance, and thus would constitute an adverse effect on
26 water quality. Mitigation Measure WQ-18 is available to reduce these effects.

27 **CEQA Conclusion:** Implementation of CM2, CM3, CM8, CM9, and CM11–CM22 would not present
28 new or substantially changed sources of organic carbon to the affected environment of the Delta,
29 and thus would not contribute substantially to changes in long-term average DOC concentrations in
30 the Delta. Therefore, related long-term water quality degradation would not be expected to occur
31 and, thus, no adverse effects on beneficial uses would occur through implementation of CM2, CM3,
32 CM8, CM9, and CM11–CM22. Furthermore, DOC is not bioaccumulative, therefore changes in DOC
33 concentrations would not cause bioaccumulative problems in aquatic life or humans. Nevertheless,
34 implementation of CM4–CM7 and 10 would present new localized sources of DOC to the study area,
35 and in some circumstances would substitute for existing sources related to replaced agriculture.
36 Depending on localized hydrodynamics and proximity to municipal drinking water intakes, such
37 restoration activities could contribute substantial amounts of DOC to municipal raw water. The
38 potential for substantial increases in long-term average DOC concentrations related to the habitat
39 restoration elements of CM4–CM7 and 10 could contribute to long-term water quality degradation
40 with respect to DOC and, thus, adversely affect MUN beneficial uses. The impact is considered to be
41 significant and mitigation is required. It is uncertain whether implementation of Mitigation Measure
42 WQ-18 would reduce identified impacts to a less-than-significant level. Hence, this impact remains
43 significant and unavoidable.

44 In addition to and to supplement Mitigation Measure WQ-18, the BDCP proponents have
45 incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*, a

1 separate, non-environmental commitment to address the potential increased water treatment costs
 2 that could result from DOC concentration effects on municipal and industrial water purveyor
 3 operations. Potential options for making use of this financial commitment include funding or
 4 providing other assistance towards implementing treatment for DOC and/or DBPs or DOC source
 5 control strategies. Please refer to Appendix 3B, *Environmental Commitments*, for the full list of
 6 potential actions that could be taken pursuant to this commitment in order to reduce the water
 7 quality treatment costs associated with water quality effects relating to DOC.

8 **Mitigation Measure WQ-18: Design Wetland and Riparian Habitat Features to Minimize**
 9 **Effects on Municipal Intakes**

10 The BDCP proponents will design wetland and riparian habitat features taking into
 11 consideration effects on Delta hydrodynamics and impacts on municipal intakes. Locate
 12 restoration features such that impacts on municipal intakes are minimized and habitat benefits
 13 are maximized. Incorporate design features to control the load and/or timing of DOC exports
 14 from habitat restoration features. This could include design elements to control seepage from
 15 non-tidal wetlands (e.g., incorporation of slurry walls into levees), and features to increase
 16 retention time and decrease tidal exchange in tidal wetlands and riparian and channel margin
 17 habitat designs. For restoration features directly connected to open channel waters, design
 18 wetlands with only channel margin exchanges to decrease DOC loading. Stagger construction of
 19 wetlands and channel margin/riparian sites both spatially and temporally so as to allow aging of
 20 the restoration features and associated decreased creation of localized “hot spots” and net Delta
 21 loading.

22 The BDCP proponents will also establish measures to help guide the design and creation of the
 23 target wetland habitats. At a minimum, the measures should limit potential increases in long-
 24 term average DOC concentrations, and thus guide efforts to site, design, and maintain wetland
 25 and riparian habitat features, consistent with the biological goals and objectives of the BDCP.
 26 For example, restoration activities could be designed and located with the goal of preventing,
 27 consistent with the biological goals and objectives of the BDCP, net long-term average DOC
 28 concentration increases of greater than 0.5 mg/L at any municipal intake location within the
 29 Delta.

30 However, it must be noted that some of these measures could limit the benefit of restoration
 31 areas by limiting the amount of carbon supplied by these areas to the Delta as a whole. In some
 32 cases, these measures would run directly counter to the goals and objectives of the BDCP. This
 33 mitigation measure should not be implemented in such a way that it reduces the benefits to the
 34 Delta ecosystem provided by restoration areas. As mentioned above, the BDCP proponents have
 35 incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*, a
 36 separate, non-environmental commitment to address the potential increased water treatment
 37 costs that could result from DOC concentration effects on municipal and industrial water
 38 purveyor operations.

39 **Impact WQ-19: Effects on Pathogens Resulting from Facilities Operations and Maintenance**
 40 **(CM1)**

41 ***Upstream of the Delta***

42 Under Alternative 4, Scenarios H1–H4, the only pathogen sources expected to change in the
 43 watersheds upstream of the Delta relative to Existing Conditions or the No Action Alternative would

1 be associated with population growth, i.e., increased municipal wastewater discharges and
2 development contributing to increased urban runoff.

3 Increased municipal wastewater discharges resulting from future population growth would not be
4 expected to measurably increase pathogen concentrations in receiving waters due to state and
5 federal water quality regulations requiring disinfection of effluent discharges and the state's
6 implementation of Title 22 filtration requirements for many wastewater dischargers in the
7 Sacramento River and San Joaquin River watersheds.

8 Pathogen loading from urban areas would generally occur in association with both dry and wet
9 weather runoff from urban landscapes. Municipal stormwater regulations and permits have become
10 increasingly stringent in recent years, and such further regulation of urban stormwater runoff is
11 expected to continue in the future. Municipalities may implement BMPs for reducing pollutant
12 loadings from urban runoff, particularly in response to NPDES stormwater-related regulations
13 requiring reduction of pollutant loading in urban runoff. The ability of these BMPs to consistently
14 reduce pathogen loadings and the extent of future implementation is uncertain, but would be
15 expected to improve as new technologies are continually tested and implemented. Also, some of the
16 urbanization may occur on lands used by other pathogens sources, such as grazing lands, resulting
17 in a change in pathogen source, but not necessarily an increase (and possibly a decrease) in
18 pathogen loading.

19 Pathogen concentrations in the Sacramento and San Joaquin Rivers have a minimal relationship to
20 flow rate in these rivers, although most of the high concentrations observed have been during the
21 wet months (Tetra Tech 2007). Further, urban runoff contributions during the dry season would be
22 expected to be a relatively small fraction of the rivers' total flow rates. During wet weather events,
23 when urban runoff contributions would be higher, the flows in the rivers also would be higher.
24 Given the small magnitude of urban runoff contributions relative to the magnitude of river flows,
25 that pathogen concentrations in the rivers have a minimal relationship to river flow rate, and the
26 expected reduced pollutant loadings in response to NPDES stormwater-related regulations, river
27 flow rate and reservoir storage reductions that would occur under Alternative 4, Scenarios H1-H4,
28 relative to Existing Conditions and the No Action Alternative, would not be expected to result in a
29 substantial adverse change in pathogen concentrations in the reservoirs and rivers upstream of the
30 Delta. As such, none of the operational scenarios of Alternative 4 would be expected to substantially
31 increase the frequency with which applicable Basin Plan objectives or U.S. EPA-recommended
32 pathogen criteria would be exceeded in water bodies of the affected environment located upstream
33 of the Delta or substantially degrade the quality of these water bodies, with regard to pathogens.

34 **Delta**

35 The *Conceptual Model for Pathogens and Pathogen Indicators in the Central Valley and Sacramento-*
36 *San Joaquin Delta* (Pathogens Conceptual Model; Tetra Tech 2007) provides a comprehensive
37 evaluation of factors affecting pathogen levels in the Delta. The Pathogens Conceptual Model
38 characterizes relative pathogen contributions to the Delta from the Sacramento and San Joaquin
39 Rivers and various pathogen sources, including wastewater discharges and urban runoff.
40 Contributions from the San Francisco Bay to the Delta are not addressed. The Pathogens Conceptual
41 Model is based on a database compiled by the Central Valley Drinking Water Policy Group in 2004–
42 2005, supplemented with data from Natomas East Main Drainage Canal Studies, North Bay Aqueduct
43 sampling, and the USGS. Data for multiple sites in the Sacramento River and San Joaquin River
44 watersheds, and in the Delta were compiled. Indicator species evaluated include fecal coliforms,

1 total coliforms, and *E. coli*. Because of its availability, *Cryptosporidium* and *Giardia* data for the
 2 Sacramento River also were evaluated. Key results of the data evaluation are:

3 **Total Coliform**

- 4 • In the Sacramento Valley, the highest total coliform concentrations (>10,000 MPN/100 ml)
 5 were located near urban areas.
- 6 • Similarly high total coliform concentrations were not observed in the San Joaquin Valley,
 7 because reported results were capped at about 2,400 MPN/100 ml, though a large number of
 8 results were reported as being greater than this value.
- 9 • The data should not to be interpreted to conclude that Sacramento River has higher total
 10 coliform concentrations; rather, the “appearance” of the lower total coliform concentrations in
 11 the San Joaquin Valley is attributed to a lower upper limit of reporting (2,400 MPN/100 ml
 12 versus 10,000 MPN/100 ml).

13 ***E. coli***

- 14 • Comparably high concentrations observed in the Sacramento River and San Joaquin River
 15 watersheds for waters affected by urban environments and intensive agriculture.
- 16 • The highest concentrations in the San Joaquin River were not at the most downstream location
 17 monitored, but rather at an intermediate location near Hills Ferry.
- 18 • *E. coli* concentrations in the Delta were somewhat higher than in the San Joaquin River and
 19 Sacramento River, indicating the importance of in-Delta sources and influence of distance of
 20 pathogen source on concentrations at a particular location in the receiving waters.
- 21 • Temporal (seasonal) trends were weak, however, the highest concentrations in the Sacramento
 22 River were observed during the wet months and the lowest concentrations were observed in
 23 July and August.

24 **Fecal Coliform**

- 25 • There was limited data from which to make comparisons/observations.

26 **Cryptosporidium and Giardia**

- 27 • Data were available only for the Sacramento River, limiting the ability to make comparisons
 28 between sources.
- 29 • Often not detected and when detected, concentrations typically less than 1 organism per liter.
- 30 • There may be natural/artificial barriers/processes that limit transport to water. Significant die
 31 off of those that reach the water contribute to the low frequency of detection.

32 The Pathogens Conceptual Model found that coliform indicators vary by orders of magnitudes over
 33 small distances and short time-scales. Concentrations appear to be more closely related to what
 34 happens in the proximity of a sampling station, rather than what happens in the larger watershed
 35 where significant travel time and concomitant pathogen die-off can occur. Sites in the Delta close to
 36 urban discharges had elevated concentrations of coliform organisms. The highest total coliform and
 37 *E. coli* concentrations were observed in the discharge from the Natomas East Main Drainage Canal
 38 and several stations near sloughs, indicating the relative influence of urban and wildlife pathogen
 39 sources on receiving water concentrations.

1 The effects of the operational scenarios of Alternative 4 relative to Existing Conditions and the No
2 Action Alternative would be changes in the relative percentage of water throughout the Delta being
3 comprised of various source waters (i.e., water from the Sacramento River, San Joaquin River, Bay
4 water, eastside tributaries, and agricultural return flow), due to potential changes in inflows
5 particularly from the Sacramento River watershed due to increased water demands (see Table 8-55)
6 and somewhat modified SWP and CVP operations. However, it is expected there would be no
7 substantial change in Delta pathogen concentrations in response to a shift in the Delta source water
8 percentages under this alternative or substantial degradation of these water bodies, with regard to
9 pathogens. This conclusion is based on the Pathogens Conceptual Model, which found that pathogen
10 sources in close proximity to a Delta site appear to have the greatest influence on pathogen levels at
11 the site, rather than the primary source(s) of water to the site. In-Delta potential pathogen sources,
12 including water-based recreation, tidal habitat, wildlife, and livestock-related uses, would continue
13 under this alternative.

14 ***SWP/CVP Export Service Areas***

15 None of the operational scenarios of Alternative 4 are expected to result in substantial changes in
16 pathogen levels in Delta waters, relative to Existing Conditions or the No Action Alternative. As such,
17 there is not expected to be substantial, if even measurable, changes in pathogen concentrations in
18 the SWP/CVP Export Service Area waters.

19 ***NEPA Effects:*** The effects on pathogens from implementing Alternative 4, Scenarios H1–H4, is
20 determined to not be adverse.

21 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
22 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
23 purpose of making the CEQA impact determination for this constituent. For additional details on the
24 effects assessment findings that support this CEQA impact determination, see the effects assessment
25 discussion that immediately precedes this conclusion.

26 River flow rate and reservoir storage reductions that would occur due to implementation of CM1
27 (water facilities and operations) under Alternative 4, relative to Existing Conditions, would not be
28 expected to result in a substantial adverse change in pathogen concentrations in the reservoirs and
29 rivers upstream of the Delta, given the small magnitude of urban runoff contributions relative to the
30 magnitude of river flows, that pathogen concentrations in the rivers have a minimal relationship to
31 river flow rate, and the expected reduced pollutant loadings in response to NPDES stormwater-
32 related regulations.

33 It is expected there would be no substantial change in Delta pathogen concentrations in response to
34 a shift in the Delta source water percentages under this alternative or substantial degradation of
35 these water bodies, with regard to pathogens. This conclusion is based on the Pathogens Conceptual
36 Model, which found that pathogen sources in close proximity to a Delta site appear to have the
37 greatest influence on pathogen levels at the site, rather than the primary source(s) of water to the
38 site. In-Delta potential pathogen sources, including water-based recreation, tidal habitat, wildlife,
39 and livestock-related uses, would continue under this alternative.

40 In the SWP/CVP Export Service Areas waters, relative to Existing Conditions, an increased
41 proportion of water coming from the Sacramento River would not adversely affect beneficial uses in
42 the SWP/CVP Export Service Areas. The pathogen levels in the Sacramento River are similar to or
43 lower than the water diverted at the Delta export pumps. Further, it is localized sources of

1 pathogens that appear to have the greatest influence on concentrations. Thus, an increased
2 proportion of Sacramento River water diverted to the SWP/CVP Export Service Areas would result
3 in minimal changes in pathogen levels in the SWP/CVP Export Service Areas waters.

4 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
5 objectives by frequency, magnitude, and geographic extent that would cause adverse effects on any
6 beneficial uses of waters in the affected environment. Because pathogen concentrations are not
7 expected to increase substantially, no long-term water quality degradation for pathogens is
8 expected to occur and, thus, no adverse effects on beneficial uses would occur. The San Joaquin
9 River in the Stockton Deep Water Ship Channel is Clean Water Act section 303(d) listed for
10 pathogens. Because no measurable increase in Deep Water Ship Channel pathogen concentrations
11 are expected to occur on a long-term basis, further degradation and impairment of this area is not
12 expected to occur. Finally, pathogens are not bioaccumulative constituents. This impact is
13 considered to be less than significant. No mitigation is required.

14 **Impact WQ-20: Effects on Pathogens Resulting from Implementation of CM2–CM22**

15 **NEPA Effects:** CM2–CM11 would involve habitat restoration actions, and CM22 involves waterfowl
16 and shorebird areas. Tidal wetlands are known to be sources of coliforms originating from aquatic,
17 terrestrial, and avian wildlife that inhabit these areas (Desmarais et al. 2001, Grant et al. 2001,
18 Evanson and Ambrose 2006, Tetra Tech 2007). Specific locations of restoration areas for this
19 alternative have not yet been established. However, most low-lying land suitable for restoration is
20 unsuitable for livestock. Therefore, it is likely that the majority of land to be converted to wetlands
21 would be crop-based agriculture or fallow/idle land. Because of a great deal of scientific uncertainty
22 in the loading of coliforms from these various sources, the resulting change in coliform loading is
23 uncertain, but it is anticipated that coliform loading to Delta waters would increase. Based on
24 findings from the Pathogens Conceptual Model that pathogen concentrations are greatly influenced
25 by the proximity to the source, this could result in localized increases in wildlife-related coliforms
26 relative to the No Action Alternative. The Delta currently supports similar habitat types and, with
27 the exception of the Clean Water Act section 303(d) listing for the Stockton Deep Water Ship
28 Channel, is not recognized as exhibiting pathogen concentrations that rise to the level of adversely
29 affecting beneficial uses. As such, the potential increase in wildlife-related coliform concentrations
30 due to tidal habitat creation is not expected to adversely affect beneficial uses.

31 CM19, which would fund projects to contribute to reducing pollutant discharges in stormwater,
32 would be expected to reduce pathogen load relative to the No Action Alternative. The remaining
33 conservation measures would not be expected to affect pathogen levels, because they are actions
34 that do not affect the presence of pathogen sources.

35 The effects on pathogens from implementing CM2–CM22 is determined to not be adverse.

36 **CEQA Conclusion:** Based on findings from the Pathogens Conceptual Model that pathogen
37 concentrations are greatly influenced by the proximity to the source, implementation of CM2–CM11
38 and CM22 could result in localized increases in wildlife-related coliforms relative to Existing
39 Conditions. The Delta currently supports similar habitat types and, with the exception of the Clean
40 Water Act section 303(d) listing for the Stockton Deep Water Ship Channel, is not recognized as
41 exhibiting pathogen concentrations that rise to the level of adversely affecting beneficial uses. As
42 such, the potential increase in wildlife-related coliform concentrations due to tidal habitat creation
43 is not expected to adversely affect beneficial uses. Therefore, this alternative is not expected to cause
44 additional exceedance of applicable water quality objectives by frequency, magnitude, and

1 geographic extent that would cause adverse effects on any beneficial uses of waters in the affected
 2 environment. Because pathogen concentrations are not expected to increase substantially, no long-
 3 term water quality degradation for pathogens is expected to occur and, thus, no adverse effects on
 4 beneficial uses would occur. The San Joaquin River in the Stockton Deep Water Ship Channel is Clean
 5 Water Act section 303(d) listed for pathogens. Because no measurable increase in Deep Water Ship
 6 Channel pathogen concentrations are expected to occur on a long-term basis, further degradation
 7 and impairment of this area is not expected to occur. Finally, pathogens are not bioaccumulative
 8 constituents. This impact is considered to be less than significant. No mitigation is required.

9 **Impact WQ-21: Effects on Pesticide Concentrations Resulting from Facilities Operations and**
 10 **Maintenance (CM1)**

11 Residues of “legacy” OC pesticides enter rivers primarily through surface runoff and erosion of
 12 terrestrial soils during storm events, and through resuspension of riverine bottom sediments, the
 13 combination of which to this day may contribute to excursions above water quality objectives
 14 (Central Valley Water Board 2010c). Operation of the CVP/SWP does not affect terrestrial sources,
 15 but may result in geomorphic changes to the affected environment that ultimately could result in
 16 changes to sediment suspension and deposition. However, as discussed in greater detail for
 17 Turbidity/TSS, operations under any alternative would not be expected to change TSS or turbidity
 18 levels (highs, lows, typical conditions) to any substantial degree. Changes in the magnitude,
 19 frequency, and geographic distribution of legacy pesticides in water bodies of the affected
 20 environment that would result in new or more severe adverse effects on aquatic life or other
 21 beneficial uses, relative to Existing Conditions or the No Action Alternative, would not be expected
 22 to occur. Therefore, the pesticide assessment focuses on the present use pesticides for which
 23 substantial information is available, namely diazinon, chlorpyrifos, pyrethroids, and diuron.

24 ***Upstream of the Delta***

25 Pyrethroid and OP insecticides are applied to agricultural fields, orchards, row crops, and confined
 26 animal facilities on an annual basis, with peaks in agricultural application during the winter
 27 dormant season (January–February) and during field cropping in the spring and summer.
 28 Applications of diuron occur year-round, but the majority of diuron is applied to road rights-of-way
 29 as a pre-emergent and early post emergent weed treatment during the late fall and early winter
 30 (Green and Young 2006). Pyrethroid insecticides and urban use herbicides are additionally applied
 31 around urban and residential structures and landscapes on an annual basis. These applications
 32 throughout the upstream watershed represent the source and potential pool of these pesticides that
 33 may enter the rivers upstream of the Delta by way of surface runoff and/or drift. Principal factors
 34 contributing to pesticide loading in the Sacramento River watershed include the amount of pesticide
 35 used and amount of precipitation (Guo et al. 2004). Although urban dry weather runoff occurs, this
 36 is generally believed to be less significant source of pesticides to main stem receiving waters, but for
 37 pyrethroids a recent study concluded that municipal wastewater treatment plants in Sacramento
 38 and Stockton represent a continuous year-round source of pyrethroids to the lower Sacramento and
 39 San Joaquin River’s (Weston and Lydy 2010).

40 Pesticide-related toxicity has historically been observed throughout the affected environment
 41 regardless of season or water year type; however, toxicity is generally observed with increased
 42 incidence during spring and summer months of April to June, coincident with the peak in irrigated
 43 agriculture in the Sacramento and San Joaquin Valleys, as well as the winter rainy season,
 44 particularly December through February, coincident with urban and agricultural storm-water runoff

1 and the orchard dormant spraying season (Fox and Archibald 1997). Although OP insecticide
2 incidence and related toxicity can be observed throughout the year, diazinon is most frequently
3 observed during the winter months and chlorpyrifos is most frequently observed in the summer
4 irrigation months (Central Valley Water Board 2007). These seasonal trends coincide with their use,
5 where diazinon is principally used as an orchard dormant season spray, and chlorpyrifos is
6 primarily used on crops during the summer.

7 Application of diuron peaks in the late fall and early winter. Coincidentally, diuron is found most
8 frequently in surface waters during the winter precipitation and runoff months of January through
9 March (Green and Young 2006), although diuron can be found much less frequently in surface
10 waters throughout the year (Johnson et al. 2010).

11 Monitoring for pyrethroid insecticides in main-stem rivers is limited and detections are rather few.
12 With the replacement of many traditionally OP related uses, however, it is conservatively assumed
13 that pyrethroid incidence and associated toxicity could ultimately take a pattern of seasonality
14 similar to that of the chlorpyrifos or diazinon.

15 In comparison to the Valley floor, relatively small amounts of pesticides are used in watersheds
16 upstream of project reservoirs. Water released from reservoirs flow through urban and agricultural
17 areas at which point these waters may acquire a burden of pesticide from agricultural or urban
18 sourced discharges. These discharges with their potential burden of pesticides are effectively
19 diluted by reservoir water. Under the operational scenarios of Alternative 4, no activity of the SWP
20 or CVP would substantially drive a change in pesticide use, and thus pesticide sources would remain
21 unaffected. Nevertheless, changes in the timing and magnitude of reservoir releases could have an
22 effect on available dilution capacity along river segments such as the Sacramento, Feather,
23 American, and San Joaquin Rivers.

24 Under the operational scenarios of Alternative 4, winter (November–March) and summer (April–
25 October) season average flow rates on the Sacramento River at Freeport, American River at Nimbus,
26 Feather River at Thermalito and the San Joaquin River at Vernalis would change. Relative to Existing
27 Conditions and the No Action Alternative, seasonal average flow rates on the Sacramento for
28 Scenarios H1–H4 would decrease no more than 7% during the summer and 4% during the winter
29 (Appendix 8L, Seasonal average flows Tables 1-4). On the Feather River, average flow rates for
30 Scenarios H1–H4 would decrease no more than 9% during the summer and 2% during the winter,
31 while on the American River average flow rates would decrease by as much as 19% in the summer
32 but would increase by as much as 8% in the winter. Seasonal average flow rates for Scenarios H1–
33 H4 on the San Joaquin River would decrease by as much as 12% in the summer, but increase by as
34 much as 1% in the winter.

35 As previously stated, historically chlorpyrifos is used in greater amounts in agriculture in the
36 summer, and consequently observed in surface waters with greater frequency in the summer, while
37 diazinon and diuron are used and observed in surface water with greater frequency in the winter.
38 While flow reductions in the summer on the American River would not coincide with urban
39 stormwater discharges, summer flow reductions on the San Joaquin River would correspond to the
40 agricultural irrigation season. However, summer average flow reductions of up to 19% are not
41 considered of sufficient magnitude to substantially increase in-river concentrations or alter the
42 long-term risk of pesticide-related effects on aquatic life beneficial uses. Greater long-term average
43 flow reductions, and corresponding reductions in dilution/assimilative capacity, would be necessary

1 before long-term risk of pesticide related effects on aquatic life beneficial uses would be adversely
2 altered.

3 **Delta**

4 Sources of diuron, OP and pyrethroid insecticides to the Plan Area include direct input of surface
5 runoff from in-Delta agriculture and Delta urbanized areas as well as inputs from rivers upstream of
6 the Delta. Similar to Upstream of the Delta, CVP/SWP operations under Scenarios H1–H4 of
7 Alternative 4 would not affect these sources.

8 Under Scenarios H1–H4, the distribution and mixing of Delta source waters would change. Percent
9 change in monthly average source water fraction were evaluated for the modeled 16-year (1976–
10 1991) hydrologic period and a representative drought period (1987–1991), with special attention
11 given to changes in San Joaquin River, Sacramento River and Delta Agriculture sources water
12 fractions. Changes in source water fractions at the modeled Delta assessment locations would vary
13 depending on operational scenario, but relative differences between the operational scenarios
14 would be small. Relative to Existing Conditions, under Scenarios H1–H4 of Alternative 4 modeled
15 San Joaquin River fractions would increase greater than 10% at Buckley Cove (drought period only),
16 Franks Tract, Rock Slough, and Contra Costa PP No. 1, with the largest changes occurring under
17 Scenario H4 (Appendix 8D, Source Water Fingerprinting). At Buckley Cove under Scenario H4,
18 change in drought period San Joaquin River source water fractions would increase 11% in July and
19 16% in August. At Franks Tract under Scenario H4, change in San Joaquin River source water
20 fractions when modeled for the 16-year hydrologic period, would increase 11–16% during October
21 through November and February through June. At Rock Slough, modeled San Joaquin River source
22 water fractions under Scenario H4 would increase 15–22% during September through March (11–
23 15% during October and November of the modeled drought period). Similarly, under Scenario H4
24 modeled San Joaquin River fractions at Contra Costa Pumping Plant No. 1 would increase 15–23%
25 during October through April (12% during October and November of the modeled drought period).
26 While the modeled 22–23% increases of San Joaquin River Fraction at Rock Slough and Contra Costa
27 PP No. 1 in November are considerable, the resultant net fraction would be $\leq 29\%$. For all
28 operational scenarios, relative to Existing Conditions, there would be no modeled increases in
29 Sacramento River fractions greater than 14% (with exception to Banks and Jones, discussed below)
30 and Delta agricultural fractions greater than 8%. These modeled changes in the source water
31 fractions of Sacramento, San Joaquin and Delta agriculture water are not of sufficient magnitude to
32 substantially alter the long-term risk of pesticide-related toxicity to aquatic life, nor adversely affect
33 other beneficial uses of the Delta.

34 When compared to the No Action Alternative, changes in source water fractions resulting from
35 Scenarios H1–H4 would be similar in season, geographic extent, and magnitude to those discussed
36 for Existing Conditions, with exception to Buckley Cove. Relative to the No Action Alternative, on a
37 source water basis Buckley Cove is comprised predominantly of water of San Joaquin River origin
38 (i.e., typically $>80\%$ San Joaquin River) for all months of the year but July and August. In July and
39 August, the combined operational effects on Delta hydrodynamics of the Delta Cross Channel being
40 open, the absence of a barrier at Head of Old River, and seasonally high exports from south Delta
41 pumps results in substantially lower San Joaquin River source water fraction at Buckley Cove
42 relative to all other months of the year. Under the operational scenarios of Alternative 4, however,
43 modeled July and August San Joaquin River fractions at Buckley Cove would increase relative to the
44 No Action Alternative, with increases between 16–17% in July (31–34% for the modeled drought
45 period) and 24–25% in August (47–49% for the modeled drought period) (Appendix 8D, Source

1 Water Fingerprinting). Despite these San Joaquin River increases, the resulting net San Joaquin
 2 River source water fraction for July and August would remain less than all other months. As a result,
 3 these modeled changes in the source water fractions are not of sufficient magnitude to substantially
 4 alter the long-term risk of pesticide-related toxicity to aquatic life, nor adversely affect other
 5 beneficial uses of the Delta.

6 ***SWP/CVP Export Service Areas***

7 Assessment of effects in SWP/CVP Export Service Areas is based on effects seen in the Plan Area at
 8 the Banks and Jones pumping plants. Under all operational scenarios of Alternative 4, Sacramento
 9 River source water fractions would increase substantially at both Banks and Jones pumping plants
 10 relative to Existing Conditions and the No Action Alternative (Appendix 8D, Source Water
 11 Fingerprinting). Sacramento River source water fractions would increase similarly by both season
 12 and magnitude extent under all operational scenarios at both Banks and Jones pumping plant. At
 13 Banks pumping plant, Sacramento source water fractions would generally increase from 16–48%
 14 for the period of January through June (12–35% for March through April of the modeled drought
 15 period) and at Jones pumping plant Sacramento source water fractions would generally increase
 16 from 21–56% for the period of January through June (15–48% for February through May of the
 17 modeled drought period). These increases in Sacramento source water fraction would primarily
 18 balance through equivalent decreases in San Joaquin River water. Based on the general observation
 19 that San Joaquin River, in comparison to the Sacramento River, is a greater contributor of OP
 20 insecticides in terms of greater frequency of incidence and presence at concentrations exceeding
 21 water quality benchmarks, modeled increases in Sacramento River fraction at Banks and Jones
 22 would generally represent an improvement in export water quality respective to pesticides.

23 ***NEPA Effects:*** In summary, the changes in long-term average flows on the Sacramento, Feather,
 24 American, and San Joaquin Rivers, under Scenarios H1–H4 of Alternative 4 relative to the No Action
 25 Alternative, are of insufficient magnitude to substantially increase the long-term risk of pesticide-
 26 related water quality degradation and related toxicity to aquatic life in these water bodies upstream
 27 of the Delta. Similarly, modeled changes in source water fractions to the Delta are of insufficient
 28 magnitude to substantially alter the long-term risk of pesticide-related water quality degradation
 29 and related toxicity to aquatic life in the Delta or CVP/SWP export service areas. The effects on
 30 pesticides from operations and maintenance (CM1) are determined not to be adverse.

31 ***CEQA Conclusion:*** Key findings discussed in the effects assessment relative to Existing Conditions
 32 provided above are summarized here, and are then compared to the CEQA thresholds of significance
 33 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this
 34 constituent. For additional details on the effects assessment findings that support this CEQA impact
 35 determination, see the effects assessment discussion that immediately precedes this conclusion.

36 Sources of pesticides upstream of the Delta include direct input of pesticide containing surface
 37 runoff from agriculture and urbanized areas. Flows in rivers receiving these discharges dilute these
 38 pesticide inputs. For all operational scenarios relative to Existing Conditions, however, modeled
 39 changes in long-term average flows on the Sacramento, Feather, American, and San Joaquin Rivers
 40 are of insufficient magnitude to substantially increase the long-term risk of pesticide-related water
 41 quality degradation and related toxicity to aquatic life in these water bodies upstream of the Delta.

42 In the Delta, sources of pesticides include direct input of surface runoff from Delta agriculture and
 43 Delta urbanized areas as well as inputs from rivers upstream of the Delta. While facilities operations
 44 and maintenance activities under Scenarios H1–H4 would not affect these sources, changes in Delta

1 source water fraction could change the relative risk associated with pesticide related toxicity to
2 aquatic life. Under Scenarios H1–H4 of Alternative 4, however, modeled changes in source water
3 fractions relative to Existing Conditions are of insufficient magnitude to substantially alter the long-
4 term risk of pesticide-related toxicity to aquatic life within the Delta, nor would such changes result
5 in adverse pesticide-related effects on any other beneficial uses of Delta waters.

6 The assessment of Alternative 4 effects on pesticides in the SWP/CVP Export Service Areas is based
7 on assessment of changes predicted at Banks and Jones pumping plants. As just discussed regarding
8 Scenario H1–H4 effects to pesticides in the Delta, modeled changes in source water fractions at the
9 Banks and Jones pumping plants are of insufficient magnitude to substantially alter the long-term
10 risk of pesticide-related toxicity to aquatic life beneficial uses, or any other beneficial uses, in water
11 bodies of the SWP and CVP export service area.

12 Based on the above, the considered operational scenarios of Alternative 4 would not result in any
13 substantial change in long-term average pesticide concentration or result in substantial increase in
14 the anticipated frequency with which long-term average pesticide concentrations would exceed
15 aquatic life toxicity thresholds or other beneficial use effect thresholds upstream of the Delta, at the
16 11 assessment locations analyzed for the Delta, or the SWP/CVP service area. Numerous pesticides
17 are currently used throughout the affected environment, and while some of these pesticides may be
18 bioaccumulative, those present-use pesticides for which there is sufficient evidence for their
19 presence in waters affected by SWP and CVP operations (i.e., diazinon, chlorpyrifos, diuron, and
20 pyrethroids) are not considered bioaccumulative, and thus changes in their concentrations would
21 not directly cause bioaccumulative problems in aquatic life or humans. Furthermore, while there are
22 numerous 303(d) listings throughout the affected environment that name pesticides as the cause for
23 beneficial use impairment, the modeled changes in upstream river flows and Delta source water
24 fractions under Scenarios H1–H4 would not be expected to make any of these beneficial use
25 impairments measurably worse. Because long-term average pesticide concentrations are not
26 expected to increase substantially, no long-term water quality degradation with respect to
27 pesticides is expected to occur and, thus, no adverse effects on beneficial uses would occur. This
28 impact is considered to be less than significant. No mitigation is required.

29 **Impact WQ-22: Effects on Pesticide Concentrations Resulting from Implementation of CM2–** 30 **CM22**

31 **NEPA Effects:** With the exception of CM13, the mostly non-land disturbing CM12–CM22 present no
32 new sources of pesticides to the affected environment, including areas Upstream of the Delta, within
33 the Plan Area, and the SWP/CVP Export Service Area. Implementation of urban stormwater
34 treatment measures (CM19) may result in beneficial effects, to the extent that control measures
35 treat or reduce pesticide loading from urban land uses. However, control of nonnative aquatic
36 vegetation (CM13) associated with tidal habitat restoration efforts would include killing invasive
37 and nuisance aquatic vegetation through direct application of herbicides or through alternative
38 mechanical means. Use and selection of type of herbicides would largely be circumstance specific,
39 but would follow existing control methods used by the CDBW. The CDBW's use of herbicides is
40 regulated by permits and regulatory agreements with the Central Valley Water Board, US Fish and
41 Wildlife Service, and National Marine Fisheries Service and is guided by research conducted on the
42 efficacy of vegetation control in the Delta through herbicide use. Through a program of adaptive
43 management and assessment, the CDBW has employed a program of herbicide use that reduces
44 potential environmental impacts, nevertheless, the CDBW found that impacts on water quality and
45 associated aquatic beneficial uses would continue to occur and could not be avoided, including non-

1 target impacts on aquatic invertebrates and beneficial aquatic plants (California Department of
2 Boating and Waterways 2006).

3 In addition to the potential beneficial and adverse effects of CM19 and CM13, respectively, the
4 various restoration efforts of CM2–CM11 could involve the conversion of active or fallow
5 agricultural lands to natural landscapes, such as wetlands, grasslands, floodplains, and vernal pools.
6 In the long-term, conversion of agricultural land to natural landscapes could possibly result in a
7 limited reduction in pesticide use throughout the Delta. In the short-term, tidal and non-tidal
8 wetland restoration, as well as seasonal floodplain restoration (i.e., CM4, CM5, and CM10) over
9 former agricultural lands may include the contamination of water with pesticide residues contained
10 in the soils. Present use pesticides typically degrade fairly rapidly, and in such cases where pesticide
11 containing soils are flooded, dissipation of those pesticides would be expected to occur rapidly.
12 Moreover, seasonal floodplain restoration (CM5) and Yolo Bypass enhancements (CM2) may be
13 managed alongside continuing agriculture, where pesticides may be used on a seasonal basis and
14 where water during flood events may come in contact with residues of these pesticides. Similarly,
15 however, rapid dissipation would be expected, particularly in the large volumes of water involved in
16 flooding. During these flooding events, pesticides potentially suspended in water would not be
17 expected to cause toxicity to aquatic life or cause substantial adverse effects on any other beneficial
18 uses of these water bodies.

19 In summary, CM13 of Alternative 4 proposes the use of herbicides to control invasive aquatic
20 vegetation around habitat restoration sites. Herbicides directly applied to water could adversely
21 affect non-target aquatic life, such as aquatic invertebrates and beneficial aquatic plants. Use of
22 herbicides could potentially exceed aquatic life toxicity objectives with sufficient frequency and
23 magnitude such that beneficial uses would be adversely affected, thus constituting an adverse effect
24 on water quality. Mitigation Measure WQ-22 would be available to reduce this effect.

25 **CEQA Conclusion:** With the exception of CM13, implementation of CM2–CM22 would not present
26 new or substantially increased sources of pesticides in the Plan Area. In the long-term,
27 implementation of conservation measures could possibly result in a limited reduction in pesticide
28 use throughout the Delta through the potential repurposing of active or fallow agricultural land for
29 natural habitat purposes. In the short-term, the repurposing of agricultural land associated with
30 CM4, CM5, and CM10 may expose water used for habitat restoration to pesticide residues. Moreover,
31 CM2 and CM5 may be managed alongside continuing agriculture, where pesticides may be used on a
32 seasonal basis and where water during flood events may come in contact with residues of these
33 pesticides. However, rapid dissipation would be expected, particularly in the large volumes of water
34 involved in flooding, such that aquatic life toxicity objectives would not be exceeded by frequency,
35 magnitude, and geographic extent whereby adverse effects on beneficial uses would be expected.
36 Conservation Measures 2–22 do not include the use of pesticides known to be bioaccumulative in
37 animals or humans, nor do the conservation measures propose the use of any pesticide currently
38 named in a Section 303(d) listing of the affected environment. CM13 proposes the use of herbicides
39 to control invasive aquatic vegetation around habitat restoration sites. Herbicides directly applied to
40 water could include adverse effects on non-target aquatic life, such as aquatic invertebrates and
41 beneficial aquatic plants. As such, aquatic life toxicity objectives could be exceeded with sufficient
42 frequency and magnitude such that beneficial uses would be impacted. Potential environmental
43 effects related only to CM13 are considered significant. Mitigation Measure WQ-22 is available to
44 partially reduce this impact of pesticides on water quality; however, because of the uncertainty
45 about successful implementation of this measure at specific restoration sites programmatic impact
46 is considered significant and unavoidable.

1 **Mitigation Measure WQ-22: Implement Least Toxic Integrated Pest Management**
 2 **Strategies**

3 Implement the principals of IPM in the management of invasive aquatic vegetation under CM13,
 4 including the selective use of pesticides applied in a manner that minimizes risks to human
 5 health, nontarget organisms and the aquatic ecosystem. In doing so, the BDCP proponents will
 6 consult with the Central Valley Water Board, USFWS, NMFS, and CDBW to obtain effective IPM
 7 strategies such as selective application of pesticides, timing of applications in order to minimize
 8 tidal dispersion, and timing to target the invasive plant species at the most vulnerable times
 9 such that less herbicide can be used or the need for repeat applications can be reduced.

10 **Impact WQ-23: Effects on Phosphorus Concentrations Resulting from Facilities Operations**
 11 **and Maintenance (CM1)**

12 *Upstream of the Delta*

13 A conceptual model of nutrients in the Delta stated that: “previous attempts to relate concentration
 14 data to flow data in the Central Valley and Delta showed little correlation between the two variables
 15 (Tetra Tech 2006b, Conceptual Model for Organic Carbon in the Central Valley). One possible reason
 16 is that the Central Valley and Delta system is a highly managed system with flows controlled by
 17 major reservoirs on most rivers” (Tetra Tech 2006b:4-1 to 4-2). Attempts made in the Nitrate
 18 section of this chapter also showed weak correlation between nitrate and flows for major source
 19 waters to the Delta. The linear regressions between average dissolved ortho-phosphate
 20 concentrations and average flows in the San Joaquin and Sacramento Rivers were derived for this
 21 analysis (Figure 8-58 and Figure 8-59). As expected, neither relationship is very strong, although
 22 over the large range in flows for the Sacramento River, the relationship is stronger than for the San
 23 Joaquin River. However, over smaller changes in flows, neither relationship can function as a
 24 predictor of phosphorus concentrations because the variability in the data over small to medium
 25 ranges of flows (i.e., < 10,000 CFS) is large.

26 Because phosphorus loading to waters upstream of the Delta is not anticipated to change, and
 27 because changes in flows do not necessarily result in changes in concentrations or loading of
 28 phosphorus to these water bodies, substantial changes in phosphorus concentration are not
 29 anticipated under the operational scenarios of Alternative 4, relative to Existing Conditions or the
 30 No Action Alternative. Any negligible changes in phosphorus concentrations that may occur in the
 31 water bodies of the affected environment located upstream of the Delta would not be of frequency,
 32 magnitude and geographic extent that would adversely affect any beneficial uses or substantially
 33 degrade the quality of these water bodies, with regards to phosphorus.

34 *Delta*

35 Because phosphorus concentrations in the major source waters to the Delta are similar for much of
 36 the year, phosphorus concentrations in the Delta are not anticipated to change substantially on a
 37 long term-average basis. Phosphorus concentrations may increase during January through March at
 38 locations where the source fraction of San Joaquin River water increases, due to the higher
 39 concentration of phosphorus in the San Joaquin River during these months compared to Sacramento
 40 River water or San Francisco Bay water. Based on the DSM2 fingerprinting results (see Appendix
 41 8D), together with source water concentrations shown in Figure 8-56, the magnitude of increases
 42 during these months may range from negligible up to approximately 0.05 mg/L. However, there are
 43 no state or federal objectives/criteria for phosphorus and thus any increases would not cause

1 exceedances of objectives/criteria. Because algal growth rates are limited by availability of light in
2 the Delta, increases in phosphorus levels that may occur at some locations and times within the
3 Delta under Alternative 4, Scenarios H1–H4, would be expected to have little effect on primary
4 productivity in the Delta. Moreover, such increases in concentrations would not be anticipated to be
5 of frequency, magnitude and geographic extent that would adversely affect any beneficial uses or
6 substantially degrade the water quality at these locations, with regards to phosphorus.

7 ***SWP/CVP Export Service Areas***

8 The assessment of effects of phosphorus under Alternative 4, Scenarios H1–H4, in the SWP and CVP
9 Export Service Areas is based on effects on phosphorus at the Banks and Jones pumping plants.

10 As noted in the Delta Region section above, phosphorus concentrations in the Delta (including Banks
11 and Jones pumping plants) are not anticipated to change substantially on a long term-average basis.
12 During January through March, phosphorus concentrations may increase as a result of more San
13 Joaquin River water reaching Banks and Jones pumping plants and the higher concentration of
14 phosphorus in the San Joaquin River. However, based on the DSM2 fingerprinting results (see
15 Appendix 8D), together with source water concentrations show in Figure 8-56, the magnitude of this
16 increase is expected to be negligible (<0.01 mg/L-P). Additionally, there are no state or federal
17 objectives for phosphorus. Moreover, given the many factors that contribute to potential algal
18 blooms in the SWP and CVP canals within the Export Service Area, and the lack of studies that have
19 shown a direct relationship between nutrient concentrations in the canals and reservoirs and
20 problematic algal blooms in these water bodies, there is no basis to conclude that any seasonal
21 increases in phosphorus concentrations at the levels expected under this alternative, should they
22 occur, would increase the potential for problem algal blooms in the SWP and CVP Export Service
23 Area.

24 Any increases in phosphorus concentrations that may occur in water exported via Banks and Jones
25 pumping plants are not expected to result in adverse effects to beneficial uses of exported water or
26 substantially degrade the quality of exported water, with regards to phosphorus.

27 ***NEPA Effects:*** In summary, based on the discussion above, effects on phosphorus of CM1 are
28 considered to be not adverse.

29 ***CEQA Conclusion:*** Key findings discussed in the effects assessment relative to Existing Conditions is
30 provided above are summarized here, and are then compared to the CEQA thresholds of significance
31 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this
32 constituent. For additional details on the effects assessment findings that support this CEQA impact
33 determination, see the effects assessment discussion that immediately precedes this conclusion.

34 Because phosphorus loading to waters upstream of the Delta is not anticipated to change, and
35 because changes in flows do not necessarily result in changes in concentrations or loading of
36 phosphorus to these water bodies, substantial changes in phosphorus concentration upstream of the
37 Delta are not anticipated for any operational scenario of Alternative 4, relative to Existing
38 Conditions.

39 Because phosphorus concentrations in the major source waters to the Delta are similar for much of
40 the year, phosphorus concentrations in the Delta are not anticipated to change substantially on a
41 long term-average basis under the operational scenarios of Alternative 4, relative to Existing
42 Conditions. Algal growth rates are limited by availability of light in the Delta, and therefore any

1 minor increases in phosphorus levels that may occur at some locations and times within the Delta
2 would be expected to have little effect on primary productivity in the Delta.

3 The assessment of effects of phosphorus under the various operational scenarios of Alternative 4 in
4 the SWP and CVP Export Service Areas is based on effects on phosphorus at the Banks and Jones
5 pumping plants. As noted above, phosphorus concentrations in the Delta (including Banks and Jones
6 pumping plants) are not anticipated to change substantially on a long term-average basis.

7 Based on the above, there would be no substantial, long-term increase in phosphorus concentrations
8 in the rivers and reservoirs upstream of the Delta, in the Delta Region, or the waters exported to the
9 CVP and SWP service areas under any operational scenario of Alternative 4 relative to Existing
10 Conditions. As such, this alternative is not expected to cause additional exceedance of applicable
11 water quality objectives/criteria by frequency, magnitude, and geographic extent that would cause
12 adverse effects on any beneficial uses of waters in the affected environment. Because phosphorus
13 concentrations are not expected to increase substantially, no long-term water quality degradation is
14 expected to occur and, thus, no adverse effects to beneficial uses would occur. Phosphorus is not
15 303(d) listed within the affected environment and thus any minor increases that may occur in some
16 areas would not make any existing phosphorus-related impairment measurably worse because no
17 such impairments currently exist. Because phosphorus is not bioaccumulative, minor increases that
18 may occur in some areas would not bioaccumulate to greater levels in aquatic organisms that would,
19 in turn, pose substantial health risks to fish, wildlife, or humans. This impact is considered to be less
20 than significant. No mitigation is required.

21 **Impact WQ-24: Effects on Phosphorus Concentrations Resulting from Implementation of** 22 **CM2–CM22**

23 **NEPA Effects:** CM2–CM11 include activities that create additional aquatic habitat within the affected
24 environment, and therefore may increase the total amount of algae and plant-life within the Delta.
25 These activities would not affect phosphorus loading to the affected environment, but may affect
26 phosphorus dynamics and speciation. For example, water column concentrations of total
27 phosphorus may increase or decrease in localized areas as a result of increased or decreased
28 suspended solids, while ortho-phosphate concentrations may be locally altered as a result of
29 changing planktonic and macroinvertebrate species contributing to the cycling of phosphorus
30 within the affected environment. Additionally, depending on age, configuration, location, operation,
31 and season, some of the restoration measures included under these conservation measures may
32 function to remove or sequester phosphorus, but since presently, the specific design, operational
33 criteria, and location of these activities are not well established, the degree to which this would
34 occur is unknown. Overall, phosphorus concentrations are not expected to change substantially in
35 the affected environment as a result of CM2–CM22. Because increases or decreases in phosphorus
36 levels are, in general, expected to have little effect on productivity, any changes in phosphorus
37 concentrations that may occur at certain locations within the affected environment are not
38 anticipated to be of frequency, magnitude and geographic extent that would adversely affect any
39 beneficial uses or substantially degrade the water quality at these locations, with regards to
40 phosphorus.

41 Because urban stormwater is a source of phosphorus in the affected environment, CM19, Urban
42 Stormwater Treatment, is expected to slightly reduce phosphorus loading to the Delta, thus slightly
43 decreasing phosphorus concentrations relative to the No Action Alternative. Implementation of

1 CM12–CM18 and CM20–CM22 is not expected to substantially alter phosphorus concentrations in
2 the affected environment.

3 The effects on phosphorus from implementing CM2–22 are considered to be not adverse.

4 **CEQA Conclusion:** There would be no substantial, long-term increase in phosphorus concentrations
5 in the rivers and reservoirs upstream of the Delta, in the Delta Region, or the waters exported to the
6 CVP and SWP service areas due to implementation of CM2–CM22 under Alternative 4 relative to
7 Existing Conditions. Because urban stormwater is a source of phosphorus in the affected
8 environment, CM19, Urban Stormwater Treatment, is expected to slightly reduce phosphorus
9 loading to the Delta. As such, implementation of these conservation measures is not expected to
10 cause adverse effects on any beneficial uses of waters in the affected environment. Because
11 phosphorus concentrations are not expected to increase substantially due to these conservation
12 measures, no long-term water quality degradation is expected to occur and, thus, no adverse effects
13 to beneficial uses would occur. Phosphorus is not 303(d) listed within the affected environment and
14 thus any minor increases that may occur in some areas would not make any existing phosphorus-
15 related impairment measurably worse because no such impairments currently exist. Because
16 phosphorus is not bioaccumulative, minor increases that may occur in some areas would not
17 bioaccumulate to greater levels in aquatic organisms that would, in turn, pose substantial health
18 risks to fish, wildlife, or humans. This impact is considered to be less than significant. No mitigation
19 is required.

20 **Impact WQ-25: Effects on Selenium Concentrations Resulting from Facilities Operations and** 21 **Maintenance (CM1)**

22 ***Upstream of the Delta***

23 Substantial point sources of selenium do not exist upstream in the Sacramento River watershed, in
24 the watersheds of the eastern tributaries (Cosumnes, Mokelumne, and Calaveras Rivers), or
25 upstream of the Delta in the San Joaquin River watershed. Nonpoint sources of selenium within the
26 watersheds of the Sacramento River and the eastern tributaries also are relatively low, resulting in
27 generally low selenium concentrations in the reservoirs and rivers of those watersheds.
28 Consequently, any modified reservoir operations and subsequent changes in river flows under
29 Alternative 4, Scenarios H1–H4, relative to Existing Conditions or the No Action Alternative, are
30 expected to have negligible, if any, effects on reservoir and river selenium concentrations upstream
31 of Freeport in the Sacramento River watershed or in the eastern tributaries upstream of the Delta.

32 Non-point sources of selenium in the San Joaquin River watershed are associated with discharges of
33 subsurface agricultural drainage to the river and its tributaries. Selenium concentrations at Vernalis
34 are generally higher during lower San Joaquin River flows, with considerable variability in
35 concentrations below about 3,000 cfs, as shown in Appendix 8M (Table 31 and Figures 4 through
36 17). The only monthly average selenium concentrations greater than 2 µg/L were in March 2002
37 (2.3 µg/L) and February and March 2003 (2.1 and 2.3 µg/L), when monthly average flows were
38 1,879 to 2,193 cfs. Under the four operational scenarios of Alternative 4, modeling indicates that
39 long-term annual average flows on the San Joaquin River would decrease by 6% relative to Existing
40 Conditions and would remain virtually the same relative to the No Action Alternative (Appendix 5A).
41 Given these relatively small decreases in flows and the considerable variability in the relationship
42 between selenium concentrations and flows in the San Joaquin River, it is expected that selenium
43 concentrations in the San Joaquin River would be minimally affected, if at all, by anticipated changes

1 in flow rates under the operational scenarios of Alternative 4. Thus, available information indicates
 2 selenium concentrations are well below the Basin Plan objective and are likely to remain so. Any
 3 negligible changes in selenium concentrations that may occur in the water bodies of the affected
 4 environment located upstream of the Delta would not be of frequency, magnitude, and geographic
 5 extent that would adversely affect any beneficial uses or substantially degrade the quality of these
 6 water bodies as related to selenium.

7 **Delta**

8 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 9 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 10 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 11 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 12 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
 13 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

14 All scenarios (H1, H2, H3, and H4) under Alternative 4 would result in small changes in average
 15 selenium concentrations in water relative to Existing Conditions and No Action Alternative at almost
 16 all modeled Delta assessment locations (Appendix 8M, Table M-10B). These small changes in
 17 selenium concentrations in water are reflected in small percent changes (10% or less) in available
 18 assimilative capacity for selenium (based on 2 µg/L ecological risk benchmark) for all years (Figures
 19 8-59 and 8-60). Relative to Existing Conditions, Scenario H1 would result in the largest modeled
 20 increase in assimilative capacity (range of +1% at Buckley Cove to -3% at Contra Costa PP), and the
 21 largest decrease would be under Scenario H4 (range of -4% at Contra Costa PP to +1% at Buckley
 22 Cove). Relative to the No Action Alternative, the largest modeled increase in assimilative capacity
 23 would be under Scenario H1 (range of <+1% at Staten Island to -4% at Buckley Cove) and the largest
 24 decrease would be under Scenario H4 (range of -4% at Buckley Cove to + 1% at Staten Island)
 25 (Figure 8-60). Although some small negative changes in selenium concentrations in water are
 26 expected, the effect of any of the scenarios under Alternative 4 would generally be minimal for the
 27 Delta locations. Furthermore, the modeled selenium concentrations in water (Appendix 8M, Table
 28 M-10B) for Existing Conditions (range 0.21–0.76 µg/L), No Action Alternative (range 0.21–0.69
 29 µg/L), Alternative 4 Scenarios H1 (range 0.21–0.74 µg/L), H2 (range 0.21–0.74 µg/L), H3 (range
 30 0.22–0.74 µg/L), and H4 (range 0.22–0.74 µg/L) are generally similar, and would all be below the
 31 ecological risk benchmark (2 µg/L).

32 Relative to Existing Conditions and the No Action Alternative, all scenarios under Alternative 4
 33 would result in small changes in estimated selenium concentrations in biota (whole-body fish, bird
 34 eggs [invertebrate diet or fish diet], and fish fillets) (Appendix 8M, Tables M-15A through M-15D
 35 and Addendum M.A to Appendix 8M, Table M.A-2). Relative to Existing Conditions for all scenarios
 36 under Alternative 4, the largest increase of selenium concentrations in all biota would be at Contra
 37 Costa PP for all years and in sturgeon at the San Joaquin River at Antioch in all years, and the largest
 38 decrease of selenium in all biota would be at Buckley Cove for drought years. Relative to the No
 39 Action Alternative, the largest increases and decreases in estimated selenium concentrations in
 40 biota for each scenario are provided below.

- 41 • Alternative 4, Scenario H1: The largest increase of estimated selenium concentrations in all
 42 biota would be at Buckley Cove for drought years (except for bird eggs [assuming a fish diet] at
 43 Buckley Cove for all years) and in sturgeon at the San Joaquin River at Antioch in all years; the

1 largest decrease in all biota would be at Staten Island for all years (except for bird eggs
2 [assuming a fish diet] at Staten Island for drought years).

- 3 • Alternative 4, Scenario H2: The largest increase of estimated selenium concentrations in all
4 biota would be at Buckley Cove for drought years (except for bird eggs [assuming a fish diet] at
5 Buckley Cove for all years) and in sturgeon at the San Joaquin River at Antioch in all years; the
6 largest decrease for all biota would be at Staten Island for drought years.
- 7 • Alternatives 4, Scenarios H3 and H4: The largest increase of estimated selenium concentrations
8 in all biota would be at Buckley Cove for drought years (except for bird eggs [assuming a fish
9 diet] at Contra Costa PP for all years) and in sturgeon at the San Joaquin River at Antioch in all
10 years; the largest decrease for all biota would be at Staten Island for drought years.

11 Except for sturgeon in the western Delta, concentrations of selenium in whole-body fish and bird
12 eggs (invertebrate and fish diets) would exceed only the lower benchmarks (4 and 6 mg/kg dry
13 weight, respectively, indicating a low potential for effects) at Buckley Cove, under drought
14 conditions, for Existing Conditions, No Action Alternative, and all scenarios for Alternative 4
15 (Figures 8-61, 8-62, and 8-63). However, Exceedance Quotients for these exceedances of the lower
16 benchmarks for all Alternative 4 scenarios are between 1.0 and 1.5 (similar to Existing Conditions,
17 and No Action Alternative), indicating a low risk to biota in the Delta and no substantial difference
18 from baseline conditions. Estimated selenium concentrations in fish fillets would not exceed the
19 screening value for protection of human health (Figure 8-64). For sturgeon in the western Delta,
20 whole-body selenium concentrations would increase from 12.3 mg/kg under Existing Conditions
21 and the No Action Alternative to 13.1-13.5 mg/kg under Alternative 4 (depending on the operational
22 scenario), a 7-10% increase (Table M.A-2). Although all of these values exceed both the low and high
23 toxicity benchmarks, it is unlikely that the modeled increases in whole-body selenium for sturgeon
24 would be measurable in the environment (see also the discussion of results provided in Addendum
25 M.A to Appendix 8M).

26 Selenium concentrations in water and biota would slightly increase progressively from Alternative
27 4, Scenario H1 (smallest) to Alternative 4, Scenario H4 (largest). However, relative to baseline
28 conditions, all scenarios under Alternative 4 would result in essentially no change in selenium
29 concentrations throughout the Delta. Consequently, Alternative 4 scenarios would not be expected
30 to substantially increase the frequency with which applicable benchmarks would be exceeded in the
31 Delta or substantially degrade the quality of water in the Delta, with regard to selenium.

32 ***SWP/CVP Export Service Areas***

33 Alternative 4 scenarios would result in small changes in average selenium concentrations in water
34 at both modeled Export Service Area assessment locations relative to baseline conditions (Appendix
35 8M, Table M-10B). These small changes are reflected in small percent changes (10% or less) in
36 available assimilative capacity for selenium for all years (Figures 8-59 and 8-60) and generally
37 would have a small positive effect on the Export Service Area locations. Relative to Existing
38 Conditions, Alternative 4, Scenarios H1, H2, H3, and H4 would result in modeled increases in
39 assimilative capacity at Banks PP (5%, 4%, 5%, and 4%, respectively) and at Jones PP (7%, 8%, 8%,
40 and 8%, respectively). Relative to the No Action Alternative, Alternative 4, Scenarios H1, H2, H3, and
41 H4 would result in modeled increases in assimilative capacity at Banks PP (5%, 4%, 4%, and 4%,
42 respectively) and at Jones PP (8%, 9%, 9%, and 9%, respectively). The modeled selenium
43 concentrations in water (Appendix 8M, Table M-10B) for Existing Conditions (range 0.37–0.58
44 µg/L), No Action Alternative (range 0.37–0.59 µg/L), Alternative 4, Scenarios H1 (range 0.37–0.47

1 µg/L), H2 (range 0.37–0.46 µg/L), H3 (range 0.37–0.47 µg/L), and H4 (range 0.37–0.46 µg/L) are all
2 similar, and all would be below the ecological risk benchmark (2 µg/L).

3 Relative to baseline conditions for Export Service Areas, all scenarios under Alternative 4 would
4 result in small changes in estimated selenium concentrations in biota (Appendix 8M, Table M-15A
5 through M-15D). Relative to Existing Conditions and No Action Alternative, the largest increase of
6 selenium concentrations in biota, under all scenarios, would be at Banks PP for drought years
7 (except for bird eggs [assuming a fish diet] at Banks PP for all years). Relative to Existing Conditions,
8 under all scenarios, the largest decrease would be at Jones PP for all years (except for bird eggs
9 (assuming a fish diet) at Jones PP for drought years). Relative to the No Action Alternative, the
10 largest decreases in estimated selenium concentrations in biota for each scenario are provided
11 below.

- 12 • Scenarios H1, H2, and H3: The largest decrease of estimated selenium concentration for biota
13 would be at Jones PP for all years (except for bird eggs (assuming a fish diet) at Jones PP for
14 drought years).
- 15 • Scenario H4: the largest decrease of selenium concentrations in all biota would be at Jones PP
16 for drought years.

17 Concentrations of selenium in biota would not exceed any benchmarks under any scenario for
18 Alternative 4 (Figures 8-61 through 8-64). Thus, relative to baseline conditions, all scenarios under
19 Alternative 4 would result in minimal changes in selenium concentrations at the Export Service Area
20 locations. Selenium concentrations in water and biota generally would decrease for Alternative 4
21 scenarios and would not exceed ecological benchmarks at either location, whereas the lower
22 benchmark for bird eggs (fish diet) would be exceeded under Existing Conditions and No Action
23 Alternative at Jones PP under drought conditions. This small positive change in selenium
24 concentrations under Alternative 4 scenarios would be expected to slightly decrease the frequency
25 with which applicable benchmarks would be exceeded or slightly improve the quality of water at the
26 Export Service Area locations, with regard to selenium.

27 **NEPA Effects:** Selenium concentrations in water and biota very slightly increase progressively from
28 Scenario H1 (smallest) to Scenario H4 (largest). However, based on the discussion above, the effects
29 on selenium (both as waterborne and as bioaccumulated in biota) from all scenarios under
30 Alternative 4 are not considered to be adverse.

31 Based on the discussion above, the effects on selenium (both as waterborne and as bioaccumulated
32 in biota) from Alternative 4 are not considered to be adverse.

33 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
34 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
35 purpose of making the CEQA impact determination for selenium. For additional details on the effects
36 assessment findings that support this CEQA impact determination, see the effects assessment
37 discussion that immediately precedes this conclusion.

38 There are no substantial point sources of selenium in watersheds upstream of the Delta, and no
39 substantial nonpoint sources of selenium in the watersheds of the Sacramento River and the eastern
40 tributaries. Nonpoint sources in the San Joaquin Valley that contribute selenium to the Delta will be
41 controlled through a TMDL developed by the Central Valley Water Board (2001) for the lower San
42 Joaquin River, established limits for the Grassland Bypass Project, and Basin Plan objectives (Central
43 Valley Water Board 2010c) and State Water Board (2010d, 2010e) that are expected to result in

1 decreasing discharges of selenium from the San Joaquin River to the Delta. Consequently, any
2 modified reservoir operations and subsequent changes in river flows under Alternative 4 scenarios,
3 relative to Existing Conditions, are expected to cause negligible changes in selenium concentrations
4 in water. Any negligible changes in selenium concentrations that may occur in the water bodies of
5 the affected environment located upstream of the Delta would not be of frequency, magnitude, and
6 geographic extent that would adversely affect any beneficial uses or substantially degrade the
7 quality of these water bodies as related to selenium.

8 Relative to Existing Conditions, modeling estimates indicate that all scenarios under Alternative 4
9 would result in essentially no change in selenium concentrations throughout the Delta.

10 Assessment of effects of selenium in the SWP and CVP Export Service Areas is based on effects on
11 selenium concentrations at the Banks and Jones pumping plants. Relative to Existing Conditions, all
12 scenarios under Alternative 4 would slightly decrease the frequency with which applicable
13 benchmarks would be exceeded or slightly improve the quality of water in selenium concentrations
14 at the Banks and Jones pumping plants locations.

15 Based on the above, selenium concentrations that would occur in water under all Alternative 4
16 scenarios would not cause additional exceedances of applicable state or federal numeric or narrative
17 water quality objectives/criteria, or other relevant water quality effects thresholds identified for
18 this assessment (Table 8-54), by frequency, magnitude, and geographic extent that would result in
19 adverse effects to one or more beneficial uses within affected water bodies. In comparison to
20 Existing Conditions, water quality conditions under all scenarios for Alternative 4 would not
21 increase levels of selenium by frequency, magnitude, and geographic extent such that the affected
22 environment would be expected to have measurably higher body burdens of selenium in aquatic
23 organisms, thereby substantially increasing the health risks to wildlife (including fish) or humans
24 consuming those organisms. Water quality conditions under these alternative scenarios with
25 respect to selenium would not cause long-term degradation of water quality in the affected
26 environment, and therefore would not result in use of available assimilative capacity such that
27 exceedances of water quality objectives/criteria would be likely and would result in substantially
28 increased risk for adverse effects to one or more beneficial uses. All scenarios under this alternative
29 would not further degrade water quality by measurable levels, on a long-term basis, for selenium
30 and, thus, cause the 303(d)-listed impairment of beneficial use to be made discernibly worse. This
31 impact is considered to be less than significant. No mitigation is required.

32 **Impact WQ-26: Effects on Selenium Concentrations Resulting from Implementation of CM2-** 33 **CM22**

34 **NEPA Effects:** In general, with the possible exception of changes in Delta hydrodynamics resulting
35 from habitat restoration, CM2–CM11 would not substantially increase selenium concentrations in
36 the water bodies of the affected environment. Modeling scenarios included assumptions regarding
37 how certain habitat restoration activities (CM2 and CM4) would affect Delta hydrodynamics, and
38 thus such effects of these restoration measures were included in the assessment of CM1 facilities
39 operations and maintenance (see Impact WQ-25).

40 However, implementation of these conservation measures may increase water residence time
41 within the restoration areas. Increased restoration area water residence times could potentially
42 increase the bioaccumulation of selenium in biota, thereby potentially increasing fish tissue and bird
43 egg concentrations of selenium, but models are not available to quantitatively estimate the level of
44 changes in residence time and the associated selenium bioavailability. If increases in fish tissue or

1 bird egg selenium were to occur, the increases would likely be of concern only where fish tissues or
2 bird eggs are already elevated in selenium to near or above thresholds of concern. That is, where
3 biota concentrations are currently low and not approaching thresholds of concern, changes in
4 residence time alone would not be expected to cause them to then approach or exceed thresholds of
5 concern. In consideration of this factor, although the Delta as a whole is a 303(d)-listed water body
6 for selenium, and although monitoring data of fish tissue or bird eggs in the Delta are sparse, the
7 most likely areas in which biota tissues would be at levels high enough that additional
8 bioaccumulation due to increased residence time from restoration areas would be a concern are the
9 western Delta and Suisun Bay, and the South Delta in areas that receive San Joaquin River water.

10 The western Delta and Suisun Bay receive elevated selenium loads from North San Francisco Bay
11 (including San Pablo Bay, Carquinez Strait, and Suisun Bay) and from the San Joaquin River. Point
12 sources of selenium in North San Francisco Bay (i.e., refineries) that contribute selenium to Suisun
13 Bay are expected to be reduced through a TMDL under development by the San Francisco Bay Water
14 Board (San Francisco Bay Water Board 2012) that is expected to result in decreasing discharges of
15 selenium. Nonpoint sources of selenium in the San Joaquin Valley that contribute selenium to the
16 San Joaquin River, and thus the Delta and Suisun Bay, will be controlled through a TMDL developed
17 by the Central Valley Water Board (2001) for the lower San Joaquin River, established limits for the
18 Grassland Bypass Project, and Basin Plan objectives (Central Valley Water Board 2010c, d) that are
19 expected to result in decreasing discharges of selenium from the San Joaquin River to the Delta. If
20 selenium levels are not sufficiently reduced via these efforts, it is expected that the State Water
21 Board and the San Francisco Bay and Central Valley Water Boards would initiate additional actions
22 to further control sources of selenium.

23 The South Delta receives elevated selenium loads from the San Joaquin River. In contrast to Suisun
24 Bay and possibly the western Delta in the future, the South Delta lacks the overbite clam (*Corbula*
25 [*Potamocorbula*] *amurensis*), which is considered a key driver of selenium bioaccumulation in
26 Suisun Bay, due to its high bioaccumulation of selenium and its role in the benthic food web that
27 includes long-lived sturgeon. The South Delta does have *Corbicula fluminea*, another bivalve that
28 bioaccumulates selenium, but it is not as invasive as the overbite clam and thus likely makes up a
29 smaller fraction of sturgeon diet. Also, as mentioned above, nonpoint sources of selenium in the San
30 Joaquin Valley that contribute selenium to the Delta will be controlled through a TMDL developed by
31 the Central Valley Water Board (2001) for the lower San Joaquin River, established limits for the
32 Grassland Bypass Project, and Basin Plan objectives (Central Valley Water Board 2010c, d) that are
33 expected to result in decreasing discharges of selenium from the San Joaquin River to the Delta.
34 Further, if selenium levels in the San Joaquin River are not sufficiently reduced via these efforts, it is
35 expected that the State Water Board and Central Valley Water Board would initiate additional
36 TMDLs to further control nonpoint sources of selenium.

37 Wetland restoration areas will not be designed such that water flows in and does not flow out.
38 Exchange of water between the restoration areas and existing Delta channels is an important design
39 factor, since one goal of the restoration areas is to export food produced in these areas to the rest of
40 the Delta (see BDCP Chapter 3, *Conservation Strategy*, Section 3.3, Biological Goals and Objectives).
41 Thus, these areas can be thought of as “flow-through” systems. Consequently, although water
42 residence times associated with BDCP restoration could increase, they are not expected to increase
43 without bound. and selenium concentrations in the water column would not continue to build up
44 and be recycled in sediments and organisms as may be the case within a closed system.

1 However, because increases in bioavailable selenium in the habitat restoration areas are uncertain,
2 proposed avoidance and minimization measures would require evaluating risks of selenium
3 exposure at a project level for each restoration area, minimizing to the extent practicable potential
4 risk of additional bioaccumulation, and monitoring selenium levels in fish and/or wildlife to
5 establish whether, or to what extent, additional bioaccumulation is occurring. See Appendix 3B,
6 *Environmental Commitments* for a description of the environmental commitment BDCP proponents
7 are making with respect to Selenium Management; and Appendix 3.C. of the BDCP for additional
8 detail on this avoidance and minimization measure (AMM27). Data generated as part of the
9 avoidance and minimization measures will assist the State and Regional Water Boards in
10 determining whether beneficial uses are being impacted by selenium, and thus will provide the data
11 necessary to support regulatory actions (including additional TMDL development), should such
12 actions be warranted.

13 Given the factors discussed in the assessment above, any increases in bioaccumulation rates from
14 water-borne selenium that could occur in some areas as a result of increased water residence time
15 would not be of sufficient magnitude and geographic extent that any portion of the Delta would be
16 expected to have measurably higher body burdens of selenium in aquatic organisms and, therefore,
17 would not substantially increase risk for adverse effects to beneficial uses. Furthermore, although
18 the Delta is a 303(d)-listed water body for selenium, given the discussion in the assessment above, it
19 is unlikely that restoration areas would result in measurable increases in selenium in fish tissues or
20 bird eggs such that the beneficial use impairment would be made discernibly worse.

21 Because it is unlikely that substantial increases in selenium in fish tissues or bird eggs would occur
22 such that effects on aquatic life beneficial uses would be anticipated, and because of the avoidance
23 and minimization measures that are designed to further minimize and evaluate the risk of such
24 increases, the effects of WQ-26 are considered not adverse.

25 **CEQA Conclusion:** There would be no substantial, long-term increase in selenium concentrations in
26 water in the rivers and reservoirs upstream of the Delta, water in the Delta, or the waters exported
27 to the CVP and SWP service areas due to implementation of CM2–CM22 relative to Existing
28 Conditions. Waterborne selenium concentrations under this alternative would not exceed applicable
29 water quality objectives/criteria.

30 Given the factors discussed in the assessment above, any increases in bioaccumulation rates from
31 water-borne selenium that could occur in some areas as a result of increased water residence times
32 would not be of sufficient magnitude and geographic extent that any portion of the Delta would be
33 expected to have measurably higher body burdens of selenium in aquatic organisms, and therefore
34 would not substantially increase risk for adverse effects to beneficial uses. CM2-22 would not cause
35 long-term degradation of water quality resulting in sufficient use of available assimilative capacity
36 such that occasionally exceeding water quality objectives/criteria would be likely. Also, CM2-22
37 would not result in substantially increased risk for adverse effects to any beneficial uses.
38 Furthermore, although the Delta is a 303(d)-listed water body for selenium, given the discussion in
39 the assessment above, it is unlikely that restoration areas would result in measurable increases in
40 selenium in fish tissues or bird eggs such that the beneficial use impairment would be made
41 discernibly worse.

42 Since it is unlikely that substantial increases in selenium in fish tissues or bird eggs would occur
43 such that effects on aquatic life beneficial uses would be anticipated, and because of the avoidance
44 and minimization measures that are designed to further minimize and evaluate the risk of such

1 increases (see Appendix 3.C. of the BDCP for more detail on AMM27) as well as the Selenium
 2 Management environmental commitment (see Appendix 3B, *Environmental Commitments*), this
 3 impact is considered less than significant. No mitigation is required.

4 **Impact WQ-27: Effects on Trace Metal Concentrations Resulting from Facilities Operations** 5 **and Maintenance (CM1)**

6 *Upstream of the Delta*

7 Relative to Existing Conditions and the No Action Alternative, under Alternative 4, Scenarios H1–H4,
 8 sources of trace metals would not be expected to change substantially with exception to sources
 9 related to population growth, such as increased municipal wastewater discharges and development
 10 contributing to increased urban dry and wet weather runoff. Facility operations could have an effect
 11 on these sources if concentrations of dissolved metals were closely correlated to river flow,
 12 suggesting that changes in river flow, and the related capacity to dilute these sources, could
 13 ultimately have a substantial effect on long-term metals concentrations.

14 On the Sacramento River, available dissolved trace metals data and river flow at Freeport are poorly
 15 associated (Appendix 8N, Figure 1). Similarly, dissolved copper, iron, and manganese concentrations
 16 on the San Joaquin River at Vernalis are poorly associated (Appendix 8N, Figure 2). While there is an
 17 insufficient number of data for the other trace metals to observe trends at Vernalis, it is reasonable
 18 to assume that these metals similarly show poor association to San Joaquin River flow, as shown for
 19 the corresponding dissolved metals on the Sacramento River.

20 Given the poor association of dissolved trace metal concentrations with flow, river flow rate and
 21 reservoir storage reductions that would occur under Alternative 4, Scenarios H1–H4, relative to
 22 Existing Conditions and the No Action Alternative, would not be expected to result in a substantial
 23 adverse change in trace metal concentrations in the reservoirs and rivers upstream of the Delta. As
 24 such, the Alternative 4, Scenarios H1–H4, would not be expected to substantially increase the
 25 frequency with which applicable Basin Plan objectives or CTR criteria would be exceeded in water
 26 bodies of the affected environment located upstream of the Delta or substantially degrade the
 27 quality of these water bodies, with regard to trace metals.

28 *Delta*

29 For metals of primarily aquatic life concern (copper, cadmium, chromium, lead, nickel, silver, and
 30 zinc), average and 95th percentile trace metal concentrations of the primary source waters to the
 31 Delta are very similar, with difference typically not greater than a factor of 2 to 5 (Appendix 8N,
 32 Table 1-7). For example, average dissolved copper concentrations on the Sacramento River, San
 33 Joaquin River, and Bay (Martinez) are 1.7 µg/L, 2.4 µg/L, and 1.7 µg/L, respectively. The 95th
 34 percentile dissolved copper concentrations on the Sacramento River, San Joaquin River, and Bay
 35 (Martinez) are 3.4 µg/L, 4.5 µg/L, and 2.4 µg/L, respectively. Given this similarity, very large
 36 changes in source water fraction would be necessary to effect a relatively small change in trace
 37 metal concentration at a particular Delta location. Moreover, average and 95th percentile trace metal
 38 concentrations for these primary source waters are all below their respective water quality criteria,
 39 including those that are hardness-based without a WER adjustment (Tables 8-51 and 8-52). No
 40 mixing of these three source waters could result in a metal concentration greater than the highest
 41 source water concentration, and given that the average and 95th percentile source water
 42 concentrations for copper, cadmium, chromium, led, nickel, silver, and zinc do not exceed their

1 respective criteria, more frequent exceedances of criteria in the Delta would not occur under the
2 operational scenario for this alternative.

3 For metals of primarily human health and drinking water concern (arsenic, iron, manganese),
4 average and 95th percentile concentrations are also very similar (Appendix 8N, Table 8-10). The
5 arsenic criterion was established to protect human health from the effects of long-term chronic
6 exposure, while secondary maximum contaminant levels for iron and manganese were established
7 as reasonable goals for drinking water quality. The primary source water average concentrations for
8 arsenic, iron, and manganese are below these criteria. No mixing of these three source waters could
9 result in a metal concentration greater than the highest source water concentration, and given that
10 the average water concentrations for arsenic, iron, and manganese do not exceed water quality
11 criteria, more frequent exceedances of drinking water criteria in the Delta would not be expected to
12 occur under this alternative.

13 Relative to Existing Conditions and the No Action Alternative, facilities operation under Alternative
14 4, Scenarios H1–H4, would result in negligible change in trace metal concentrations throughout the
15 Delta. The operational scenarios of Alternative 4 would not be expected to substantially increase the
16 frequency with which applicable Basin Plan objectives or CTR criteria would be exceeded in the
17 Delta or substantially degrade the quality of water in the Delta, with regard to trace metals.

18 ***SWP/CVP Export Service Areas***

19 Alternative 4, Scenarios H1–H4, would not result in substantial increases in trace metal
20 concentrations in the water exported from the Delta or diverted from the Sacramento River through
21 the proposed conveyance facilities. As such, there is not expected to be substantial changes in trace
22 metal concentrations in the SWP/CVP export service area waters under any operational scenario of
23 Alternative 4, relative to Existing Conditions or the No Action Alternative. As such, Alternative 4,
24 Scenarios H1–H4, would not be expected to substantially increase the frequency with which
25 applicable Basin Plan objectives or CTR criteria would be exceeded in the water bodies of the
26 affected environment in the SWP and CVP Service Area or substantially degrade the quality of these
27 water bodies, with regard to trace metals.

28 ***NEPA Effects:*** In summary, relative to the No Action Alternative, Alternative 4, Scenarios H1–H4,
29 would not cause a substantial increase in long-term average trace metals concentrations within the
30 affected environment, nor would it cause an increased frequency of water quality objective/criteria
31 exceedances within the affected environment. The effect on trace metals is determined not to be
32 adverse.

33 ***CEQA Conclusion:*** Key findings discussed in the effects assessment relative to Existing Conditions is
34 provided above are summarized here, and are then compared to the CEQA thresholds of significance
35 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this
36 constituent. For additional details on the effects assessment findings that support this CEQA impact
37 determination, see the effects assessment discussion that immediately precedes this conclusion.

38 While greater water demands under the operational scenarios of Alternative 4 would alter the
39 magnitude and timing of reservoir releases north, south and east of the Delta, these activities would
40 have no substantial effect on the various watershed sources of trace metals. Moreover, long-term
41 average flow and trace metals at Sacramento River at Hood and San Joaquin River at Vernalis are
42 poorly correlated; therefore, changes in river flows would not be expected to cause a substantial
43 long-term change in trace metal concentrations upstream of the Delta.

1 Average and 95th percentile trace metal concentrations are very similar across the primary source
2 waters to the Delta. Given this similarity, very large changes in source water fraction would be
3 necessary to effect a relatively small change in trace metal concentration at a particular Delta
4 location. Moreover, average and 95th percentile trace metal concentrations for these primary source
5 waters are all below their respective water quality criteria, including those that are hardness-based
6 without a WER adjustment. No mixing of these three source waters could result in a metal
7 concentration greater than the highest source water concentration, and given that trace metals do
8 not already exceed water quality criteria, more frequent exceedances of criteria in the Delta would
9 not be expected to occur under any operational scenario of Alternative 4.

10 The assessment of Alternative 4, Scenario H1–H4, effects on trace metals in the SWP/CVP Export
11 Service Areas is based on assessment of changes in trace metal concentrations at Banks and Jones
12 pumping plants. As just discussed regarding similarities in Delta source water trace metal
13 concentrations, no operational scenario of Alternative 4 is expected to result in substantial changes
14 in trace metal concentrations in Delta waters, including Banks and Jones pumping plants, therefore
15 effects on trace metal concentrations in the SWP/CVP Export Service Area are expected to be
16 negligible.

17 Based on the above, there would be no substantial long-term increase in trace metal concentrations
18 in the rivers and reservoirs upstream of the Delta, in the Delta Region, or the SWP/CVP export
19 service area waters under any operational scenario of Alternative 4 relative to Existing Conditions.
20 As such, this alternative is not expected to cause additional exceedance of applicable water quality
21 objectives by frequency, magnitude, and geographic extent that would cause adverse effects on any
22 beneficial uses of waters in the affected environment. Because trace metal concentrations are not
23 expected to increase substantially, no long-term water quality degradation for trace metals is
24 expected to occur and, thus, no adverse effects to beneficial uses would occur. Furthermore, any
25 negligible changes in long-term trace metal concentrations that may occur in water bodies of the
26 affected environment would not be expected to make any existing beneficial use impairments
27 measurably worse. The trace metals discussed in this assessment are not considered
28 bioaccumulative, and thus would not directly cause bioaccumulative problems in aquatic life or
29 humans. This impact is considered to be less than significant. No mitigation is required.

30 **Impact WQ-28: Effects on Trace Metal Concentrations Resulting from Implementation of** 31 **CM2–CM22**

32 **NEPA Effects:** Implementation of CM2–CM22 present no new sources of trace metals to the affected
33 environment, including areas upstream of the Delta, within the Delta, or in the SWP and CVP service
34 areas. However, CM19, which would fund projects to contribute to reducing pollutant discharges in
35 urban stormwater, would be expected to reduce trace metal loading to surface waters of the affected
36 environment. The remaining conservation measures would not be expected to affect trace metal
37 levels, because they are actions that do not affect the presence of trace metal sources. As they
38 pertain to trace metals, implementation of these conservation measures would not be expected to
39 adversely affect beneficial uses of the affected environment or substantially degrade water quality
40 with respect to trace metals.

41 In summary, implementation of CM2–CM22 under Alternative 4 relative to Existing Conditions and
42 the No Action Alternative, would have negligible, if any, effect on trace metals concentrations. The
43 effect on trace metals from implementing CM2–CM22 is determined not to be adverse.

1 **CEQA Conclusion:** Implementation of CM2–CM22 under Alternative 4 would not cause substantial
2 long-term increase in trace metal concentrations in the rivers and reservoirs upstream of the Delta,
3 in the Delta Region, or the SWP/CVP export service area. As such, this alternative is not expected to
4 cause additional exceedance of applicable water quality objectives by frequency, magnitude, and
5 geographic extent that would cause adverse effects on any beneficial uses of waters in the affected
6 environment. Because trace metal concentrations are not expected to increase substantially, no
7 long-term water quality degradation for trace metals is expected to occur and, thus, no adverse
8 effects to beneficial uses would occur. Furthermore, any negligible changes in long-term trace metal
9 concentrations that may occur throughout the affected environment would not be expected to make
10 any existing beneficial use impairments measurably worse. The trace metals discussed in this
11 assessment are not considered bioaccumulative, and thus would not directly cause bioaccumulative
12 problems in aquatic life or humans. This impact is considered to be less than significant. No
13 mitigation is required.

14 **Impact WQ-29: Effects on TSS and Turbidity Resulting from Facilities Operations and**
15 **Maintenance (CM1)**

16 ***Upstream of the Delta***

17 TSS concentrations and turbidity levels in rivers upstream of the Delta are affected primarily by: 1)
18 TSS concentrations and turbidity levels of the water released from the upstream reservoirs, 2)
19 erosion occurring within the river channel beds, which is affected by river flow velocity and bank
20 protection, 3) TSS concentrations and turbidity levels of tributary inflows, point-source inputs, and
21 nonpoint runoff as influenced by surrounding land uses; and 4) phytoplankton, zooplankton and
22 other biological material in the water.

23 Alternative 4, Scenarios H1–H4, would alter the magnitude and timing of water releases from
24 reservoirs upstream of the Delta relative to Existing Conditions and the No Action Alternative, which
25 in turn would alter downstream river flows. With respect to TSS and turbidity, an increase in river
26 flow is generally the concern, as this increases shear stress on the channel, suspending particles
27 resulting in higher TSS concentrations and turbidity levels. Schoellhamer et al. (2007b) noted that
28 suspended sediment concentration was more affected by season than flow, with the higher
29 concentrations for a given flow rate occurring during “first flush events” and lower concentrations
30 occurring during spring snowmelt events. Because of such a relationship, the changes in mean
31 monthly average river flows under the operational scenarios of Alternative 4 are not expected to
32 cause river TSS concentrations or turbidity levels (highs, lows, typical conditions) to be outside the
33 ranges occurring under Existing Conditions or the No Action Alternative. Consequently, this
34 alternative is expected to have minimal effect on TSS concentrations and turbidity levels in the
35 reservoirs and rivers upstream of the Delta.

36 Changes in land use that would occur relative to Existing Conditions and the No Action Alternative
37 could have minor effects on TSS concentrations and turbidity levels throughout this portion of the
38 affected environment. Site-specific and temporal exceptions may occur due to localized temporary
39 construction activities, dredging activities, development, or other land use changes. These localized
40 actions would generally require agency permits that would regulate and limit both their short-term
41 and long-term effects on TSS concentrations and turbidity levels to less-than-substantial levels.

1 **Delta**

2 TSS concentrations and turbidity levels in Delta waters are affected by TSS concentrations and
3 turbidity levels of the Delta inflows (and associated sediment load). TSS concentrations and
4 turbidity levels within Delta waters also are affected by fluctuation in flows within the channels due
5 to the tides, with sediments depositing as flow velocities and turbulence are low at periods of slack
6 tide, and sediments becoming suspended when flow velocities and turbulence increase when tides
7 are near the maximum. TSS and turbidity variations can also be attributed to phytoplankton,
8 zooplankton and other biological material in the water.

9 Under Alternative 4, Scenarios H1–H4, any land use changes that may occur under this alternative
10 would not be expected to have permanent, substantial effects on TSS concentrations and turbidity
11 levels of Delta waters, relative to Existing Conditions or the No Action Alternative. Furthermore, this
12 alternative would not cause the TSS concentrations or turbidity levels in the rivers contributing
13 inflows to the Delta to be outside the ranges occurring under Existing Conditions or the No Action
14 Alternative. Consequently, this alternative is expected to have minimal effect on TSS concentrations
15 and turbidity levels in the Delta region. As such, any minor TSS and turbidity changes that may occur
16 under Alternative 4, Scenarios H1–H4, would not be of sufficient frequency, magnitude, and
17 geographic extent that would result in adverse effects on beneficial uses in the Delta region, or
18 substantially degrade the quality of these water bodies, with regard to TSS and turbidity.

19 **SWP/CVP Export Service Areas**

20 The operational scenarios of Alternative 4 are expected to have minimal effect on TSS
21 concentrations and turbidity levels in Delta waters, including water exported at the south Delta
22 pumps, relative to Existing Conditions or the No Action Alternative. As such, Alternative 4 is
23 expected to have minimal effect on TSS concentrations and turbidity levels in the SWP/CVP Export
24 Service Areas waters.

25 **NEPA Effects:** The effects on TSS and turbidity from implementing any operational scenario of
26 Alternative 4 is determined to not be adverse.

27 **CEQA Conclusion:** Key findings discussed in the effects assessment relative to Existing Conditions is
28 provided above are summarized here, and are then compared to the CEQA thresholds of significance
29 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this
30 constituent. For additional details on the effects assessment findings that support this CEQA impact
31 determination, see the effects assessment discussion that immediately precedes this conclusion.

32 Changes in river flow rate and reservoir storage that would occur under the operational scenarios of
33 Alternative 4, relative to Existing Conditions, would not be expected to result in a substantial
34 adverse change in TSS concentrations and turbidity levels in the reservoirs and rivers upstream of
35 the Delta, given that suspended sediment concentrations are more affected by season than flow.
36 Site-specific and temporal exceptions may occur due to localized temporary construction activities,
37 dredging activities, development, or other land use changes would be site-specific and temporal,
38 which would be regulated to limit both their short-term and long-term effects on TSS and turbidity
39 levels to less than substantial levels.

40 Within the Delta, geomorphic changes associated with sediment transport and deposition are
41 usually gradual, occurring over years, and high storm event inflows would not be substantially
42 affected. Thus, it is expected that the TSS concentrations and turbidity levels in the affected channels
43 would not be substantially different from the levels under Existing Conditions. Consequently, this

1 alternative is expected to have minimal effect on TSS concentrations and turbidity levels in the Delta
2 region, relative to Existing Conditions.

3 There is not expected to be substantial, if even measurable, changes in TSS concentrations and
4 turbidity levels in the SWP/CVP Export Service Areas waters under any operational scenario of
5 Alternative 4, relative to Existing Conditions, because as stated above, this alternative is not
6 expected to result in substantial changes in TSS concentrations and turbidity levels at the south
7 Delta export pumps, relative to Existing Conditions.

8 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
9 objectives where such objectives are not exceeded under Existing Conditions. Because TSS
10 concentrations and turbidity levels are not expected to be substantially different, long-term water
11 quality degradation is not expected, and, thus, beneficial uses are not expected to be adversely
12 affected. Finally, TSS and turbidity are neither bioaccumulative nor Clean Water Act section 303(d)
13 listed constituents. This impact is considered to be less than significant. No mitigation is required.

14 **Impact WQ-30: Effects on TSS and Turbidity Resulting from Implementation of CM2–CM22**

15 **NEPA Effects:** Creation of habitat and open water through implementation of CM2–CM11 could
16 affect Delta hydrodynamics and, thus, erosion and deposition potential in certain Delta channels.
17 The magnitude of increases in TSS concentrations and turbidity levels in the affected channels due
18 to higher potential of erosion cannot be readily quantified. The increases in TSS concentrations and
19 turbidity levels in the affected channels could be substantial in localized areas, depending on how
20 rapidly the Delta hydrodynamics are altered and the channels equilibrate with the new tidal flux
21 regime, after implementation of this alternative. However, geomorphic changes associated with
22 sediment transport and deposition are usually gradual, occurring over years. Within the
23 reconfigured channels there could be localized increases in TSS concentrations and turbidity levels,
24 but within the greater Plan Area it is expected that the TSS concentrations and turbidity levels
25 would not be substantially different from the levels under the No Action Alternative.

26 CM19, which would fund projects to contribute to reducing pollutant discharges in stormwater,
27 would be expected to reduce TSS and turbidity in urban discharges relative to the No Action
28 Alternative. The remaining conservation measures would not be expected to affect TSS
29 concentrations and turbidity levels, because they are actions that do not affect the presence of TSS
30 and turbidity sources.

31 The effects on TSS and turbidity from implementing CM2–CM22 is determined to not be adverse.

32 **CEQA Conclusion:** It is expected that the TSS concentrations and turbidity levels Upstream of the
33 Delta, in the Plan Area, and the SWP/CVP Export Service Areas due to implementation of CM2–CM22
34 under Alternative 4 would not be substantially different relative to Existing Conditions, except
35 within localized areas of the Delta modified through creation of habitat and open water. Therefore,
36 this alternative is not expected to cause additional exceedance of applicable water quality objectives
37 where such objectives are not exceeded under Existing Conditions. Because TSS concentrations and
38 turbidity levels Upstream of the Delta, in the greater Plan Area, and in the SWP/CVP Export Service
39 Areas are not expected to be substantially different, long-term water quality degradation is not
40 expected relative to TSS and turbidity, and, thus, beneficial uses are not expected to be adversely
41 affected. Finally, TSS and turbidity are neither bioaccumulative nor Clean Water Act section 303(d)
42 listed constituents. This impact is considered to be less than significant. No mitigation is required.

1 **Impact WQ-31: Water Quality Effects Resulting from Construction-Related Activities (CM1-** 2 **CM22)**

3 This section addresses construction-related water quality effects to constituents of concern other
4 than effects caused by changes in the operations and maintenance of CM1–CM22, which are
5 addressed in terms of constituent-specific impact assessments elsewhere in this chapter. The
6 conveyance features for CM1 under Alternative 4 would be very similar to those discussed for
7 Alternative 1A and most of the construction activity would occur in the Delta. The primary
8 difference between Alternative 4 and Alternative 1A is that under Alternative 4, there would be two
9 fewer intakes and two fewer pumping plant locations, which would result in a reduced level of
10 construction activity. However, construction techniques and locations of major features of the
11 conveyance system within the Delta would be similar. Alternative 4 additionally would include
12 construction of an operable barrier at the head of Old River. The remainder of the facilities
13 constructed under Alternative 4, including CM2–CM22, would be very similar to, or the same as,
14 those to be constructed for Alternative 1A. Few, if any, of the CM1–CM22 actions involve
15 construction work in the SWP and CVP Service Area or areas upstream of the Delta. The
16 conservation measures, or components of measures, that are anticipated to be constructed in areas
17 upstream of the Delta would be limited to: (1) the Yolo Bypass Fishery Enhancement (CM2) (i.e., the
18 Fremont Weir component of the action), (2) Conservation Hatcheries (CM18) (i.e., the new hatchery
19 facility), and (3) Urban Stormwater Treatment (CM19). Anticipated construction activities that may
20 occur under CM11–CM22, if any, would involve relatively minor disturbances, and thus would not be
21 anticipated to result in substantial discharges of any constituents of concern.

22 Within the Delta, the construction-related activities for Alternative 4 would be most extensive for
23 CM1 involving the new water conveyance facilities. Construction of water conveyance facilities
24 would involve vegetation removal, material storage and handling, excavation, overexcavation for
25 facility foundations, surface grading, trenching, road construction, levee construction, construction
26 site dewatering, soil stockpiling, RTM dewatering basin construction and storage operations, and
27 other general facility construction activities (i.e., concrete, steel, carpentry, and other building
28 trades) over approximately 7,500 acres during the course of constructing the facilities. Vegetation
29 would be removed (via grubbing and clearing) and grading and other earthwork would be
30 conducted at the intakes, pumping plants, the intermediate forebay, the expanded Clifton Court
31 Forebay, culvert siphon between the northern cell of the expanded Clifton Court Forebay to a new
32 canal to the Jones Pumping Plant and a siphon under the Byron Highway into a short segment of
33 canal leading to the Banks Pumping Plant, borrow areas, RTM and spoil storage areas, setback and
34 transition levees, sedimentation basins, solids handling facilities, transition structures, surge shafts
35 and towers, substations, transmission line footings, access roads, concrete batch plants, fuel stations,
36 bridge abutments, barge unloading facilities, and laydown areas. Construction of each intake would
37 take nearly 4 years to complete.

38 Construction activities necessary to develop the new habitat restoration areas for CM2 and CM4–
39 CM10 including restored tidal wetlands, floodplain, and related channel margin and off-channel
40 habitats, would likely involve a variety of extensive conventional clearing and grading activities on
41 relatively dry sites of the Delta that are currently separated from the Delta channels by levees.
42 Construction would involve new setback levees, excavation and soil placement for new wetland and
43 other habitat feature development, and a variety of potential in-water construction activities such as
44 excavation, sediment dredging, levee breaching, and hauling and placement or disposal of excavated
45 sediment or dredge material. Construction activities for the proposed restoration sites, due to the
46 direct connectivity with Delta channels, have the potential to result in direct discharge of eroded soil

1 and construction-related contaminants, or indirectly through erosion and site inundation during the
2 weeks or months following construction prior to stabilization of newly contoured and restored
3 landforms and colonization by vegetation.

4 **NEPA Effects:** The types and magnitude of potential construction-related water quality effects
5 associated with implementation of CM1–CM22 under Alternative 4 would be very similar to the
6 effects discussed for Alternative 1A, and the effects anticipated with implementation of CM2–CM22
7 would be essentially identical. Potential construction-related water quality effects may include
8 discharges of turbidity/TSS due to the erosion of disturbed soils and associated sedimentation
9 entering surface water bodies or other construction-related wastes (e.g., concrete, asphalt, cleaning
10 agents, paint, and trash). Construction activities also may result in temporary or permanent changes
11 in stormwater generation or drainage and runoff patterns (i.e., velocity, volume, and direction) that
12 may cause or contribute to soil erosion and offsite sedimentation, such as creation of additional
13 impervious surfaces (e.g., pavement, buildings, compacted soils), blockage or restriction of existing
14 drainage channels, or general surface drainage changes from grading and excavation activity.
15 Additionally, the use of heavy earthmoving equipment may result in spills and leakage of oils,
16 gasoline, diesel fuel, and related petroleum contaminants used in the fueling and operation of such
17 construction equipment.

18 Land surface grading and excavation activities, or exposure of disturbed sites immediately following
19 construction and prior to stabilization, could result in rainfall- and stormwater-related soil erosion,
20 runoff, and offsite sedimentation in surface water bodies. The initial runoff following construction,
21 or return of seasonal rains to previously disturbed sites, can result in runoff with peak pollutant
22 levels and is referred to as “first flush” storm events. Soil erosion and runoff can also result in
23 increased concentrations and loading of organic matter, nutrients (nitrogen and phosphorus), and
24 other contaminants contained in the soil such as trace metals, pesticides, or animal-related
25 pathogens. Graded and exposed soils also can be compacted by heavy machinery, resulting in
26 reduced infiltration of rainfall and runoff, thus increasing the rate of runoff (and hence
27 contaminants) to downstream water bodies.

28 Construction activities also would be anticipated to involve the transport, handling, and use of a
29 variety of hazardous substances and non-hazardous materials that may adversely affect water
30 quality if discharged inadvertently to construction sites or directly to water bodies. Typical
31 construction-related contaminants include petroleum products for refueling and maintenance of
32 machinery (e.g., fuel, oils, solvents), concrete, paints and other coatings, cleaning agents, debris and
33 trash, and human wastes. Construction activities also would involve large material storage and
34 laydown areas, and occasional accidental spills of hazardous materials stored and used for
35 construction may occur. Contaminants released or spilled on bare soil also may result in
36 groundwater contamination. Dewatering operations may contain elevated levels of suspended
37 sediment or other constituents that may cause water quality degradation.

38 The intensity of construction activity along with the fate and transport characteristics of the
39 chemicals used, would largely determine the magnitude, duration, and frequency of construction-
40 related discharges and resulting concentrations and degradation associated with the specific
41 constituents of concern. The potential water quality concerns associated with the major categories
42 of contaminants that might be discharged as a result of construction activity include the following.

- 43 • Suspended sediment: May increase turbidity (i.e., reduce water clarity) that can affect aquatic
44 organisms and increase the costs and effort of removal in municipal/industrial water supplies.

1 Downstream sedimentation can affect aquatic habitat, or cause a nuisance if it affects functions
2 of agricultural or municipal intakes, or boat navigation.

- 3 • Organic matter: May contribute turbidity and oxygen demanding substances (i.e., reduce
4 dissolved oxygen levels) that can affect aquatic organisms. Organic carbon may increase the
5 potential for disinfection byproduct formation in municipal drinking water supplies.
- 6 • Nutrients: May contribute nitrogen, phosphorus, and other key nutrients that can contribute to
7 nuisance biostimulation of algae and vascular aquatic plants, which may affect municipal water
8 supplies, recreation, aquatic life, and aesthetics.
- 9 • Petroleum hydrocarbons: May contribute toxic compounds to aquatic life, and oily sheens may
10 reduce oxygen/gas transfer in water, foul aquatic habitats, and reduce water quality for
11 municipal supplies, recreation, and aesthetics.
- 12 • Trace constituents (metals, pesticides, synthetic organic compounds): Compounds in eroded soil
13 or construction-related materials (e.g., paints, coatings, cleaning agents) may be toxic to aquatic
14 life.
- 15 • Pathogens: Bacteria, viruses, and protozoans may affect aquatic life and increase human health
16 risks via municipal water supplies, reduced recreational water quality, or contaminated shellfish
17 beds.
- 18 • Other inorganic compounds: Construction-related materials can contain inorganic compounds
19 such as acidic/basic materials which can change pH and may adversely affect aquatic life and
20 habitats. Concrete contains lime which can increase pH levels, and drilling fluids may alter pH.

21 Some construction-related contaminants, such as PAHs that may be in some fuel and oil petroleum
22 byproducts, may be bioaccumulative in aquatic and terrestrial organisms. Construction activities
23 also may disturb areas where bioaccumulative constituents are present in the soil (e.g., mercury,
24 selenium, organochlorine pesticides, PCBs, and dioxin/furan compounds), or may disturb soils that
25 contain constituents included on the Section 303(d) lists of impaired water bodies in the affected
26 environment. While the 303(d)-listed Delta channels impaired by mercury are widespread,
27 impairment by selenium, pesticides, PCBs, and dioxin/furan compounds is more limited, and there
28 are no 303(d) listings for PAH impairment. Bioaccumulation of constituents in the aquatic
29 foodchain, and 303(d)-related impaired water bodies, arise as a result of long-term loading of a
30 constituent or a pervasive and widespread source of constituent discharge (e.g., mercury). However,
31 as a result of the generally localized disturbances, and intermittent and temporary nature of
32 construction-related activities, construction would not be anticipated to result in contaminant
33 discharges of substantial magnitude or duration to contribute to long-term bioaccumulation
34 processes, or cause measureable long-term degradation such that existing 303(d) impairments
35 would be made discernibly worse or TMDL actions to reduce loading would be adversely affected.

36 The environmental commitments for construction-related water quality protection would be
37 specifically designed as a part of the final design, included in construction contracts as a required
38 element, and would be implemented for Alternative 4 to avoid, prevent, and minimize the potential
39 discharges of constituents of concern to water bodies and associated adverse water quality effects
40 and comply with state water quality regulations. Additionally, temporary and permanent changes in
41 stormwater drainage and runoff would be minimized and avoided through construction of new or
42 modified drainage facilities, as described in the Chapter 3, *Description of Alternatives*. Alternative 4
43 would include installation of temporary drainage bypass facilities, long-term cross drainage, and

1 replacement of existing drainage facilities that would be disrupted due to construction of new
2 facilities.

3 Construction-related activities under Alternative 4 would be conducted in accordance with the
4 environmental commitment to develop and implement BMPs for all activities that may result in
5 discharge of soil, sediment, or other construction-related contaminants to surface water bodies, and
6 obtain authorization for the construction activities under the State Water Board's NPDES
7 Stormwater General Permit for Stormwater Discharges Associated with Construction and Land
8 Disturbance Activities (Order No. 2009-0009-DWQ/NPDES Permit No. CAS000002). The General
9 Construction NPDES Permit requires the preparation and implementation of SWPPPs, which are the
10 principal plans within the required PRDs that identify the proposed erosion control and pollution
11 prevention BMPs that would be used to avoid and minimize construction-related erosion and
12 contaminant discharges. The development of the SWPPPs, and applicability of other provisions of
13 this General Construction Permit depends on the "risk" classification for the construction which is
14 determined based on the potential for erosion to occur as well as the susceptibility of the receiving
15 water to potential adverse effects of construction. While the determination of project risk level, and
16 planning and development of the SWPPPs and BMPs to be implemented, would be completed as a
17 part of final design and contracting for the work, the responsibility for compliance with the
18 provisions of the General Construction Permit necessitates that BMPs are applied to all disturbance
19 activities. In addition to the BMPs, the SWPPPs would include BMP inspection and monitoring
20 activities, and identify responsibilities of all parties, contingency measures, agency contacts, and
21 training requirements and documentation for those personnel responsible for installation,
22 inspection, maintenance, and repair of BMPs. The General Construction Permit contains NALs and
23 for pH and turbidity, and specifies storm event water quality monitoring to determine if
24 construction is resulting in elevated discharges of these constituents, and monitoring for any non-
25 visible contaminants determined to have been potentially released. If an NAL is determined to have
26 been exceeded, the General Construction Permit requires the discharger to conduct a construction
27 site and run-on evaluation to determine whether contaminant sources associated with the site's
28 construction activity may have caused or contributed to the exceedance and immediately implement
29 corrective actions if they are needed.

30 The BMPs that are routinely implemented in the construction industry and have proven successful
31 at reducing adverse water quality effects include, but are not limited to, the following broad
32 categories of actions (letters refer to categories of specific BMPs identified in Appendix 3B,
33 *Environmental Commitments*), for which Appendix 3B identifies specific BMPs within these
34 categories:

- 35 ● Waste Management and Spill Prevention and Response (BMP categories A.2 and A.3): Waste
36 management BMPs are designed to minimize exposure of waste materials at all construction
37 sites and staging areas such as waste collection and disposal practices, containment and
38 protection of wastes from wind and rain, and equipment cleaning measures. Spill prevention
39 and response BMPs involve planning, equipment, and training for personnel for emergency
40 event response.
- 41 ● Erosion and Sedimentation Control (BMP categories A.4 and A.5): Erosion control BMPs are
42 designed to prevent erosion processes or events including scheduling work to avoid rain events,
43 stabilizing exposed soils; minimize offsite sediment runoff; remove sediment from onsite runoff
44 before it leaves the site; and slow runoff rates across construction sites. Identification of
45 appropriate temporary and long-term seeding, mulching, and other erosion control measures as
46 necessary. Sedimentation BMPs are designed to minimize offsite sediment runoff once erosion

1 has occurred involving drainage controls, perimeter controls, detention/sedimentation basins,
2 or other containment features.

- 3 • Good Housekeeping and Non-Stormwater Discharge Management (BMP category A.6 and A.7):
4 Good housekeeping BMPs are designed to reduce exposure of construction sites and materials
5 storage to stormwater runoff including truck tire tracking control facilities; equipment washing;
6 litter and construction debris; and designated refueling and equipment inspection/maintenance
7 practices Non-stormwater discharge management BMPs involve runoff measures for
8 contaminants not directly associated with rain or wind including vehicle washing and street
9 cleaning operations.
- 10 • Construction Site Dewatering and Pipeline Testing (BMP category A.8). Dewatering BMPs
11 involve actions to prevent discharge of contaminants present in dewatering of groundwater
12 during construction, discharges of water from testing of pipelines or other facilities, or the
13 indirect erosion that may be caused by dewatering discharges.
- 14 • BMP Inspection and Monitoring (BMP category A.9): Identification of clear objectives for
15 evaluating compliance with SWPPP provisions, and specific BMP inspection and monitoring
16 procedures, environmental awareness training, contractor and agency roles and responsibilities,
17 reporting procedures, and communication protocols.

18 In addition to the Category “A” BMPs for surface land disturbances identified in the environmental
19 commitments (Appendix 3B, *Environmental Commitments*), BMPs implemented for Alternative 4
20 also would include the Category “B” BMPs for tunnel/pipeline construction that involves actions
21 primarily to avoid and minimize sediment and contaminant discharges associated with RTM
22 excavation, hauling, and RTM dewatering operations. Additionally, habitat restoration activities
23 under CM2 and CM4–CM10 would be subject to implementation of the Category “C” BMPs (In-Water
24 Construction BMPs) and Category “D” BMPs (Tidal and Wetland Restoration) designed to minimize
25 disturbance and direct discharge of turbidity/suspended solids to the water during in-water
26 construction activities. Category “E” BMPs identify general permanent post-construction actions that
27 would be implemented for all terrestrial, in-water, and habitat restoration activities and would
28 involve planning, design, and development of final site stabilization, revegetation, and drainage
29 control features.

30 Finally, acquisition of applicable environmental permits may be required for specific conservation
31 measures, which as described for the No Action Alternative, may include specific WDRs or CWA
32 Section 401 water quality certifications from the appropriate Regional Water Boards, CDFW
33 Streambed Alteration Agreements, and USACE CWA Section 404 dredge and fill permits. These other
34 permit processes may include requirements to implement additional action-specific BMPs that may
35 reduce potential adverse discharge effects of constituents of concern.

36 The potential construction-related contaminant discharges that could result from projects defined
37 under Alternative 4 would not be anticipated to result in adverse water quality effects at a
38 magnitude, frequency, or regional extent that would cause substantial adverse effects to aquatic life.
39 Relative to Existing Conditions, this assessment indicates the following.

- 40 • Projects would be managed under state water quality regulations and project-defined actions to
41 avoid and minimize contaminant discharges.
- 42 • Individual projects would generally be dispersed, and involve infrequent and temporary
43 activities, thus not likely resulting in substantial exceedances of water quality standards or long-
44 term degradation.

- 1 • Potential construction-related contaminant discharges under the Alternative 4 would not cause
2 additional exceedance of applicable water quality objectives where such objectives are not
3 exceeded under Existing Conditions. Long-term water quality degradation is not anticipated,
4 and hence would not be expected to adversely affect beneficial uses.
- 5 • By the intermittent and temporary frequency of construction-related activities and potential
6 contaminant discharges, the constituent-specific effects would not be of substantial magnitude
7 or duration to contribute to long-term bioaccumulation processes, or cause measureable long-
8 term degradation such that existing 303(d) impairments would be made discernibly worse or
9 TMDL actions to reduce loading would be adversely affected.

10 Consequently, because the construction-related activities for the conservation measures would be
11 conducted with implementation of environmental commitments, including but not limited to those
12 identified in Appendix 3B, with respect to the Existing Conditions and No Action Alternative
13 conditions, Alternative 4 would not be expected to cause constituent discharges of sufficient
14 frequency and magnitude to result in a substantial increase of exceedances of water quality
15 objectives/criteria, or substantially degrade water quality with respect to the constituents of
16 concern, and thus would not adversely affect any beneficial uses in the Delta.

17 In summary, with implementation of environmental commitments in Appendix 3B, the potential
18 construction-related water quality effects are considered to be not adverse.

19 **CEQA Conclusion:** Because environmental commitments would be implemented under Alternative 4
20 for construction-related activities along with agency-issued permits that also contain construction
21 requirements to protect water quality, the construction-related effects, relative to Existing
22 Conditions, would not be expected to cause or contribute to substantial alteration of existing
23 drainage patterns which would result in substantial erosion or siltation on- or off-site, substantial
24 increased frequency of exceedances of water quality objectives/criteria, or substantially degrade
25 water quality with respect to the constituents of concern on a long-term average basis, and thus
26 would not adversely affect any beneficial uses in water bodies upstream of the Delta, within the
27 Delta, or in the SWP and CVP service area. Moreover, because the construction-related activities
28 would be temporary and intermittent in nature, the construction would involve negligible
29 discharges, if any, of bioaccumulative or 303(d) listed constituents to water bodies of the affected
30 environment. As such, construction activities would not contribute measurably to bioaccumulation
31 of contaminants in organisms or humans or cause 303(d) impairments to be discernibly worse.
32 Based on these findings, this impact is determined to be less than significant. No mitigation is
33 required.

34 **8.4.3.10 Alternative 5—Dual Conveyance with Pipeline/Tunnel and** 35 **Intake (3,000 cfs; Operational Scenario C)**

36 Alternative 5 would comprise physical/structural components similar to those under Alternative 1A
37 with the principal exception that Alternative 5 would convey up to 3,000 cfs of water from the north
38 Delta to the south Delta. Diverted water would be conveyed through pipelines/tunnels from a single
39 screened intake (i.e., Intake 1) located on the east bank of the Sacramento River between Clarksburg
40 and Walnut Grove. Alternative 5 would include a 750 acre intermediate forebay and pumping plant.
41 A new 600 acre Byron Tract Forebay, adjacent to and south of Clifton Court Forebay, would be
42 constructed which would provide water to the south Delta pumping plants. Water supply and
43 conveyance operations would follow the guidelines described as Scenario C, which includes fall X2.

1 Conservation Measures 2–22 (CM2–22) would be implemented under this alternative, and would be
 2 the same as those under Alternative 1A with the exception of CM4, which would involve 25,000
 3 acres of tidal habitat restoration instead of 65,000 acres under the other action alternatives. See
 4 Chapter 3, *Description of Alternatives*, Section 3.5.10, for additional details on Alternative 5.

5 **Effects of the Alternative on Delta Hydrodynamics**

6 Under the No Action Alternative and Alternatives 1–9, the following two primary factors can
 7 substantially affect water quality within the Delta:

- 8 • Within the south, west, and interior Delta, a decrease in the percentage of Sacramento River-
 9 sourced water and a concurrent increase in San Joaquin River-sourced water can increase the
 10 concentrations of numerous constituents (e.g., boron, bromide, chloride, electrical conductivity,
 11 nitrate, organic carbon, some pesticides, selenium). This source water replacement is caused by
 12 decreased exports of San Joaquin River water (due to increased Sacramento River water
 13 exports), or effects of climate change on timing of flows in the rivers. Changes in channel flows
 14 also can affect water residence time and many related physical, chemical, and biological
 15 variables.
- 16 • Particularly in the west Delta, sea water intrusion as a result of sea level rise or decreased Delta
 17 outflow can increase the concentration of salts (bromide, chloride) and levels of electrical
 18 conductivity. Conversely, increased Delta outflow (e.g., as a result of Fall X2 operations in wet
 19 and above normal water years) will decrease levels of these constituents, particularly in the
 20 west Delta.

21 Under Alternative 5, over the long term, average annual delta exports are anticipated to decrease by
 22 358 TAF relative to Existing Conditions, and increase by 346 TAF relative to the No Action
 23 Alternative. Since, over the long-term, approximately 25% of the exported water will be from the
 24 new north Delta intakes, average monthly diversions at the south Delta intakes would be decreased
 25 because of the shift in diversions to the north Delta intakes (see Chapter 5, *Water Supply*, for more
 26 information). The result of this is increased San Joaquin River water influence throughout the south,
 27 west, and interior Delta, and a corresponding decrease in Sacramento River water influence. This
 28 can be seen, for example, in Appendix 8D, ALT 5–Old River at Rock Slough for ALL years (1976–
 29 1991), which shows increased San Joaquin River (SJR) percentage and decreased Sacramento River
 30 (SAC) percentage under the alternative, relative to Existing Conditions and the No Action
 31 Alternative.

32 Under Alternative 5, long-term average annual Delta outflow is anticipated to increase 401 TAF
 33 relative to Existing Conditions, due to both changes in operations (including north Delta intake
 34 capacity of 3,000 cfs and numerous other operational components of Scenario C) and climate
 35 change/sea level rise (see Chapter 5, *Water Supply*, for more information). Long-term average
 36 annual Delta outflow is anticipated to decrease under Alternative 5 by 349 TAF relative to the No
 37 Action Alternative, due only to changes in operations. The result of this is increased sea water
 38 intrusion in the west Delta. The increases in sea water intrusion (represented by an increase in San
 39 Francisco Bay (BAY) percentage) can be seen, for example, in Appendix 8D, ALT 5–Sacramento River
 40 at Mallard Island for ALL years (1976–1991).

Impact WQ-1: Effects on Ammonia Concentrations Resulting from Facilities Operations and Maintenance (CM1)

Upstream of the Delta

For the same reasons stated for the No Action Alternative, Alternative 5 would have negligible, if any, effect on ammonia concentrations in the rivers and reservoirs upstream of the Delta relative to Existing Conditions and the No Action Alternative. Any negligible increases in ammonia-N concentrations that could occur in the water bodies of the affected environment located upstream of the Delta would not be of frequency, magnitude and geographic extent that would adversely affect any beneficial uses or substantially degrade the quality of these water bodies, with regard to ammonia.

Delta

Assessment of effects of ammonia under Alternative 5 is the same as discussed under Alternative 1A, except that because flows in the Sacramento River at Freeport are different between the two alternatives, estimated monthly average and long term annual average predicted ammonia-N concentrations in the Sacramento River downstream of Freeport are different.

As Table 8-68 shows, estimated ammonia-N concentrations in the Sacramento River downstream of Freeport (upon full mixing of the SRWTP discharge with river water) under Alternative 5 and the No Action Alternative are expected to be similar. Minor increases in ammonia-N concentrations would occur during January through March, August, September, November, and December, and remaining months would be unchanged or have a minor decrease. A minor increase in the annual average concentration would occur under Alternative 5, compared to the No Action Alternative. Moreover, the estimated concentrations downstream of Freeport under Alternative 5 would be similar to existing source water concentrations for the San Francisco Bay and San Joaquin River. Consequently, changes in source water fraction anticipated under Alternative 5, relative to the No Action Alternative, are not expected to substantially increase ammonia concentrations at any Delta locations.

Table 8-68. Estimated Ammonia-N (mg-L as N) Concentrations in the Sacramento River Downstream of the Sacramento Regional Wastewater Treatment Plant for the No Action Alternative and Alternative 5

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual Average
No Action Alternative	0.074	0.084	0.069	0.060	0.057	0.060	0.058	0.064	0.067	0.060	0.067	0.064	0.065
Alternative 5	0.072	0.088	0.070	0.061	0.058	0.061	0.058	0.064	0.064	0.060	0.070	0.067	0.066

Any negligible increases in ammonia-N concentrations that could occur at certain locations in the Delta would not be of frequency, magnitude and geographic extent that would adversely affect any beneficial uses or substantially degrade the water quality at these locations, with regards to ammonia.

1 **SWP/CVP Export Service Areas**

2 The assessment of effects on ammonia in the SWP/CVP Export Service Area is based on assessment
3 of ammonia-N concentrations at Banks and Jones pumping plants. Similar to the discussion for
4 Alternative 1A, under Alternative 5 for areas of the Delta that are influenced by Sacramento River
5 water, including Banks and Jones pumping plants, ammonia-N concentrations are expected to
6 decrease, relative to Existing Conditions (in association with less diversion of water influenced by
7 the SRWTP). This decrease in ammonia-N concentrations for water exported via the south Delta
8 pumps is not expected to result in adverse effects on beneficial uses or substantially degrade water
9 quality of exported water, with regards to ammonia.

10 Furthermore, as discussed above for the Plan Area, for all areas of the Delta, including Banks and
11 Jones pumping plants, ammonia-N concentrations are not expected to be substantially different
12 under Alternative 5, relative to No Action Alternative. Any negligible increases in ammonia-N
13 concentrations that could occur at Banks and Jones pumping plants would not be of frequency,
14 magnitude and geographic extent that would adversely affect any beneficial uses or substantially
15 degrade the water quality at these locations, with regards to ammonia.

16 **NEPA Effects:** In summary, based on the discussion above, effects on ammonia from implementation
17 of CM1 are considered to be not adverse.

18 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
19 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
20 purpose of making the CEQA impact determination for this constituent. For additional details on the
21 effects assessment findings that support this CEQA impact determination, see the effects assessment
22 discussion that immediately precedes this conclusion.

23 Ammonia-N concentrations are generally low in the reservoirs and rivers of the watersheds, owing
24 to the lack of substantial point and nonpoint sources of ammonia-N upstream of the SRWTP in the
25 Sacramento River watershed, in the watersheds of the eastern tributaries (Cosumnes, Mokelumne,
26 and Calaveras Rivers), or upstream of the Delta in the San Joaquin River watershed. Consequently,
27 any modified reservoir operations and subsequent changes in river flows under Alternative 5,
28 relative to Existing Conditions, are expected to have negligible, if any, effects on reservoir and river
29 ammonia-N concentrations upstream of Freeport in the Sacramento River watershed and upstream
30 of the Delta in the San Joaquin River watershed.

31 Ammonia-N concentrations in the Sacramento River downstream of the SRWTP would be
32 substantially lower under Alternative 5, relative to Existing Conditions, due to upgrades to the
33 SRWTP that are assumed to be in place, and thus, ammonia concentrations for all areas of the Delta
34 that are influenced by Sacramento River water are expected to decrease. At locations which are not
35 influenced notably by Sacramento River water, concentrations are expected to remain relatively
36 unchanged, due to the similarity in SJR and BAY concentrations and the lack of expected changes in
37 either of these concentrations.

38 The assessment of effects on ammonia in the SWP/CVP Export Service Areas is based on assessment
39 of ammonia-N concentrations at Banks and Jones pumping plants. As discussed above for the Plan
40 Area, for areas of the Delta that are influenced by Sacramento River water, including Banks and
41 Jones pumping plants, ammonia-N concentrations are expected to decrease under Alternative 5,
42 relative to Existing Conditions.

1 Based on the above, there would be no substantial, long-term increase in ammonia-N concentrations
2 in the rivers and reservoirs upstream of the Delta, in the Plan Area, or the waters exported to the
3 CVP and SWP service areas under Alternative 5 relative to Existing Conditions. As such, this
4 alternative is not expected to cause additional exceedance of applicable water quality
5 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
6 on any beneficial uses of waters in the affected environment. Because ammonia concentrations are
7 not expected to increase substantially, no long-term water quality degradation is expected to occur
8 and, thus, no adverse effects on beneficial uses would occur. Ammonia is not 303(d) listed within the
9 affected environment and thus any minor increases that could occur in some areas would not make
10 any existing ammonia-related impairment measurably worse because no such impairments
11 currently exist. Because ammonia-N is not bioaccumulative, minor increases that could occur in
12 some areas would not bioaccumulate to greater levels in aquatic organisms that would, in turn, pose
13 substantial health risks to fish, wildlife, or humans. This impact is considered to be less than
14 significant. No mitigation is required.

15 **Impact WQ-2: Effects on Ammonia Concentrations Resulting from Implementation of CM2-**
16 **CM22**

17 *NEPA Effects:* Effects of CM2–CM22 on ammonia under Alternative 5 are the same as those
18 discussed for Alternative 1A and are considered to be not adverse.

19 *CEQA Conclusion:* Conservation Measures 2–22 proposed under Alternative 5 would be similar to
20 those proposed under Alternative 1A. As such, effects on ammonia resulting from the
21 implementation of CM2–CM22 would be similar to that previously discussed for Alternative 1A. This
22 impact is considered to be less than significant. No mitigation is required.

23 **Impact WQ-3: Effects on Boron Concentrations Resulting from Facilities Operations and**
24 **Maintenance (CM1)**

25 *Upstream of the Delta*

26 Effects of CM1 on boron under Alternative 5 in areas upstream of the Delta would be very similar to
27 the effects discussed for Alternative 1A. There would be no expected change to the sources of boron
28 in the Sacramento and east-side tributary watersheds, and resultant changes in flows from altered
29 system-wide operations would have negligible, if any, effects on the concentration of boron in the
30 rivers and reservoirs of these watersheds. The modeled long-term annual average lower San Joaquin
31 River flow at Vernalis would decrease slightly compared to Existing Conditions (in association with
32 project operations, climate change, and increased water demands) and would be similar compared
33 to the No Action Alternative considering only changes due to Alternative 5 operations. The reduced
34 flow would result in possible increases in long-term average boron concentrations of up to about
35 3% relative to the Existing Conditions (Appendix 8F, Table 24). The increased boron concentrations
36 would not increase the frequency of exceedances of any applicable objectives or criteria and would
37 not be expected to cause further degradation at measurable levels in the lower San Joaquin River,
38 and thus would not cause the existing impairment there to be discernibly worse. Consequently,
39 Alternative 5 would not be expected to cause exceedance of boron objectives/criteria or
40 substantially degrade water quality with respect to boron, and thus would not adversely affect any
41 beneficial uses of the Sacramento River, the east-side tributaries, associated reservoirs upstream of
42 the Delta, or the San Joaquin River.

1 Delta

2 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
3 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
4 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
5 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
6 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
7 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

8 Effects of CM1 on boron under Alternative 5 in the Delta would be similar to the effects discussed for
9 Alternative 1A. Relative to the Existing Conditions and No Action Alternative, Alternative 5 would
10 result in increased long-term average boron concentrations for the 16-year period modeled at
11 interior and western Delta locations (by as much as 7% at the SF Mokelumne River at Staten Island,
12 2% at the San Joaquin River at Buckley Cove, 8% at Franks Tract, and 7% at Old River at Rock
13 Slough) (Appendix 8F, Table Bo-14). This comparison to Existing Conditions reflects changes due to
14 both Alternative 5 operations (including north Delta intake capacity of 3,000 cfs and numerous
15 other operational components of Scenario C) and climate change/sea level rise. The comparison to
16 the No Action Alternative reflects changes due only to operations.

17 Implementation of tidal habitat restoration under CM4 also may contribute to increased boron
18 concentrations at western Delta assessment locations (more discussion of this phenomenon is
19 included in Section 8.3.1.3), and thus would not be anticipated to substantially affect agricultural
20 diversions which occur primarily at interior Delta locations. The long-term annual average and
21 monthly average boron concentrations, for either the 16-year period or drought period modeled,
22 would never exceed the 2,000 µg/L human health advisory objective (i.e., for children) or 500 µg/L
23 agricultural objective at any of the eleven Delta assessment locations, which represents no change
24 from the Existing Conditions and No Action Alternative (Appendix 8F, Table Bo-3A). Reductions in
25 long-term average assimilative capacity of up to 4% at interior Delta locations (i.e., Franks Tract and
26 Old River at Rock Slough) would be small with respect to the 500 µg/L agricultural objective
27 (Appendix 8F, Table Bo-15). However, because the absolute boron concentrations would still be well
28 below the lowest 500 µg/L objective for the protection of the agricultural beneficial use under
29 Alternative 5, the levels of boron degradation would not be of sufficient magnitude to substantially
30 increase the risk of exceeding objectives or cause adverse effects to municipal and agricultural water
31 supply beneficial uses, or any other beneficial uses, in the Delta (Appendix 8F, Figure Bo-4).

32 SWP/CVP Export Service Areas

33 Effects of CM1 on boron under Alternative 5 in the Delta would be similar to the effects discussed for
34 Alternative 1A. Under Alternative 5, long-term average boron concentrations would decrease by as
35 much as 11% at the Banks Pumping Plant and Jones Pumping Plant relative to the Existing
36 Conditions and No Action Alternative (Appendix 8F, Table Bo-14) as a result of export of a greater
37 proportion of low-boron Sacramento River water. Commensurate with the decrease in exported
38 boron concentrations, boron concentrations in the lower San Joaquin River may be reduced and
39 would likely alleviate or lessen any expected increase in boron concentrations at Vernalis associated
40 with flow reductions (see discussion of Upstream of the Delta), as well as locations in the Delta
41 receiving a large fraction of San Joaquin River water. Reduced export boron concentrations also may
42 contribute to reducing the existing 303(d) impairment in the lower San Joaquin River and associated
43 TMDL actions for reducing boron loading.

1 Maintenance of SWP and CVP facilities under Alternative 5 would not be expected to create new
2 sources of boron or contribute towards a substantial change in existing sources of boron in the
3 affected environment. Maintenance activities would not be expected to cause any substantial
4 increases in boron concentrations or degradation with respect to boron such that objectives would
5 be exceeded more frequently, or any beneficial uses would be adversely affected anywhere in the
6 affected environment.

7 **NEPA Effects:** In summary, relative to the No Action Alternative conditions, Alternative 5 would
8 result in relatively small increases in long-term average boron concentrations in the Delta and not
9 appreciably change boron levels in the lower San Joaquin River. However, the predicted changes
10 would not be expected to cause exceedances of applicable objectives or further measurable water
11 quality degradation, and thus would not constitute an adverse effect on water quality.

12 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
13 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
14 purpose of making the CEQA impact determination for this constituent. For additional details on the
15 effects assessment findings that support this CEQA impact determination, see the effects assessment
16 discussion that immediately precedes this conclusion.

17 Boron is not a constituent of concern in the Sacramento River watershed upstream of the Delta, thus
18 river flow rate and reservoir storage reductions that would occur under the Alternative 5, relative to
19 Existing Conditions, would not be expected to result in a substantial adverse change in boron levels.
20 Additionally, relative to Existing Conditions, Alternative 5 would not result in reductions in river
21 flow rates (i.e., less dilution) or increased boron loading such that there would be any substantial
22 increases in boron concentration upstream of the Delta in the San Joaquin River watershed.

23 Small increased boron levels predicted for interior and western Delta locations in response (i.e., up
24 to 8% increase) to a shift in the Delta source water percentages and tidal habitat restoration under
25 this alternative would not be expected to cause exceedances of objectives, or substantial
26 degradation of these water bodies. Alternative 5 maintenance also would not result in any
27 substantial increases in boron concentrations in the affected environment. Boron concentrations
28 would be reduced in water exported from the Delta to the CVP/SWP Export Service Areas, thus
29 reflecting a potential improvement to boron loading in the lower San Joaquin River.

30 Boron is not a bioaccumulative constituent, thus any increased concentrations under Alternative 5
31 would not result in adverse boron bioaccumulation effects to aquatic life or humans. Relative to
32 Existing Conditions, Alternative 5 would not result in substantially increased boron concentrations
33 such that frequency of exceedances of municipal and agricultural water supply objectives would
34 increase. The levels of boron degradation that may occur under Alternative 5 would not be of
35 sufficient magnitude to cause substantially increased risk for adverse effects to municipal or
36 agricultural beneficial uses within the affected environment. Long-term average boron
37 concentrations would decrease in Delta water exports to the SWP and CVP service area, which may
38 contribute to reducing the existing 303(d) impairment of agricultural beneficial uses in the lower
39 San Joaquin River. Based on these findings, this impact is determined to be less than significant. No
40 mitigation is required.

41 **Impact WQ-4: Effects on Boron Concentrations Resulting from Implementation of CM2–CM22**

42 **NEPA Effects:** Effects of CM2–CM22 on boron under Alternative 5 are the same as those discussed
43 for Alternative 1A and are determined to be not adverse.

1 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 5 would be similar to
 2 those proposed under Alternative 1A. As such, effects on boron resulting from the implementation
 3 of CM2–CM22 would be similar to that previously discussed for Alternative 1A. This impact is
 4 considered to be less than significant. No mitigation is required.

5 **Impact WQ-5: Effects on Bromide Concentrations Resulting from Facilities Operations and**
 6 **Maintenance (CM1)**

7 ***Upstream of the Delta***

8 Under Alternative 5 there would be no expected change to the sources of bromide in the Sacramento
 9 and eastside tributary watersheds. Bromide loading in these watersheds would remain unchanged
 10 and resultant changes in flows from altered system-wide operations under Alternative 5 would have
 11 negligible, if any, effects on the concentration of bromide in the rivers and reservoirs of these
 12 watersheds. Consequently, Alternative 5 would not be expected to adversely affect the MUN
 13 beneficial use, or any other beneficial uses, of the Sacramento River, the eastside tributaries, or their
 14 associated reservoirs upstream of the Delta.

15 Under Alternative 5, modeling indicates that long-term annual average flows on the San Joaquin
 16 River would decrease by 6%, relative to Existing Conditions, and would remain virtually the same
 17 relative to the No Action Alternative (Appendix 5A). These decreases in flow would result in
 18 possible increases in long-term average bromide concentrations of about 3%, relative to Existing
 19 Conditions and less than <1% relative to the No Action Alternative (Appendix 8E, Bromide Table
 20 22). The small increases in lower San Joaquin River bromide levels that could occur under
 21 Alternative 5, relative to existing and the No Action Alternative conditions would not be expected to
 22 adversely affect the MUN beneficial use, or any other beneficial uses, of the lower San Joaquin River.

23 ***Delta***

24 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 25 and CM4) would affect Delta hydrodynamics. To the extent that restoration actions alter
 26 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 27 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 28 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
 29 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

30 Under Alternative 5, the geographic extent of effects pertaining to long-term average bromide
 31 concentrations in the Delta would be similar to that previously described for Alternative 1A,
 32 although the magnitude of predicted long-term change and relative frequency of concentration
 33 threshold exceedances would be different. Using the mass-balance modeling approach for bromide
 34 (see Section 8.3.1.3), relative to Existing Conditions, modeled long-term average bromide
 35 concentrations would increase at Staten Island, Emmaton, and Barker Slough, while modeled long-
 36 term average bromide concentrations would decrease at the other assessment locations (Appendix
 37 8E, *Bromide*, Table 12). Overall effects would be greatest at Barker Slough, where predicted long-
 38 term average bromide concentrations would increase from 51 µg/L to 63 µg/L (23% relative
 39 increase) for the modeled 16-year hydrologic period and would increase from 54 µg/L to 98 µg/L
 40 (84% relative increase) for the modeled drought period. At Barker Slough, the predicted 50 µg/L
 41 exceedance frequency would decrease from 49% under Existing Conditions to 38% under
 42 Alternative 5, but would increase from 55% to 68% during the drought period. At Barker Slough, the
 43 predicted 100 µg/L exceedance frequency would increase from 0% under Existing Conditions to

1 18% under Alternative 5, and would increase from 0% to 38% during the drought period. In
2 contrast, increases in bromide at Staten Island would result in a 50 µg/L bromide threshold
3 exceedance increase from 47% under Existing Conditions to 67% under Alternative 5 (52% to 77%
4 during the modeled drought period). However, unlike Barker Slough, modeling shows that long-
5 term average bromide concentration at Staten Island would exceed the 100 µg/L assessment
6 threshold concentration 1% under Existing Conditions and 2% under Alternative 5 (0% to 2%
7 during the modeled drought period). The long-term average bromide concentrations would be 59
8 µg/L (62 µg/L for the modeled drought period) at Staten Island under Alternative 5. Changes in
9 exceedance frequency of the 50 µg/L and 100 µg/L concentration thresholds, as well as relative
10 change in long-term average concentration, at other assessment locations would be less substantial.
11 This comparison to Existing Conditions reflects changes in bromide due to both Alternative 5
12 operations (including north Delta intake capacity of 3,000 cfs and numerous other operational
13 components of Scenario C) and climate change/sea level rise.

14 Due to the relatively small differences between modeled Existing Conditions and No Action baseline,
15 changes in long-term average bromide concentrations and changes in exceedance frequencies
16 relative to the No Action Alternative are generally of similar magnitude to those previously
17 described for the existing condition comparison (Appendix 8E, *Bromide*, Table 12). Modeled long-
18 term average bromide concentration increases would similarly be greatest at Barker Slough, where
19 long-term average concentrations are predicted to increase by 27% (83% for the modeled drought
20 period) relative to the No Action Alternative. However, unlike the Existing Conditions comparison,
21 long-term average bromide concentrations at Buckley Cove, Rock Slough, and Contra Costa PP No. 1
22 would increase relative to No Action Alternative, although the increases would be relatively small
23 ($\leq 4\%$). Unlike the comparison to Existing Conditions, this comparison to the No Action Alternative
24 reflects changes in bromide due only to Alternative 5 operations.

25 At Barker Slough, modeled long-term average bromide concentrations for the two baseline
26 conditions are very similar (Appendix 8E, *Bromide*, Table 12). Such similarity demonstrates that the
27 modeled Alternative 5 change in bromide is almost entirely due to Alternative 5 operations, and not
28 climate change/sea level rise. Therefore, operations are the primary driver of effects on bromide at
29 Barker Slough, regardless whether Alternative 5 is compared to Existing Conditions, or compared to
30 the No Action Alternative.

31 Results of the modeling approach which used relationships between EC and chloride and between
32 chloride and bromide (see Section 8.3.1.3) differed somewhat from what is presented above for the
33 mass-balance approach (see Appendix 8E, *Bromide*, Table 13). For most locations, the frequency of
34 exceedance of the 50 µg/L and 100 µg/L were similar. The greatest difference between the methods
35 was predicted for Barker Slough. The increases in frequency of exceedance of the 100 µg/L
36 threshold, relative to Existing Conditions and the No Action Alternative, were not as great using this
37 alternative EC to chloride and chloride to bromide relationship modeling approach as compared to
38 that presented above from the mass-balance modeling approach. However, there were still
39 substantial increases, resulting in 9% exceedance over the modeled period under Alternative 5, as
40 compared to 1% under Existing Conditions and 2% under the No Action Alternative. For the drought
41 period, exceedance frequency increased from 0% under Existing Conditions and the No Action
42 Alternative, to 20% under Alternative 5. Because the mass-balance approach predicts a greater level
43 of impact at Barker Slough, determination of impacts was based on the mass-balance results.

44 The increase in long-term average bromide concentrations predicted at Barker Slough, principally
45 the relative increase in 100 µg/L exceedance frequency, would result in a substantial change in

1 source water quality for existing drinking water treatment plants drawing water from the North Bay
2 Aqueduct. As discussed for Alternative 1A, drinking water treatment plants obtaining water via the
3 North Bay Aqueduct utilize a variety of conventional and enhanced treatment technologies in order
4 to achieve DBP drinking water criteria. While the implications of such a modeled change in bromide
5 at Barker Slough are difficult to predict, the substantial modeled increases could lead to adverse
6 changes in the formation of disinfection byproducts such that considerable treatment plant
7 upgrades may be necessary in order to achieve equivalent levels of health protection. Because many
8 of the other modeled locations already frequently exceed the 100 µg/L threshold under Existing
9 Conditions and the No Action Alternative, these locations likely already require treatment plant
10 technologies to achieve equivalent levels of health protection, and thus no additional treatment
11 technologies would be triggered by the small increases in the frequency of exceeding the 100 µg/L
12 threshold. Hence, no further impact on the drinking water beneficial use would be expected at these
13 locations.

14 The seasonal intakes at Mallard Slough and City of Antioch are infrequently used due to water
15 quality constraints related to sea water intrusion. On a long-term average basis, bromide at these
16 locations is in excess of 3,000 µg/L, but during seasonal periods of high Delta outflow can be <300
17 µg/L. Based on modeling using the mass-balance approach, use of the seasonal intakes at Mallard
18 Slough and City of Antioch under Alternative 5 would experience a period average increase in
19 bromide during the months when these intakes would most likely be utilized. For those wet and
20 above normal water year types where mass balance modeling would predict water quality typically
21 suitable for diversion, predicted long-term average bromide would increase from 103 µg/L to 128
22 µg/L (25% increase) at City of Antioch and would increase from 150 µg/L to 194 µg/L (30%
23 increase) at Mallard Slough relative to Existing Conditions (Appendix 8E, *Bromide*, Table 23).
24 Increases would be similar for the No Action Alternative comparison. Modeling results using the EC
25 to chloride and chloride to bromide relationships show increases during these months, but the
26 relative magnitude of the increases is much lower (Appendix 8E, *Bromide* Table 24). Regardless of
27 the differences in the data between the two modeling approaches, the decisions surrounding the use
28 of these seasonal intakes is largely driven by acceptable water quality, and thus have historically
29 been opportunistic. Opportunity to use these intakes would remain, and the predicted increases in
30 bromide concentrations at the City of Antioch and Mallard Slough intake would not be expected to
31 adversely affect MUN beneficial uses, or any other beneficial use, at these locations.

32 ***SWP/CVP Export Service Areas***

33 Under Alternative 5, improvement in long-term average bromide concentrations would occur at the
34 Banks and Jones pumping plants. Long-term average bromide concentrations for the modeled 16-
35 year hydrologic period at these locations would decrease by as much as 30% relative to Existing
36 Conditions and 20% relative to No Action Alternative. Relative change in long-term average bromide
37 concentration would be less during drought conditions ($\leq 27\%$), but would still represent
38 considerable improvement (Appendix 8E, *Bromide* Table 12). As a result, less frequent bromide
39 concentration exceedances of the 50 µg/L and 100 µg/L assessment thresholds would be predicted
40 and an overall improvement in Export Service Areas water quality would be experienced respective
41 to bromide. Commensurate with the decrease in exported bromide, an improvement in lower San
42 Joaquin River bromide would also be observed since bromide in the lower San Joaquin River is
43 principally related to irrigation water deliveries from the Delta. While the magnitude of this
44 expected lower San Joaquin River improvement in bromide is difficult to predict, the relative
45 decrease in overall loading of bromide to the Export Service Areas would likely alleviate or lessen
46 any expected increase in bromide concentrations at Vernalis (see discussion of Upstream of the

1 Delta) as well as locations in the Delta receiving a large fraction of San Joaquin River water, such as
2 much of the south Delta.

3 The discussion above is based on results of the mass-balance modeling approach. Results of the
4 modeling approach which used relationships between EC and chloride and between chloride and
5 bromide (see Section 8.3.1.3) were consistent with the discussion above, and assessment of bromide
6 using these data results in the same conclusions as are presented above for the mass-balance
7 approach (see Appendix 8E, *Bromide*, Table 13).

8 Similar to the discussion pertaining to the No Action Alternative, maintenance of SWP and CVP
9 facilities under Alternative 5 would not be expected to create new sources of bromide or contribute
10 towards a substantial change in existing sources of bromide in the affected environment.
11 Maintenance activities would not be expected to cause any substantial change in bromide such that
12 MUN beneficial uses, or any other beneficial use, would be adversely affected anywhere in the
13 affected environment.

14 **NEPA Effects:** In summary, Alternative 5 operations and maintenance, relative to the No Action
15 Alternative, would result in small increases (i.e., <1%) in long-term average bromide concentrations
16 at Vernalis related to relatively small declines in long-term average flow on the San Joaquin River.
17 However, Alternative 5 operation and maintenance activities would cause substantial degradation
18 to water quality with respect to bromide at Barker Slough, source of the North Bay Aqueduct.
19 Resultant substantial change in long-term average bromide at Barker Slough could necessitate
20 changes in water treatment plant operations or require treatment plant upgrades in order to
21 maintain DBP compliance, and thus would constitute an adverse effect on water quality. Mitigation
22 Measure WQ-5 is available to reduce these effects (implementation of this measure along with a
23 separate, non-environmental commitment as set forth in EIR/EIS Appendix 3B, *Environmental*
24 *Commitments*, relating to the potential increased treatment costs associated with bromide-related
25 changes would reduce these effects).

26 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
27 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
28 purpose of making the CEQA impact determination for this constituent. For additional details on the
29 effects assessment findings that support this CEQA impact determination, see the effects assessment
30 discussion that immediately precedes this conclusion.

31 Under Alternative 5 there would be no expected change to the sources of bromide in the Sacramento
32 and eastside tributary watersheds. Bromide loading in these watersheds would remain unchanged
33 and resultant changes in flows from altered system-wide operations under Alternative 5 would have
34 negligible, if any, effects on the concentration of bromide in the rivers and reservoirs of these
35 watersheds. However, south of the Delta, the San Joaquin River is a substantial source of bromide,
36 primarily due to the use of irrigation water imported from the southern Delta. Concentrations of
37 bromide at Vernalis are inversely correlated to net river flow. Under Alternative 5, long-term
38 average flows at Vernalis would decrease only slightly, resulting in less than substantial predicted
39 increases in long-term average bromide of about 3% relative to Existing Conditions.

40 Relative to Existing Conditions, Alternative 5 would result in small decreases in long-term average
41 bromide concentration at most Delta assessment locations, with principal exceptions being the
42 North Bay Aqueduct at Barker Slough, Staten Island, and Emmaton on the Sacramento River. Overall
43 effects would be greatest at Barker Slough, where substantial increases in long-term average
44 bromide concentrations would be predicted. The increase in long-term average bromide

1 concentrations predicted for Barker Slough would result in a substantial change in source water
2 quality to existing drinking water treatment plants drawing water from the North Bay Aqueduct.
3 These modeled increases in bromide at Barker Slough could lead to adverse changes in the
4 formation of disinfection byproducts at drinking water treatment plants such that considerable
5 water treatment plant upgrades would be necessary in order to achieve equivalent levels of drinking
6 water health protection.

7 The assessment of effects on bromide in the SWP/CVP Export Service Areas is based on assessment
8 of changes in bromide concentrations at Banks and Jones pumping plants. Under Alternative 5,
9 substantial improvement would occur at the Banks and Jones pumping plants, where predicted
10 long-term average bromide concentrations are predicted to decrease by as much as 30% relative to
11 Existing Conditions. An overall improvement in bromide-related water quality would be predicted
12 in the SWP/CVP Export Service Areas.

13 Based on the above, Alternative 5 operation and maintenance would not result in any substantial
14 change in long-term average bromide concentration upstream of the Delta. Furthermore, under
15 Alternative 5, water exported from the Delta to the SWP/CVP service area would be substantially
16 improved relative to bromide. Bromide is not bioaccumulative, therefore change in long-term
17 average bromide concentrations would not directly cause bioaccumulative problems in aquatic life
18 or humans. Additionally, bromide is not a constituent related to any 303(d) listings. Alternative 5
19 operation and maintenance activities would not cause substantial long-term degradation to water
20 quality respective to bromide with the exception of water quality at Barker Slough, source of the
21 North Bay Aqueduct. At Barker Slough, modeled long-term annual average concentrations of
22 bromide would increase by 23%, and 84% during the modeled drought period. For the modeled 16-
23 year hydrologic period the frequency of predicted bromide concentrations exceeding 100 µg/L
24 would increase from 0% under Existing Conditions to 18% under Alternative 5, while for the
25 modeled drought period, the frequency would increase from 0% to 38%. Substantial changes in
26 long-term average bromide could necessitate changes in treatment plant operation or require
27 treatment plant upgrades in order to maintain DBP compliance. The model predicted change at
28 Barker Slough is substantial and, therefore, would represent a substantially increased risk for
29 adverse effects on existing MUN beneficial uses should treatment upgrades not be undertaken. The
30 impact is considered significant.

31 Implementation of Mitigation Measure WQ-5 along with a separate, non-environmental
32 commitment relating to the potential increased treatment costs associated with bromide-related
33 changes would reduce these effects. While mitigation measures to reduce these water quality effects
34 in affected water bodies to less than significant levels are not available, implementation of
35 Mitigation Measure WQ-5 is recommended to attempt to reduce the effect that increased bromide
36 concentrations may have on Delta beneficial uses. However, because the effectiveness of this
37 mitigation measure to result in feasible measures for reducing water quality effects is uncertain, this
38 impact is considered to remain significant and unavoidable. Please see Mitigation Measure WQ-5
39 under Impact WQ-5 in the discussion of Alternative 1A.

40 In addition to and to supplement Mitigation Measure WQ-5, the BDCP proponents have incorporated
41 into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*, a separate, non-
42 environmental commitment to address the potential increased water treatment costs that could
43 result from bromide-related concentration effects on municipal water purveyor operations.
44 Potential options for making use of this financial commitment include funding or providing other
45 assistance towards implementation of the North Bay Aqueduct AIP, acquiring alternative water

1 supplies, or other actions to indirectly reduce the effects of elevated bromide and DOC in existing
 2 water supply diversion facilities. Please refer to Appendix 3B, *Environmental Commitments*, for the
 3 full list of potential actions that could be taken pursuant to this commitment in order to reduce the
 4 water quality treatment costs associated with water quality effects relating to chloride, electrical
 5 conductivity, and bromide.

6 **Mitigation Measure WQ-5: Avoid, Minimize, or Offset, as Feasible, Adverse Water Quality**
 7 **Conditions**

8 Please see Mitigation Measure WQ-5 under Impact WQ-5 in the discussion of Alternative 1A.

9 **Impact WQ-6: Effects on Bromide Concentrations Resulting from Implementation of CM2–**
 10 **CM22**

11 **NEPA Effects:** Conservation Measures 2–22 proposed under Alternative 5 would be the same as
 12 those proposed under Alternative 1A, except that 25,000 rather than 65,000 acres of tidal habitat
 13 would be restored. As discussed for Alternative 1A, implementation of the CM2–CM22 would not
 14 present new or substantially changed sources of bromide to the study area. Some conservation
 15 measures may replace or substitute for existing irrigated agriculture in the Delta. This replacement
 16 or substitution is not expected to substantially increase or present new sources of bromide. CM2–
 17 CM22 would not be expected to cause any substantial change in bromide such that MUN beneficial
 18 uses, or any other beneficial use, would be adversely affected anywhere in the affected environment.

19 In summary, implementation of CM2–CM22 under Alternative 5, relative to the No Action
 20 Alternative, would have negligible, if any, effects on bromide concentrations. The effects on bromide
 21 from implementing CM2–CM22 are determined to not be adverse.

22 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 5 would be similar to
 23 those proposed under Alternative 1A, except that 25,000 rather than 65,000 acres of tidal habitat
 24 would be restored. As discussed for Alternative 1A, implementation of the CM2–CM22 (CM2–CM22)
 25 would not present new or substantially changed sources of bromide to the study area. As such,
 26 effects on bromide resulting from the implementation of CM2–CM22 would be similar to that
 27 previously discussed for Alternative 1A. This impact is considered to be less than significant. No
 28 mitigation is required.

29 **Impact WQ-7: Effects on Chloride Concentrations Resulting from Facilities Operations and**
 30 **Maintenance (CM1)**

31 ***Upstream of the Delta***

32 Under Alternative 5 there would be no expected change to the sources of chloride in the Sacramento
 33 and eastside tributary watersheds. Chloride loading in these watersheds would remain unchanged
 34 and resultant changes in flows from altered system-wide operations would have negligible, if any,
 35 effects on the concentration of chloride in the rivers and reservoirs of these watersheds. The
 36 modeled long-term annual average flows on the lower San Joaquin River at Vernalis would decrease
 37 slightly compared to Existing Conditions and be similar compared to the No Action Alternative (as a
 38 result of climate change). The reduced flow would result in possible increases in long-term average
 39 chloride concentrations of about 2%, relative to the Existing Conditions and no change relative to No
 40 Action Alternative (Appendix 8G, Table Cl-62). Consequently, Alternative 5 would not be expected to
 41 cause exceedance of chloride objectives/criteria or substantially degrade water quality with respect

1 to chloride, and thus would not adversely affect any beneficial uses of the Sacramento River, the
2 eastside tributaries, associated reservoirs upstream of the Delta, or the San Joaquin River.

3 **Delta**

4 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
5 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
6 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
7 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
8 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
9 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

10 Relative to Existing Conditions, modeling predicts that Alternative 5 would result in similar or
11 reduced long-term average chloride concentrations for the 16-year period modeled at most of the
12 assessment locations, and, depending on modeling approach (see Section 8.3.1.3), would result in
13 increased concentrations at the North Bay Aqueduct at Barker Slough (i.e., $\leq 18\%$), Sacramento River
14 at Emmaton (i.e., $\leq 3\%$), and San Joaquin River at Staten Island (i.e., $\leq 16\%$) (Appendix 8G, *Chloride*,
15 Table CI-31 and Table CI-32). Additionally, implementation of tidal habitat restoration under CM4
16 would increase the tidal exchange volume in the Delta, and thus may contribute to increased
17 chloride concentrations in the Bay source water as a result of increased salinity intrusion. More
18 discussion of this phenomenon is included in Section 8.3.1.3. Consequently, while uncertain, the
19 magnitude of chloride increases may be greater than indicated herein and would affect the western
20 Delta assessment locations the most which are influenced to the greatest extent by the Bay source
21 water. This comparison to Existing Conditions reflects changes in chloride due to both Alternative 5
22 operations (including north Delta intake capacity of 3,000 cfs and numerous other operational
23 components of Scenario C) and climate change/sea level rise.

24 Relative to the No Action Alternative conditions, the mass balance analysis of modeling results
25 indicated that Alternative 5 would result in similar or reduced long-term average chloride
26 concentrations for the 16-year period modeled at four of the assessment locations. Chloride
27 concentrations would increase at the SF Mokelumne River at Staten Island (up to 19%) and the
28 North Bay Aqueduct at Barker Slough (up to 23%) compared to the No Action Alternative conditions
29 and increase only incrementally (3% or less) at five other stations (Appendix 8G, Table CI-31). The
30 comparison to the No Action Alternative reflects changes in chloride due only to operations.

31 The following outlines the modeled chloride changes relative to the applicable objectives and
32 beneficial uses of Delta waters.

33 *Municipal Beneficial Uses—Relative to Existing Conditions*

34 Estimates of chloride concentrations generated using EC-chloride relationships and DSM2 EC output
35 (see Section 8.3.1.3) were used to evaluate the 150 mg/L Bay-Delta WQCP objective for municipal
36 and industrial beneficial uses on a basis of the percent of years the chloride objective is exceeded for
37 the modeled 16-year period. The objective is exceeded if chloride concentrations exceed 150 mg/L
38 for a specified number of days in a given water year at both the Antioch and Contra Costa Pumping
39 Plant #1 locations. For Alternative 5, the modeled frequency of objective exceedance would
40 approximately double from 6% of years under Existing Conditions, to 13% of years under
41 Alternative 5 (Appendix 8G, Table CI-64).

1 Similarly, estimates of chloride concentrations generated using EC-chloride relationships and DSM2
2 EC output (see Section 8.3.1.3) were also used to evaluate the 250 mg/L Bay-Delta WQCP objective
3 for chloride at Contra Costa Pumping Plant #1 where daily average objectives apply. The basis for
4 the evaluation was the predicted number of days the objective was exceeded for the modeled 16-
5 year period. For Alternative 5, the modeled frequency of objective exceedance would decrease by
6 approximately one half, from 6% of modeled days under Existing Conditions, to 3% of modeled days
7 under Alternative 5 (Appendix 8G, Table Cl-63).

8 Given the limitations inherent to estimating future chloride concentrations (see Section 8.3.1.3),
9 estimation of chloride concentrations through both a mass balance approach and an EC-chloride
10 relationship approach was used to evaluate the 250 mg/L Bay-Delta WQCP objectives in terms of
11 both frequency of exceedance and use of assimilative capacity. When utilizing the mass balance
12 approach to model monthly average chloride concentrations for the 16-year period, the predicted
13 frequency of exceeding the 250 mg/L objective would decrease at the Contra Costa Canal at
14 Pumping Plant #1 (Appendix 8G, Table Cl-33 and Figure Cl-9). The frequency of exceedances would
15 increase for the 16-year period modeled at the San Joaquin River at Antioch (i.e., from 66% under
16 Existing Conditions to 72%) and Sacramento River at Mallard Island (i.e., from 85% under Existing
17 Conditions to 87%) (Appendix 8G, Table Cl-33), and would cause further degradation at Antioch in
18 March and April (i.e., maximum reduction of 45% of assimilative capacity for the 16-year period
19 modeled, and 100% reduction, or elimination of assimilative capacity, during the drought period
20 modeled) (Appendix 8G, Table Cl-35 and Figure Cl-9).

21 In comparison, when utilizing the chloride-EC relationship to model monthly average chloride
22 concentrations for the 16-year period, trends in frequency of exceedance and use of assimilative
23 capacity would be similar to that discussed when utilizing the mass balance modeling approach
24 (Appendix 8G, Table Cl-34 and Table Cl-36). However, as with Alternative 1A the modeling approach
25 utilizing the chloride-EC relationships predicted changes of lesser magnitude, where predictions of
26 change utilizing the mass balance approach were generally of greater magnitude, and thus more
27 conservative. As discussed in Section 8.3.1.3, in cases of such disagreement, the approach that
28 yielded the more conservative predictions was used as the basis for determining adverse impacts.

29 Based on the additional predicted annual and seasonal exceedances of one or both Bay Delta WQCP
30 objectives for chloride, and magnitude of associated long-term average water quality degradation in
31 the western Delta, the potential exists for substantial adverse effects on the municipal and industrial
32 beneficial uses through reduced opportunity for diversion of water with acceptable chloride levels.

33 *303(d) Listed Water Bodies—Relative to Existing Conditions*

34 With respect to the 303(d) listing for chloride in Tom Paine Slough, the monthly average chloride
35 concentrations for the 16-year period modeled at Old River at Tracy Road would generally be
36 similar compared to Existing Conditions, and thus, would not be further degraded on a long-term
37 basis (Appendix 8G, Figure Cl-10). With respect to Suisun Marsh, the monthly average chloride
38 concentrations for the 16-year period modeled would generally increase compared to Existing
39 Conditions in some months during October through May at the Sacramento River at Collinsville
40 (Appendix 8G, Figure Cl-11), Mallard Island (Appendix 8G, Figure Cl-9), and increase substantially at
41 the Montezuma Slough at Beldon's Landing (i.e., over a doubling of concentration in December
42 through February) (Appendix 8G, Figure Cl-12), thereby contributing to additional, measureable
43 long-term degradation that potentially would adversely affect the necessary actions to reduce
44 chloride loading for any TMDL that is developed.

1 *Municipal Beneficial Uses—Relative to No Action Alternative*

2 Similar to the assessment conducted for Existing Conditions, estimates of chloride concentrations
3 generated using EC-chloride relationships and DSM2 EC output (see Section 8.3.1.3) were used to
4 evaluate the 150 mg/L Bay-Delta WQCP objective for municipal and industrial beneficial uses. For
5 Alternative 5, the modeled frequency of objective exceedance would increase from 6% under the No
6 Action Alternative to 13% of years under Alternative 5 (Appendix 8G, Table CI-64).

7 Similarly, estimates of chloride concentrations generated using EC-chloride relationships and DSM2
8 EC output (see Section 8.3.1.3) were also used to evaluate the 250 mg/L Bay-Delta WQCP objective
9 for chloride at Contra Costa Pumping Plant #1 where daily average objectives apply. For Alternative
10 5, the modeled frequency of objective exceedance would decrease slightly from 5% of modeled days
11 under the No Action Alternative to 3% of modeled days under Alternative 5 (Appendix 8G, Table CI-
12 63).

13 Similar to Existing Conditions, a comparative assessment of modeling approaches was utilized to
14 evaluate the 250 mg/L Bay-Delta WQCP objectives in terms of both frequency of exceedance and use
15 of assimilative capacity on a monthly average basis. When utilizing the mass balance approach to
16 model monthly average chloride concentrations for the 16-year period, a small decrease in
17 exceedance frequency would be predicted at the San Joaquin River at Antioch (i.e., from 73% for the
18 No Action Alternative to 72%), however, available assimilative capacity would be reduced in April
19 (i.e., up to 10% for the 16 year period modeled, and 100% [i.e., eliminated] for the drought period
20 modeled) (Appendix 8G, Table CI-35). The exceedance frequency would increase slightly at the
21 Sacramento River at Mallard Island (i.e., from 86% to 87%) and at the Contra Costa Canal at
22 Pumping Plant #1 (i.e., from 14% to 18%) (Appendix 8G, Table CI-33), along with reduced
23 assimilative capacity at the Contra Costa Canal at Pumping Plant #1 in September (i.e., up to 56%),
24 reflecting substantial degradation during when average concentrations would be near, or exceed,
25 the objective (Appendix 8G, Table CI-35).

26 In comparison, when utilizing the chloride-EC relationship to model monthly average chloride
27 concentrations for the 16-year period, trends in frequency of exceedance and use of assimilative
28 capacity would be similar to that discussed when utilizing the mass balance modeling approach
29 (Appendix 8G, Table CI-34 and Table CI-36). However, as with Alternative 1A the modeling approach
30 utilizing the chloride-EC relationships predicted changes of lesser magnitude, where predictions of
31 change utilizing the mass balance approach were generally of greater magnitude, and thus more
32 conservative. As discussed in Section 8.3.1.3, in cases of such disagreement, the approach that
33 yielded the more conservative predictions was used as the basis for determining adverse impacts.

34 Based on the additional predicted annual and seasonal exceedances of one or both Bay Delta WQCP
35 objectives for chloride, and the associated long-term average water quality degradation at interior
36 and western Delta locations, the potential exists for substantial adverse effects on the municipal and
37 industrial beneficial uses through reduced opportunity for diversion of water with acceptable
38 chloride levels.

39 *303(d) Listed Water Bodies—Relative to No Action Alternative*

40 With respect to the 303(d) listing for chloride, Alternative 5 would generally result in similar
41 changes to those discussed for the comparison to Existing Conditions. Monthly average chloride
42 concentrations at Tom Paine Slough would not be further degraded on a long-term basis (Appendix
43 8G, Figure CI-10). Monthly average chloride concentrations at source water channel locations for the

1 Suisun Marsh (Appendix 8G, Figures Cl-5, Cl-7, and Cl-8) would increase substantially in some
2 months during October through May compared to the No Action Alternative conditions. Therefore,
3 additional, measureable long-term degradation would occur in Suisun Marsh that potentially would
4 adversely affect the necessary actions to reduce chloride loading for any TMDL that is developed.

5 ***SWP/CVP Export Service Areas***

6 Under Alternative 5, long-term average chloride concentrations based on the mass balance analysis
7 of modeling results for the 16-year period modeled at the Banks and Jones pumping plants would
8 decrease by as much as 29% relative to Existing Conditions and 19% compared to No Action
9 Alternative (Appendix 8G, *Chloride*, Table Cl-31). The modeled frequency of exceedances of
10 applicable water quality objectives/criteria would decrease relative to Existing Conditions and No
11 Action Alternative, for both the 16-year period and the drought period modeled (Appendix 8G,
12 *Chloride*, Table Cl-33). Consequently, water exported into the SWP/CVP service area would
13 generally be of similar or better quality with regards to chloride relative to Existing Conditions and
14 the No Action Alternative conditions.

15 Results of the modeling approach which used relationships between EC and chloride (see Section
16 8.3.1.3) were consistent with the discussion above, and assessment of chloride using these data
17 results in the same conclusions as are presented above for the mass-balance approach (Appendix
18 8G, Table Cl-32 and Table Cl-34).

19 Commensurate with the reduced chloride concentrations in water exported to the service area,
20 reduced chloride loading in the lower San Joaquin River would be anticipated which would likely
21 alleviate or lessen any expected increase in chloride at Vernalis related to decreased annual average
22 San Joaquin River flows (see discussion of Upstream of the Delta).

23 Maintenance of SWP and CVP facilities would not be expected to create new sources of chloride or
24 contribute towards a substantial change in existing sources of chloride in the affected environment.
25 Maintenance activities would not be expected to cause any substantial change in chloride such that
26 any long-term water quality degradation would occur, thus, beneficial uses would not be adversely
27 affected anywhere in the affected environment.

28 ***NEPA Effects:*** In summary, relative to the No Action Alternative conditions, Alternative 5 would
29 result in increased water quality degradation and frequency of exceedance of the 150 mg/L
30 objective at Contra Costa Pumping Plant #1 and Antioch, increased water quality degradation with
31 respect to the 250 mg/L municipal and industrial objective at interior and western Delta locations
32 on a monthly average chloride basis, and measureable water quality degradation relative to the
33 303(d) impairment in Suisun Marsh. The predicted chloride increases constitute an adverse effect
34 on water quality (see Mitigation Measure WQ-7 below; implementation of this measure along with a
35 separate, non-environmental commitment relating to the potential increased chloride treatment
36 costs would reduce these effects). Additionally, the predicted changes relative to the No Action
37 Alternative conditions indicate that in addition to the effects of climate change/sea level rise,
38 implementation of CM1 and CM4 under Alternative 5 would contribute substantially to the adverse
39 water quality effects.

40 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
41 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
42 purpose of making the CEQA impact determination for this constituent. For additional details on the

1 effects assessment findings that support this CEQA impact determination, see the effects assessment
2 discussion that immediately precedes this conclusion.

3 Chloride is not a constituent of concern in the Sacramento River watershed upstream of the Delta,
4 thus river flow rate and reservoir storage reductions that would occur under the Alternative 5,
5 relative to Existing Conditions, would not be expected to result in a substantial adverse change in
6 chloride levels. Additionally, relative to Existing Conditions, the Alternative 5 would not result in
7 reductions in river flow rates (i.e., less dilution) or increased chloride loading such that there would
8 be any substantial increase in chloride concentrations upstream of the Delta in the San Joaquin River
9 watershed.

10 Relative to Existing Conditions, the Alternative 5 would result in substantially increased chloride
11 concentrations in the Delta such that frequency of exceeding the 150 mg/L Bay-Delta WQCP
12 objective would approximately double. Moreover, the frequency of exceedance of the 250 mg/L Bay-
13 Delta WQCP objective would increase at the San Joaquin River at Antioch (by 6%) and at Mallard
14 Slough (by 2%), and long-term degradation may occur, that may result in adverse effects on the
15 municipal and industrial water supply beneficial use (see Mitigation Measure WQ-7 below;
16 implementation of this measure along with a separate, non-environmental commitment relating to
17 the potential increased chloride treatment costs would reduce these effects). Relative to the Existing
18 Conditions, the modeled increased chloride concentrations and degradation in the western Delta
19 could further contribute, at measurable levels (i.e., over a doubling of concentration), to the existing
20 303(d) listed impairment due to chloride in Suisun Marsh for the protection of fish and wildlife.

21 Chloride concentrations would be reduced in water exported from the Delta to the CVP/SWP Export
22 Service Areas, thus reflecting a potential improvement to chloride loading in the lower San Joaquin
23 River.

24 Chloride is not a bioaccumulative constituent, thus any increased concentrations under Alternative
25 5 would not result in substantial chloride bioaccumulation impacts on aquatic life or humans.
26 Alternative 5 maintenance would not result in any substantial changes in chloride concentration
27 upstream of the Delta or in the SWP/CVP Export Service Areas. However, based on these findings,
28 this impact is determined to be significant due to increased chloride concentrations and degradation
29 at western Delta locations and its effects on municipal and industrial water supply and fish and
30 wildlife beneficial uses.

31 While mitigation measures to reduce these water quality effects in affected water bodies to less than
32 significant levels are not available, implementation of Mitigation Measure WQ-7 is recommended to
33 attempt to reduce the effect that increased chloride concentrations may have on Delta beneficial
34 uses. However, because the effectiveness of this mitigation measure to result in feasible measures
35 for reducing water quality effects is uncertain, this impact is considered to remain significant and
36 unavoidable. Please see Mitigation Measure WQ-7 under Impact WQ-7 in the discussion of
37 Alternative 1A.

38 In addition to and to supplement Mitigation Measure WQ-7, the BDCP proponents have incorporated
39 into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*, a separate, non-
40 environmental commitment to address the potential increased water treatment costs that could
41 result from chloride concentration effects on municipal, industrial and agricultural water purveyor
42 operations. Potential options for making use of this financial commitment include funding or
43 providing other assistance towards acquiring alternative water supplies or towards modifying
44 existing operations when chloride concentrations at a particular location reduce opportunities to

1 operate existing water supply diversion facilities. Please refer to Appendix 3B, *Environmental*
 2 *Commitments*, for the full list of potential actions that could be taken pursuant to this commitment in
 3 order to reduce the water quality treatment costs associated with water quality effects relating to
 4 chloride, electrical conductivity, and bromide.

5 **Mitigation Measure WQ-7: Conduct Additional Evaluation and Modeling of Increased**
 6 **Chloride Levels and Develop and Implement Phased Mitigation Actions**

7 Please see Mitigation Measure WQ-7 under Impact WQ-7 in the discussion of Alternative 1A.

8 **Impact WQ-8: Effects on Chloride Concentrations Resulting from Implementation of CM2–**
 9 **CM22**

10 **NEPA Effects:** Under Alternative 5, the types and geographic extent of effects on chloride
 11 concentrations in the Delta as a result of implementation of the other conservation measures (i.e.,
 12 CM2–CM22) would be similar to, and undistinguishable from, those effects previously described for
 13 Alternative 1A. The conservation measures would present no new direct sources of chloride to the
 14 affected environment. Moreover, some habitat restoration conservation measures (CM4–10) would
 15 occur on lands within the Delta currently used for irrigated agriculture, thus replacing agricultural
 16 land uses with restored tidal wetlands, floodplain, and related channel margin and off-channel
 17 habitats. The potential reduction in irrigated lands within the Delta may result in reduced
 18 discharges of agricultural field drainage with elevated chloride concentrations, which would be
 19 considered an improvement compared to No Action Alternative conditions.

20 In summary, based on the discussion above, the effects on chloride from implementing CM2-CM22
 21 are considered to be not adverse.

22 **CEQA Conclusion:** Implementation of the CM2–CM22 for Alternative 5 would not present new or
 23 substantially changed sources of chloride to the affected environment upstream of the Delta, within
 24 Delta, or in the SWP/CVP service area. Replacement of irrigated agricultural land uses in the Delta
 25 with habitat restoration conservation measures may result in some reduction in discharge of
 26 agricultural field drainage with elevated chloride concentrations, thus resulting in improved water
 27 quality conditions. Based on these findings, this impact is considered to be less than significant. No
 28 mitigation is required.

29 **Impact WQ-9: Effects on Dissolved Oxygen Resulting from Facilities Operations and**
 30 **Maintenance (CM1)**

31 **NEPA Effects:** Effects of CM1 on DO under Alternative 5 are the same as those discussed for
 32 Alternative 1A and are considered to not be adverse.

33 **CEQA Conclusion:** Effects of CM1 on DO under Alternative 5 would be similar to those discussed for
 34 Alternative 1A, and are summarized here, then compared to the CEQA thresholds of significance
 35 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this
 36 constituent. For additional details on the effects assessment findings that support this CEQA impact
 37 determination, see the effects assessment discussion under the Alternative 1A.

38 River flow rate and reservoir storage reductions that would occur under Alternative 5, relative to
 39 Existing Conditions, would not be expected to result in a substantial adverse change in DO levels in
 40 the reservoirs and rivers upstream of the Delta, given that mean monthly flows would remain within
 41 the ranges historically seen under Existing Conditions and the affected river are large and turbulent.

1 Any reduced DO saturation level that may be caused by increased water temperature would not be
 2 expected to cause DO levels to be outside of the range seen historically. Finally, amounts of oxygen
 3 demanding substances and salinity would not be expected to change sufficiently to affect DO levels.

4 It is expected there would be no substantial change in Delta DO levels in response to a shift in the
 5 Delta source water percentages under this alternative or substantial degradation of these water
 6 bodies, with regard to DO. DO levels would be affected by nutrient loading, which the state has
 7 begun to aggressively regulate the discharges of, and this loading would not be expected to lower DO
 8 levels relative to Existing Conditions based on historical DO levels. Further, the anticipated changes
 9 in salinity would have relatively minor effects on DO levels, and tidal exchange, which contribute to
 10 the reaeration of Delta waters would not be expected to change substantially.

11 There is not expected to be substantial, if even measurable, changes in DO levels in the SWP/CVP
 12 Export Service Areas waters under Alternative 5, relative to Existing Conditions, because the
 13 biochemical oxygen demand of the exported water would not be expected to substantially differ
 14 from that under Existing Conditions (due to ever increasing water quality regulations), canal
 15 turbulence and exposure of the water to the atmosphere and the algal communities that exist within
 16 the canals would establish an equilibrium for DO levels within the canals. The same would occur in
 17 downstream reservoirs.

18 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
 19 objectives by frequency, magnitude, and geographic extent that would result in significant impacts
 20 on any beneficial uses within affected water bodies. Because no substantial changes in DO levels are
 21 expected, long-term water quality degradation would not be expected to occur, and, thus, beneficial
 22 uses would not be adversely affected. Various Delta waterways are 303(d)-listed for low DO, but
 23 because no substantial decreases in DO levels would be expected, greater degradation and DO-
 24 related impairment of these areas would not be expected. This impact would be less than significant.
 25 No mitigation is required.

26 **Impact WQ-10: Effects on Dissolved Oxygen Resulting from Implementation of CM2–CM22**

27 **NEPA Effects:** Effects of CM2–CM22 on DO under Alternative 5 are the same as those discussed for
 28 Alternative 1A and are considered to not be adverse.

29 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 5 would be similar to
 30 those proposed under Alternative 1A. As such, effects on DO resulting from the implementation of
 31 CM2–CM22 would be similar to that previously discussed for Alternative 1A. This impact is
 32 considered to be less than significant. No mitigation is required.

33 **Impact WQ-11: Effects on Electrical Conductivity Concentrations Resulting from Facilities** 34 **Operations and Maintenance (CM1)**

35 ***Upstream of the Delta***

36 For the same reasons stated for the No Action Alternative, EC levels (highs, lows, typical conditions)
 37 in the Sacramento River and its tributaries, the eastside tributaries, their associated reservoirs, and
 38 the San Joaquin River upstream of the Delta under Alternative 5 are not expected to be outside the
 39 ranges occurring under Existing Conditions or would occur under the No Action Alternative. Any
 40 minor changes in EC levels that could occur under Alternative 5 in water bodies upstream of the

1 Delta would not be of sufficient magnitude, frequency and geographic extent that would cause
2 adverse effects on beneficial uses or substantially degrade water quality with regard to EC.

3 **Delta**

4 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
5 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
6 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
7 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
8 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
9 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

10 Relative to Existing Conditions, Alternative 5 would result in an increase in the number of days the
11 Bay-Delta WQCP EC objectives would be exceeded in the Sacramento River at Emmaton, San Joaquin
12 River at San Andreas Landing and Prisoners Point, and Old River at Tracy Bridge (Appendix 8H,
13 Table EC-5). The percent of days the Emmaton EC objective would be exceeded for the entire period
14 modeled (1976–1991) would increase from 6% under Existing Conditions to 23% under Alternative
15 5, and the percent of days out of compliance would increase from 11% under Existing Conditions to
16 35% under Alternative 5. The percent of days the San Andreas Landing EC objective would be
17 exceeded would increase from 1% under Existing Conditions to 4% under Alternative 5, and the
18 percent of days out of compliance with the EC objective would increase from 1% under Existing
19 Conditions to 7% under Alternative 5. The percent of days the Prisoners Point EC objective would be
20 exceeded for the entire period modeled would increase from 6% under Existing Conditions to 9%
21 under Alternative 5, and the percent of days out of compliance with the EC objective would increase
22 from 10% under Existing Conditions to 13% under Alternative 5. In Old River at Tracy Bridge, the
23 percent of days exceeding the EC objective would increase from 4% under Existing Conditions to 5%
24 under Alternative 5; the percent of days out of compliance would increase by <1% and would be
25 10% under both Existing Conditions and Alternative 5. Average EC levels at the western and
26 southern Delta compliance locations, except at Emmaton in the western Delta, would decrease from
27 2–35% for the entire period modeled and 3–32% during the drought period modeled (1987–1991)
28 (Appendix 8H, Table EC-16). At Emmaton, average EC would increase by 3% for the entire period
29 modeled and 10% for the drought period modeled. At the two interior Delta locations, there would
30 be increases in average EC: the S. Fork Mokelumne River at Terminous average EC would increase
31 3% for the entire and drought periods modeled; and San Joaquin River at San Andreas Landing
32 average EC would increase 5% for the entire period modeled and 10% during the drought period
33 modeled. On average, EC would increase at Emmaton during February through August. Average EC
34 would increase at San Andreas Landing from January through September. Average EC in the S. Fork
35 Mokelumne River at Terminous would increase from March through December (Appendix 8H, Table
36 EC-16). The comparison to Existing Conditions reflects changes in EC due to both Alternative 5
37 operations (including north Delta intake capacity of 3,000 cfs and numerous other operational
38 components of Scenario C) and climate change/sea level rise.

39 Relative to the No Action Alternative, the percent of days exceeding EC objectives and percent of
40 days out of compliance would increase at: Sacramento River at Emmaton, San Joaquin River at
41 Jersey Point, San Andreas Landing, and Prisoners Point; and Old River near Middle River and at
42 Tracy Bridge (Appendix 8H, Table EC-5). The increase in percent of days exceeding the EC objective
43 would be 11% at Emmaton and 8% or less at the remaining locations. The increase in percent of
44 days out of compliance would be 13% at Emmaton and 12% or less at the remaining locations. For
45 the entire period modeled, average EC levels would increase at: Sacramento River at Emmaton (2%),

1 S. Fork Mokelumne River (4%), San Joaquin River at San Andreas Landing (10%), and San Joaquin
 2 River at Prisoners Point (4%) (Appendix 8H, Table EC-16). During the drought period modeled,
 3 average EC would increase at these same locations, except at Emmaton, by a similar percentage as
 4 well as the San Joaquin River at Brandt Bridge (1%). The comparison to the No Action Alternative
 5 reflects changes in EC due only to Alternative 5 operations (including north Delta intake capacity of
 6 3,000 cfs and numerous other operational components of Scenario C).

7 For Suisun Marsh, October–May is the period when Bay-Delta WQCP EC objectives for protection of
 8 fish and wildlife apply. Long-term average EC would increase under Alternative 5, relative to
 9 Existing Conditions, during the months of March through May by 0.4–0.6 mS/cm in the Sacramento
 10 River at Collinsville (Appendix 8H, Table EC-21). Long-term average EC would decrease relative to
 11 Existing Conditions in Montezuma Slough at National Steel during October–May (Appendix 8H,
 12 Table EC-22). The most substantial increase would occur near Beldon Landing, with long-term
 13 average EC levels increasing by 1.6–5.0 mS/cm, depending on the month, at least doubling during
 14 some months the long-term average EC relative to Existing Conditions (Appendix 8H, Table EC-23).
 15 Sunrise Duck Club and Volanti Slough also would have long-term average EC increases during all
 16 months of 0.9–2.8 mS/cm (Appendix 8H, Tables EC-24 and EC-25). The degree to which the long-
 17 term average EC increases would cause exceedance of Bay-Delta WQCP objectives is unknown,
 18 because objectives are expressed as a monthly average of daily high tide EC, which does not have to
 19 be met if it can be demonstrated “equivalent or better protection will be provided at the location”
 20 (State Water Resources Control Board 2006:14). The described long-term average EC increase may,
 21 or may not, contribute to adverse effects on beneficial uses, depending on how and when wetlands
 22 are flooded, soil leaching cycles, and how agricultural use of water is managed, and future actions
 23 taken with respect to the marsh. However, the EC increases at certain locations would be substantial
 24 and it is uncertain the degree to which current management plans for the Suisun Marsh would be
 25 able to address these substantially higher EC levels and protect beneficial uses. Thus, these
 26 increased EC levels in Suisun Marsh are considered to have a potentially adverse effect on marsh
 27 beneficial uses. Long-term average EC increases in Suisun Marsh under Alternative 5 relative to the
 28 No Action Alternative would be similar to the increases relative to Existing Conditions.

29 Given that the southern Delta is Clean Water Act section 303(d) listed as impaired due to elevated
 30 EC, the increase in the incidence of exceedance of EC objectives under Alternative 5, relative to
 31 Existing Conditions and the No Action Alternative, has the potential to contribute to additional
 32 impairment and potentially adversely affect beneficial uses. Suisun Marsh also is section 303(d)
 33 listed as impaired due to elevated EC, and the potential increases in long-term average EC
 34 concentrations could contribute to additional impairment, because the increases would be double
 35 that relative to Existing Conditions and the No Action Alternative.

36 ***SWP/CVP Export Service Area***

37 At the Banks and Jones pumping plants, Alternative 5 would result in no exceedances of the Bay-
 38 Delta WQCP’s 1,000 μ mhos/cm EC objective for the entire period modeled (Appendix 8H, Table EC-
 39 10). Thus, there would be no adverse effect on the beneficial uses in the SWP/CVP Export Service
 40 Areas using water pumped at this location under the Alternative 5.

41 At the Banks pumping plant, relative to Existing Conditions, average EC levels under Alternative 5
 42 would decrease 19% for the entire period modeled and 18% during the drought period modeled.
 43 Relative to the No Action Alternative, average EC levels would decrease by 13% for the entire period
 44 modeled and 12% during the drought period modeled. (Appendix 8H, Table EC-16)

1 At the Jones pumping plant, relative to Existing Conditions, average EC levels under Alternative 5
2 would decrease 15% for the entire period modeled and 16% during the drought period modeled.
3 Relative to the No Action Alternative, average EC levels would decrease by 11% for the entire period
4 modeled and 12% during the drought period modeled. (Appendix 8H, Table EC-16)

5 Based on the decreases in long-term average EC levels that would occur at the Banks and Jones
6 pumping plants, Alternative 5 would not cause degradation of water quality with respect to EC in
7 the SWP/CVP Export Service Areas; rather, Alternative 5 would improve long-term average EC
8 conditions in the SWP/CVP Export Service Areas.

9 Commensurate with the EC decrease in exported waters, an improvement in lower San Joaquin
10 River average EC levels would be expected since EC in the lower San Joaquin River is, in part, related
11 to irrigation water deliveries from the Delta. While the magnitude of this expected lower San
12 Joaquin River improvement in EC is difficult to predict, the relative decrease in overall loading of EC-
13 elevating constituents to the Export Service Areas would likely alleviate or lessen any expected
14 increase in EC at Vernalis related to decreased annual average San Joaquin River flows (see EC
15 impact discussion under the No Action Alternative).

16 The export area of the Delta is listed on the state's CWA Section 303(d) list as impaired due to
17 elevated EC. Alternative 5 would result in lower average EC levels relative to Existing Conditions and
18 the No Action Alternative and, thus, would not contribute to additional beneficial use impairment
19 related to elevated EC in the SWP/CVP Export Service Areas waters.

20 **NEPA Effects:** In summary, the increased frequency of exceedance of EC objectives and increased
21 long-term and drought period average EC levels that would occur at western, interior, and southern
22 Delta compliance locations under Alternative 5, relative to the No Action Alternative, would
23 contribute to adverse effects on the agricultural beneficial uses. In addition, the increased frequency
24 of exceedance of the San Joaquin River at Prisoners Point EC objective and long-term and drought
25 period average EC could contribute to adverse effects on fish and wildlife beneficial uses. Given that
26 the western and southern Delta are Clean Water Act section 303(d) listed as impaired due to
27 elevated EC, the increase in the incidence of exceedance of EC objectives and long-term average and
28 drought period average EC in these portions of the Delta has the potential to contribute to additional
29 beneficial use impairment. The increases in long-term average EC levels that would occur in Suisun
30 Marsh would further degrade existing EC levels and could contribute additional to adverse effects on
31 the fish and wildlife beneficial uses. Suisun Marsh is section 303(d) listed as impaired due to
32 elevated EC, and the potential increases in long-term average EC levels could contribute to
33 additional beneficial use impairment. These increases in EC constitute an adverse effect on water
34 quality. Mitigation Measure WQ-11 would be available to reduce these effects (implementation of
35 this measure along with a separate, non-environmental commitment as set forth in EIR/EIS
36 Appendix 3B, *Environmental Commitments*, relating to the potential EC-related changes would
37 reduce these effects).

38 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
39 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
40 purpose of making the CEQA impact determination for this constituent. For additional details on the
41 effects assessment findings that support this CEQA impact determination, see the effects assessment
42 discussion that immediately precedes this conclusion.

43 River flow rate and reservoir storage reductions that would occur under Alternative 5, relative to
44 Existing Conditions, would not be expected to result in a substantial adverse change in EC levels in

1 the reservoirs and rivers upstream of the Delta, given that: changes in the quality of watershed
2 runoff and reservoir inflows would not be expected to occur in the future; the state's aggressive
3 regulation of point-source discharge effects on Delta salinity-elevating parameters and the expected
4 further regulation as salt management plans are developed; the salt-related TMDLs adopted and
5 being developed for the San Joaquin River; and the expected improvement in lower San Joaquin
6 River average EC levels commensurate with the lower EC of the irrigation water deliveries from the
7 Delta.

8 Relative to Existing Conditions, Alternative 5 would not result in any substantial increases in long-
9 term average EC levels in the SWP/CVP Export Service Areas. There would be no exceedance of the
10 EC objective at the Jones and Banks pumping plants. Average EC levels for the entire period modeled
11 would decrease at both plants and, thus, this alternative would not contribute to additional
12 beneficial use impairment related to elevated EC in the SWP/CVP Export Service Areas waters.
13 Rather, this alternative would improve long-term EC levels in the SWP/CVP Export Service Areas,
14 relative to Existing Conditions.

15 In the Plan Area, Alternative 5 would result in an increase in the frequency with which Bay-Delta
16 WQCP EC objectives are exceeded for the entire period modeled (1976–1991): in the Sacramento
17 River at Emmaton (agricultural objective; 17%; increase) in the western Delta, in the San Joaquin
18 River at San Andreas Landing (agricultural objective; 3% increase) and Prisoners Point (fish and
19 wildlife objective; 3% increase), both in the interior Delta; and in Old River at Tracy Bridge
20 (agricultural objective; 1% increase) in the southern Delta. Further, long-term average EC levels
21 would increase in the Sacramento River at Emmaton by 3% for the entire period modeled and 10%
22 during the drought period modeled, and in the San Joaquin River at San Andreas Landing by 5%
23 during for the entire period modeled and 10% during the drought period modeled. The increases in
24 long-term and drought period average EC levels and increased frequency of exceedance of EC
25 objectives that would occur in the Sacramento River at Emmaton and San Joaquin River at San
26 Andreas Landing would potentially contribute to adverse effects on the agricultural beneficial uses
27 in the western and interior Delta. Further, the increased frequency of exceedance of the fish and
28 wildlife objective at Prisoners Point could contribute to adverse effects on aquatic life. Because EC is
29 not bioaccumulative, the increases in long-term average EC levels would not directly cause
30 bioaccumulative problems in aquatic life or humans. The western and southern Delta are Clean
31 Water Act section 303(d) listed for elevated EC and the increased frequency of exceedance of EC
32 objectives that would occur in these portions of the Delta could make beneficial use impairment
33 measurably worse. This impact is considered to be significant.

34 Further, relative to Existing Conditions, Alternative 5 would result in substantial increases in long-
35 term average EC during the months of October through May in Suisun Marsh, such that EC levels
36 would be double that relative to Existing Conditions. The increases in long-term average EC levels
37 that would occur in Suisun Marsh could further degrade existing EC levels and thus contribute
38 additionally to adverse effects on the fish and wildlife beneficial uses. Because EC is not
39 bioaccumulative, the increases in long-term average EC levels would not directly cause
40 bioaccumulative problems in fish and wildlife. Suisun Marsh is Clean Water Act section 303(d) listed
41 for elevated EC and the increases in long-term average EC that would occur in the marsh could make
42 beneficial use impairment measurably worse. This impact is considered to be significant.

43 Implementation of Mitigation Measure WQ-11 along with a separate, non-environmental
44 commitment relating to the potential increased costs associated with EC-related changes would
45 reduce these effects. While mitigation measures to reduce these water quality effects in affected

1 water bodies to less than significant levels are not available, implementation of Mitigation Measure
 2 WQ-11 is recommended to attempt to reduce the effect that increased EC concentrations may have
 3 on Delta beneficial uses. However, because the effectiveness of this mitigation measure to result in
 4 feasible measures for reducing water quality effects is uncertain, this impact is considered to remain
 5 significant and unavoidable. Please see Mitigation Measure WQ-11 under Impact WQ-11 in the
 6 discussion of Alternative 1A.

7 In addition to and to supplement Mitigation Measure WQ-11, the BDCP proponents have
 8 incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*, a
 9 separate, non-environmental commitment to address the potential increased water treatment costs
 10 that could result from EC concentration effects on municipal, industrial and agricultural water
 11 purveyor operations. Potential options for making use of this financial commitment include funding
 12 or providing other assistance towards acquiring alternative water supplies or towards modifying
 13 existing operations when EC concentrations at a particular location reduce opportunities to operate
 14 existing water supply diversion facilities. Please refer to Appendix 3B, *Environmental Commitments*,
 15 for the full list of potential actions that could be taken pursuant to this commitment in order to
 16 reduce the water quality treatment costs associated with water quality effects relating to chloride,
 17 electrical conductivity, and bromide.

18 **Mitigation Measure WQ-11: Avoid, Minimize, or Offset, as Feasible, Reduced Water**
 19 **Quality Conditions**

20 Please see Mitigation Measure WQ-11 under Impact WQ-11 in the discussion of Alternative 1A.

21 **Impact WQ-12: Effects on Electrical Conductivity Resulting from Implementation of CM2-**
 22 **CM22**

23 **NEPA Effects:** Effects of CM2–CM22 on EC under Alternative 5 are the same as those discussed for
 24 Alternative 1A and are considered not to be adverse.

25 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 5 would be similar to
 26 those proposed under Alternative 1A. As such, effects on EC resulting from the implementation of
 27 CM2–CM22 would be similar to that previously discussed for Alternative 1A. This impact is
 28 considered to be less than significant. No mitigation is required.

29 **Impact WQ-13: Effects on Mercury Concentrations Resulting from Facilities Operations and**
 30 **Maintenance (CM1)**

31 ***Upstream of the Delta***

32 Under Alternative 5, the magnitude and timing of reservoir releases and river flows upstream of the
 33 Delta in the Sacramento River watershed and east-side tributaries would be altered, relative to
 34 Existing Conditions and the No Action Alternative.

35 The Sacramento River at Freeport and San Joaquin River at Vernalis (as summarized for water
 36 quality average concentrations in Tables 8-48 and 8-49) were examined for flow/concentration
 37 relationships for mercury and methylmercury. No significant, predictive regression relationships
 38 were discovered for mercury or methylmercury, except for total mercury with flow at Freeport
 39 (monthly or annual)(Figures 8I-10 through 8I-13, Appendix 8I). Such a positive relationship
 40 between total mercury and flow is to be expected based on the association of mercury with
 41 suspended sediment and the mobilization of sediments during storm flows. However, the changes in

1 flow in the Sacramento River under Alternative 5 relative to Existing Conditions and the No Action
2 Alternative are not of the magnitude of storm flows, in which substantial sediment-associated
3 mercury is mobilized. Therefore mercury loading should not be substantially different due to
4 changes in flow. In addition, even though it may be flow-affected, total mercury concentrations
5 remain well below criteria at upstream locations. Any negligible changes in mercury concentrations
6 that may occur in the water bodies of the affected environment located upstream of the Delta would
7 not be of frequency, magnitude, and geographic extent that would adversely affect any beneficial
8 uses or substantially degrade the quality of these water bodies as related to mercury. Both
9 waterborne methylmercury concentrations and largemouth bass fillet mercury concentrations are
10 expected to remain above guidance levels at upstream of Delta locations, but will not change
11 substantially relative to Existing Conditions or the No Action Alternative due to changes in flows
12 under Alternative 5.

13 The upstream of Delta areas in the north will benefit from the implementation of the Cache Creek,
14 Sulfur Creek, Harley Gulch, and Clear Lake Mercury TMDLs and the American River methylmercury
15 TMDL. These projects will target specific sources of mercury and methylation upstream of the Delta
16 and could result in net improvement to Delta mercury loading in the future. The implementation of
17 these projects could help to ensure that upstream of Delta environments will not be substantially
18 degraded for water quality with respect to mercury or methylmercury.

19 ***Delta***

20 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
21 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
22 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
23 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
24 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
25 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

26 The water quality impacts of waterborne concentrations of mercury and methylmercury and fish
27 tissue mercury concentrations were evaluated for 9 Delta locations. The analysis of percentage
28 change in assimilative capacity of waterborne total mercury of Alternative 5 relative to the 25 ng/L
29 ecological risk benchmark as compared to Existing Conditions showed the greatest decrease to be
30 0.9% at Old River at Rock Slough and the Contra Costa Pumping Plant, and 0.9% at Franks Tract
31 relative to the No Action Alternative (Figures 8-53 and 8-54). These changes are not expected to
32 result in adverse effects to beneficial uses. Similarly, changes in methylmercury concentration are
33 expected to be very small. The greatest annual average methylmercury concentration for drought
34 conditions was 0.165 ng/L for the San Joaquin River at Buckley Cove which was slightly higher than
35 Existing Conditions (0.161 ng/L) and slightly lower than the No Action Alternative (0.167 ng/L)
36 (Appendix 8I, Table I-6). All modeled input concentrations exceeded the methylmercury TMDL
37 guidance objective of 0.06 ng/L, therefore percentage change in assimilative capacity was not
38 evaluated for methylmercury.

39 Fish tissue estimates show only small or no increases in exceedance quotients based on long-term
40 annual average concentrations for mercury at the Delta locations. The greatest change in exceedance
41 quotients of 6 - 8% is expected for Franks Tract and Old River at Rock Slough relative to Existing
42 Conditions and 7% for the Mokelumne River (South Fork) at Staten Island relative to the No Action
43 Alternative (Figure 8-55, Appendix 8I, Table I-12b).

1 **SWP/CVP Export Service Areas**

2 The analysis of mercury and methylmercury in the SWP/CVP Export Service Areas was based on
3 concentrations estimated at the Banks and Jones pumping plants. Both waterborne total and
4 methylmercury concentrations for Alternative 5 are projected to be lower than Existing Conditions
5 and the No Action Alternative at the Jones and Banks pumping plants (Appendix 8I, Figures 8I-6 and
6 8I-7). Therefore, mercury shows an increased assimilative capacity at these locations (Figures 8-53
7 and 8-54). Bass tissue mercury concentrations are also improved under Alternative 5, relative to
8 Existing Conditions and the No Action Alternative (Figure 8-55; Appendix 8I, Table I-12a,b).

9 **NEPA Effects:** Based on the above discussion, the effects of mercury and methylmercury in
10 comparison of Alternative 5 to the No Action Alternative (as waterborne and bioaccumulated forms)
11 are not considered to be adverse.

12 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
13 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
14 purpose of making the CEQA impact determination for this constituent. For additional details on the
15 effects assessment findings that support this CEQA impact determination, see the effects assessment
16 discussion that immediately precedes this conclusion.

17 Under Alternative 5, greater water demands and climate change would alter the magnitude and
18 timing of reservoir releases and river flows upstream of the Delta in the Sacramento River
19 watershed and east-side tributaries, relative to Existing Conditions. Concentrations of mercury and
20 methylmercury upstream of the Delta will not be substantially different relative to Existing
21 Conditions due to the lack of important relationships between mercury/methylmercury
22 concentrations and flow for the major rivers.

23 Methylmercury concentrations exceed criteria at all locations in the Delta and no assimilative
24 capacity exists. However, monthly average waterborne concentrations of total and methylmercury,
25 over the period of record, are very similar to Existing Conditions. Similarly, estimates of fish tissue
26 mercury concentrations show almost no differences would occur among sites for Alternative 5 as
27 compared to Existing Conditions for Delta sites.

28 Assessment of effects of mercury in the SWP and CVP Export Service Areas were based on effects on
29 mercury concentrations and fish tissue mercury concentrations at the Banks and Jones pumping
30 plants. The Banks and Jones pumping plants are expected to show increased assimilative capacity
31 for waterborne mercury and decreased fish tissue concentrations of mercury for Alternative 5 as
32 compared to Existing Conditions.

33 As such, this alternative is not expected to cause additional exceedance of applicable water quality
34 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
35 on any beneficial uses of waters in the affected environment. Because mercury concentrations are
36 not expected to increase substantially, no long-term water quality degradation is expected to occur
37 and, thus, no adverse effects to beneficial uses would occur. Because any increases in mercury or
38 methylmercury concentrations are not likely to be measurable, changes in mercury concentrations
39 or fish tissue mercury concentrations would not make any existing mercury-related impairment
40 measurably worse. In comparison to Existing Conditions, Alternative 5 would not increase levels of
41 mercury by frequency, magnitude, and geographic extent such that the affected environment would
42 be expected to have measurably higher body burdens of mercury in aquatic organisms, thereby

1 substantially increasing the health risks to wildlife (including fish) or humans consuming those
2 organisms. This impact is considered to be less than significant. No mitigation is required.

3 **Impact WQ-14: Effects on Mercury Concentrations Resulting from Implementation of CM2-
4 CM22**

5 **NEPA Effects:** Some habitat restoration activities under Alternative 5 would occur on lands in the
6 Delta formerly used for irrigated agriculture. Tidal and other restoration proposed under
7 Alternative 5 have the potential to increase water residence times and increase accumulation of
8 organic sediments that are known to enhance methylmercury bioaccumulation in biota in the
9 restored habitat. Therefore, increases in mercury methylation in the habitat restoration areas is
10 possible but uncertain depending on the specific restoration design implemented at a particular
11 Delta location. Models to estimate the potential for methylmercury formation in restored areas are
12 not currently available. However, DSM2 modeling for Alternative 5 operations does incorporate
13 assumptions for certain habitat restoration activities proposed under CM2 and CM4 (see Section
14 8.3.1.3) that result in changes to Delta hydrodynamics compared to the No Action Alternative. These
15 modeled restoration assumptions provide some insight into potential hydrodynamic changes that
16 could be expected related to implementing CM2 and CM4 and are considered in the evaluation of the
17 potential for increased mercury and methylmercury concentrations under Alternative 5.

18 BDCP Conservation Measure 12 (CM12) addresses the potential for methylmercury bioaccumulation
19 associated with restoration activities and acknowledges the uncertainties associated with mitigating
20 or minimizing this potential effect. CM12 proposes project-specific mercury management plans for
21 restoration actions that will incorporate relevant approaches recommended in Phase 1
22 Methylmercury TMDL control studies. Specific approaches recommended under CM12 that are
23 intended to minimize or mitigate for potential increases in methylmercury bioaccumulation at
24 future restoration sites include:

- 25 ● Characterizing mercury, methylmercury, organic carbon, iron, and sulfate concentrations to
26 better inform restoration design,
- 27 ● Sequestering methylmercury at restoration sites using low intensity chemical dosing
28 techniques,
- 29 ● Minimizing microbial methylation associated with anoxic conditions by reducing the amount of
30 organic material at a restoration site,
- 31 ● Designing restoration sites to enhance photo degeneration that converts methylmercury into a
32 biologically unavailable, inorganic form of mercury,
- 33 ● Remediating restoration site soils with iron to reduce methylation in sulfide rich soils, and
34 ● Considering capping mercury laden sediments, where possible to reduce methylation potential
35 at a site.

36 Because of the uncertainties associated with site-specific estimates of methylmercury
37 concentrations and the uncertainties in source modeling and tissue modeling, the effectiveness of
38 methylmercury management proposed under CM12 to reduce methylmercury concentrations would
39 need to be evaluated separately for each restoration effort, as part of design and implementation.
40 Because of this uncertainty and the known potential for methylmercury creation in the Delta this
41 potential effect of implementing CM2–CM22 is considered adverse.

1 **CEQA Conclusion:** There would be no substantial, long-term increase in mercury or methylmercury
2 concentrations or loads in the rivers and reservoirs upstream of the Delta or the waters exported to
3 the CVP and SWP service areas due to implementation of CM2–CM22 relative to Existing Conditions.
4 However, uptake of mercury from water and/or methylation of inorganic mercury may increase to
5 an unquantified degree as part of the creation of new, marshy, shallow, or organic-rich restoration
6 areas. Methylmercury is 303(d)-listed within the affected environment, and therefore any potential
7 measurable increase in methylmercury concentrations would make existing mercury-related
8 impairment measurably worse. Because mercury is bioaccumulative, increases in water-borne
9 mercury or methylmercury that could occur in some areas could bioaccumulate to somewhat
10 greater levels in aquatic organisms and would, in turn, pose health risks to fish, wildlife, or humans.
11 Design of restoration sites under Alternative 5 would be guided by CM12 which requires
12 development of site specific mercury management plans as restoration actions are implemented.
13 The effectiveness of minimization and mitigation actions implemented according to the mercury
14 management plans is not known at this time although the potential to reduce methylmercury
15 concentrations exists based on current research. Although the BDCP will implement CM12 with the
16 goal to reduce this potential effect the uncertainties related to site specific restoration conditions
17 and the potential for increases in methylmercury concentrations in the Delta result in this potential
18 impact being considered significant. No mitigation measures would be available until specific
19 restoration actions are proposed. Therefore this programmatic impact is considered significant and
20 unavoidable.

21 **Impact WQ-15: Effects on Nitrate Concentrations Resulting from Facilities Operations and** 22 **Maintenance (CM1)**

23 ***Upstream of the Delta***

24 For the same reasons stated for the No Action Alternative, Alternative 5 would have negligible, if
25 any, impact on nitrate concentrations in the rivers and reservoirs upstream of the Delta in the
26 Sacramento River watershed relative to Existing Conditions and the No Action Alternative.

27 Under Alternative 5, modeling indicates that long-term annual average flows on the San Joaquin
28 River would decrease by an estimated 6%, relative to Existing Conditions, and would remain
29 virtually the same relative to the No Action Alternative (Appendix 5A). Given these relatively small
30 decreases in flows and the weak correlation between nitrate and flows in the San Joaquin River (see
31 Nitrate Appendix 8J, Figure 2), it is expected that nitrate concentrations in the San Joaquin River
32 would be minimally affected, if at all, by changes in flow rates under Alternative 5.

33 Any negligible changes in nitrate-N concentrations that may occur in the water bodies of the affected
34 environment located upstream of the Delta would not be of frequency, magnitude and geographic
35 extent that would adversely affect any beneficial uses or substantially degrade the quality of these
36 water bodies, with regards to nitrate.

37 ***Delta***

38 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
39 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
40 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
41 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
42 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
43 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

1 Results of the mixing calculations indicate that under Alternative 5, relative to Existing Conditions
 2 and the No Action Alternative, nitrate concentrations throughout the Delta are anticipated to remain
 3 low (<1.4 mg/L-N) relative to adopted objectives (Nitrate Appendix 8J, Table 19 and 20). Although
 4 changes at specific Delta locations and for specific months may be substantial on a relative basis, the
 5 absolute concentration of nitrate in Delta waters would remain low (<1.4 mg/L-N) in relation to the
 6 drinking water MCL of 10 mg/L-N, as well as all other thresholds identified in Table 8-50. Long-term
 7 average nitrate concentrations are anticipated to remain below 1 mg/L-N at all 11 assessment
 8 locations except the San Joaquin River at Buckley Cove, where long-term average concentrations
 9 would be somewhat above 1 mg/L-N. Nevertheless, at this location, long-term average nitrate
 10 concentration would be somewhat reduced under Alternative 5, relative to Existing Conditions, and
 11 slightly increased relative to the No Action Alternative. No additional exceedances of the MCL are
 12 anticipated at any location (Nitrate Appendix 8J, Table 19). On a monthly average basis and on a
 13 long term annual average basis, for all modeled years and for the drought period (1987–1991) only,
 14 use of assimilative capacity available under Existing Conditions and the No Action Alternative,
 15 relative to the drinking water MCL of 10 mg/L-N, was low or negligible (i.e., <4%) for all locations
 16 and months, except San Joaquin River at Buckley Cove in August, which showed a 5.6% use of
 17 assimilative capacity available under the No Action Alternative, for the drought period (1987–1991)
 18 (Nitrate Appendix 8J, Table 21).

19 Nitrate concentrations will likely be higher than the modeling results indicate in certain locations.
 20 This includes in the Sacramento River between Freeport and Mallard Island and other areas in the
 21 Delta downstream of Freeport that are influenced by Sacramento River water. These increases are
 22 associated with ammonia and nitrate that are discharged from the SRWTP, which are not included in
 23 the modeling.

- 24 • Under Existing Conditions, most of the ammonia discharged from the SRWTP is converted to
 25 nitrate downstream of the facility's discharge at Freeport, and thus, nitrate concentrations
 26 under Existing Conditions in these areas are expected to be higher than the modeling
 27 predicts, the increase becoming greater with increasing distance downstream. However, the
 28 increase in nitrate concentrations downstream of the SRWTP is expected to be small—the
 29 existing increase appears to be from approximately 0.1 mg/L-N to approximately 0.4–0.5
 30 mg/L-N over this reach, due to approximately a 1:1 conversion of ammonia-N to nitrate-N
 31 (Central Valley Water Board 2010a:32).
- 32 • Under Alternative 5, the planned upgrades to the SRWTP, which include nitrification/partial
 33 denitrification, would substantially decrease ammonia concentrations in the discharge, but
 34 would increase nitrate concentrations in the discharge up to 10 mg/L-N, which is
 35 substantially higher than under Existing Conditions.
- 36 • Overall, under Alternative 5, the nitrogen load from the SRWTP discharge is expected to
 37 decrease (by up to 50%), relative to Existing Conditions, due to nitrification/partial
 38 denitrification upgrades at the SRWTP facility. Thus, while concentrations of nitrate
 39 downstream of the facility are expected to be higher than modeling results indicate for both
 40 Existing Conditions and Alternative 5, the increase is expected to be greater under Existing
 41 Conditions than for Alternative 5 due to the upgrades that are assumed under Alternative 5.

42 The other areas in which nitrate concentrations will be higher than the modeling results indicate are
 43 immediately downstream of other wastewater treatment plants that practice nitrification, but not
 44 denitrification (e.g., City of Rio Vista Beach WWTF, Town of Discovery Bay WWTF, City of Stockton

1 RWCF). For all such facilities in the Delta, the Regional Water Boards have issued NPDES permits
2 that allow discharge of wastewater containing nitrate into the Delta, and under these permits, the
3 State has determined that no beneficial uses are adversely affected by the discharge, and that the
4 discharger's use of available assimilative capacity of the water body is acceptable. When dilution is
5 necessary in order for the discharge to be in compliance with the Basin Plans (which incorporate the
6 10 mg/L-N MCL by reference), not all of the assimilative capacity of the receiving water is granted to
7 the discharger. Thus, limited decreases in flows are not anticipated to result in systemic
8 exceedances of the MCLs by these POTWs. Furthermore, NPDES permits are renewed on a 5-year
9 basis, and thus, if under changes in flows, dilution was no longer sufficient to maintain nitrate below
10 the MCL in the receiving water, the NPDES permit renewal process would address such cases.

11 Therefore, any increases in nitrate-N concentrations that may occur at certain locations within the
12 Delta would not be of frequency, magnitude and geographic extent that would adversely affect any
13 beneficial uses or substantially degrade the water quality at these locations, with regards to nitrate.

14 ***SWP/CVP Export Service Areas***

15 Assessment of effects of nitrate in the SWP and CVP Export Service Areas is based on effects on
16 nitrate-N at the Banks and Jones pumping plants.

17 Results of the mixing calculations indicate that under Alternative 5, relative to Existing Conditions
18 and the No Action Alternative, nitrate concentrations at Banks and Jones pumping plants are
19 anticipated to decrease on a long-term average annual basis (Nitrate Appendix 8J, Table 19 and 20).
20 During the late summer, particularly in the drought period assessed, concentrations are expected to
21 increase substantially on a relative basis (i.e., >50%), but the absolute value of these changes (i.e., in
22 mg/L-N) is small. Additionally, given the many factors that contribute to potential algal blooms in
23 the SWP and CVP canals within the Export Service Area, and the lack of studies that have shown a
24 direct relationship between nutrient concentrations in the canals and reservoirs and problematic
25 algal blooms in these water bodies, there is no basis to conclude that these small (i.e., generally <0.3
26 mg/L-N), seasonal increases in nitrate concentrations would increase the potential for problem algal
27 blooms in the SWP and CVP Export Service Area. No additional exceedances of the MCL are
28 anticipated (Nitrate Appendix 8J, Table 19). On a monthly average basis and on a long term annual
29 average basis, for all modeled years and for the drought period (1987–1991) only, use of
30 assimilative capacity available under Existing Conditions and the No Action Alternative, relative to
31 the 10 mg/L-N MCL, was negligible (<4%) for both Banks and Jones pumping plants (Nitrate
32 Appendix 8J, Table 21).

33 Any increases in nitrate-N concentrations that may occur in water exported via Banks and Jones
34 pumping plants are not expected to result in adverse effects to beneficial uses or substantially
35 degrade the quality of exported water, with regards to nitrate.

36 ***NEPA Effects:*** In summary, based on the discussion above, the effects on nitrate from implementing
37 CM1 are considered to be not adverse.

38 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
39 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
40 purpose of making the CEQA impact determination for this constituent. For additional details on the
41 effects assessment findings that support this CEQA impact determination, see the effects assessment
42 discussion that immediately precedes this conclusion.

1 Nitrate-N concentrations are generally low in the reservoirs and rivers of the watersheds, owing to
2 substantial dilution available for point sources and the lack of substantial nonpoint sources of
3 nitrate-N upstream of the SRWTP in the Sacramento River watershed, and in the watersheds of the
4 eastern tributaries (Cosumnes, Mokelumne, and Calaveras Rivers). Although higher in the San
5 Joaquin River watershed, nitrate-N concentrations are not well-correlated with flow rates.
6 Consequently, any modified reservoir operations and subsequent changes in river flows under
7 Alternative 5, relative to Existing Conditions, are expected to have negligible, if any, effects on
8 reservoir and river nitrate-N concentrations upstream of Freeport in the Sacramento River
9 watershed and upstream of the Delta in the San Joaquin River watershed.

10 In the Delta, results of the mixing calculations indicate that under Alternative 5, relative to Existing
11 Conditions, nitrate concentrations throughout the Delta are anticipated to remain low (<1.4 mg/L-
12 N) relative to adopted objectives. No additional exceedances of the MCL are anticipated at any
13 location, and use of assimilative capacity available under Existing Conditions, relative to the
14 drinking water MCL of 10 mg/L-N, was low or negligible (i.e., <4%) for virtually all locations and
15 months.

16 Assessment of effects of nitrate in the SWP and CVP Export Service Areas is based on effects on
17 nitrate-N concentrations at the Banks and Jones pumping plants. Results of the mixing calculations
18 indicate that under Alternative 5, relative to Existing Conditions, long-term average nitrate
19 concentrations at Banks and Jones pumping plants are anticipated to change negligibly. No
20 additional exceedances of the MCL are anticipated, and use of assimilative capacity available under
21 Existing Conditions, relative to the MCL was negligible (i.e., <4%) for both Banks and Jones pumping
22 plants for all months.

23 Based on the above, there would be no substantial, long-term increase in nitrate-N concentrations in
24 the rivers and reservoirs upstream of the Delta, in the Delta Region, or the waters exported to the
25 CVP and SWP service areas under Alternative 5 relative to Existing Conditions. As such, this
26 alternative is not expected to cause additional exceedance of applicable water quality
27 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
28 on any beneficial uses of waters in the affected environment. Because nitrate concentrations are not
29 expected to increase substantially, no long-term water quality degradation is expected to occur and,
30 thus, no adverse effects to beneficial uses would occur. Nitrate is not 303(d) listed within the
31 affected environment and thus any increases that may occur in some areas and months would not
32 make any existing nitrate-related impairment measurably worse because no such impairments
33 currently exist. Because nitrate is not bioaccumulative, increases that may occur in some areas and
34 months would not bioaccumulate to greater levels in aquatic organisms that would, in turn, pose
35 substantial health risks to fish, wildlife, or humans. This impact is considered to be less than
36 significant. No mitigation is required.

37 **Impact WQ-16: Effects on Nitrate Concentrations Resulting from Implementation of CM2-**
38 **CM22**

39 **NEPA Effects:** Effects of CM2–CM22 on nitrate under Alternative 5 are the same as those discussed
40 for Alternative 1A and are considered not to be adverse.

41 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 5 would be similar to
42 those proposed under Alternative 1A. As such, effects on nitrate resulting from the implementation
43 of CM2–CM22 would be similar to that previously discussed for Alternative 1A. This impact is
44 considered to be less than significant. No mitigation is required.

1 **Impact WQ-17: Effects on Dissolved Organic Carbon Concentrations Resulting from Facilities**
 2 **Operations and Maintenance (CM1)**

3 ***Upstream of the Delta***

4 Under Alternative 5, there would be no substantial change to the sources of DOC within the
 5 watersheds upstream of the Delta. Moreover, long-term average flow and DOC levels in the
 6 Sacramento River at Hood and San Joaquin River at Vernalis are poorly correlated. Thus changes in
 7 system operations and resulting reservoir storage levels and river flows would not be expected to
 8 cause a substantial long-term change in DOC concentrations in the water bodies upstream of the
 9 Delta. Any negligible changes in DOC levels in water bodies upstream of the Delta under Alternative
 10 5, relative to Existing Conditions and the No Action Alternative, would not be of sufficient frequency,
 11 magnitude and geographic extent that would adversely affect any beneficial uses or substantially
 12 degrade the quality of these water bodies, with regards to DOC.

13 ***Delta***

14 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 15 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 16 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 17 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 18 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
 19 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

20 Under Alternative 5, the geographic extent of effects pertaining to long-term average DOC
 21 concentrations in the Delta would be similar to that previously described for Alternative 1A,
 22 although the magnitude of predicted long-term change and relative frequency of concentration
 23 threshold exceedances would be distributed differently. Modeled effects would be greatest at Franks
 24 Tract, Rock Slough, and Contra Costa PP No. 1., where for the 16-year hydrologic period and the
 25 modeled drought period, long-term average concentration increases ranging from 0.2–0.3 mg/L
 26 would be predicted ($\leq 8\%$ net increase) (Appendix 8K, DOC Table 6). Increases in long-term average
 27 concentrations would correspond to more frequent concentration threshold exceedances, with the
 28 greatest change occurring at Rock Slough and Contra Costa PP No. 1 locations. For Rock Slough,
 29 long-term average DOC concentrations exceeding 3 mg/L would increase from 52% under Existing
 30 Conditions to 64% under the Alternative 5 (an increase from 47% to 62% for the drought period),
 31 and concentrations exceeding 4 mg/L would increase from 30% to 32% (32% to 37% for the
 32 drought period). For Contra Costa PP No. 1, long-term average DOC concentrations exceeding 3
 33 mg/L would increase from 52% under Existing Conditions to 70% under Alternative 5 (45% to 75%
 34 for the drought period), and concentrations exceeding 4 mg/L would increase from 32% to 35%
 35 (35% to 40% for the drought period). Relative change in frequency of threshold exceedance for
 36 other assessment locations would be similar or less. While Alternative 5 would generally lead to
 37 slightly higher long-term average DOC concentrations (≤ 0.3 mg/L) at some municipal water intakes
 38 and Delta interior locations, the predicted change would not be expected to adversely affect MUN
 39 beneficial uses, or any other beneficial use. This comparison to Existing Conditions reflects changes
 40 in DOC due to both Alternative 5 operations (including north Delta intake capacity of 3,000 cfs and
 41 numerous other operational components of Scenario C) and climate change/sea level rise.

42 In comparison, Alternative 5 relative to the No Action Alternative would generally result in a similar
 43 magnitude of change to that discussed for the comparison to Existing Conditions. Maximum
 44 increases of 0.1–0.2 mg/L DOC (i.e., $\leq 6\%$) would be predicted at Franks Tract, Rock Slough, and

1 Contra Costa PP No. 1 relative to No Action Alternative (Appendix 8K, DOC Table 6). Threshold
2 concentration exceedance frequency trends would also be similar to that discussed for the existing
3 condition comparison, with exception to the predicted 4 mg/L exceedance frequency at Buckley
4 Cove. In comparison to the No Action Alternative, the frequency which long-term average DOC
5 concentrations exceeded 4 mg/L at Buckley Cove would increase from 27% to 31% (42% to 53% for
6 the modeled drought period). While the Alternative 5 would generally lead to slightly higher long-
7 term average DOC concentrations at some Delta assessment locations when compared to No Action
8 Alternative conditions, the predicted change would not be expected to adversely affect MUN
9 beneficial uses, or any other beneficial use, particularly when considering the relatively small
10 change in long-term annual average concentration. Unlike the comparison to Existing Conditions,
11 this comparison to the No Action Alternative reflects changes in DOC due only to Alternative 5
12 operations.

13 As discussed for Alternative 1A, substantial change in ambient DOC concentrations would need to
14 occur before significant changes in drinking water treatment plant design or operations are
15 triggered. The increases in long-term average DOC concentrations estimated to occur at various
16 Delta locations under Alternative 5 are of sufficiently small magnitude that they would not require
17 existing drinking water treatment plants to substantially upgrade treatment for DOC removal above
18 levels currently employed.

19 Relative to existing and No Action Alternative conditions, Alternative 5 would lead to predicted
20 improvements in long-term average DOC concentrations at Barker Slough, as well as Banks and
21 Jones pumping plants (discussed below). At Barker Slough, long-term average DOC concentrations
22 would be predicted to decrease by as much as 0.1–0.2 mg/L depending on baseline conditions
23 comparison and modeling period.

24 ***SWP/CVP Export Service Areas***

25 Under Alternative 5, modeled long-term average DOC concentrations would decrease at Banks and
26 Jones pumping plants for the modeled 16-year hydrologic period, relative to Existing Conditions and
27 No Action Alternative. Relative to Existing Conditions, long-term average DOC concentrations at
28 Banks would be predicted to decrease by 0.3 mg/L (0.1 mg/L during drought period) (Appendix 8K,
29 DOC Table 6). At Jones, long-term average DOC concentrations would be predicted to decrease by
30 0.2 mg/L, but be predicted to increase by 0.1 mg/L for the modeled drought period. Such decreases
31 in long-term average DOC, however, would not necessarily translate into lower exceedance
32 frequencies for concentration thresholds. To the contrary, long-term average DOC concentrations at
33 Banks exceeding 3 mg/L would increase from 64% under Existing Conditions to 69% under
34 Alternative 5 (57% to 83% for the drought period), and at Jones would increase from 71% to 78%
35 (72% to 93% for the drought period). Relative to the 4 mg/L concentration threshold, long-term
36 average DOC concentrations at Banks would decrease from 33% under Existing Conditions to 27%
37 under Alternative 5, but would increase slightly from 42% to 44% for the modeled drought period.
38 At Jones, concentrations exceeding 4 mg/L would increase slightly from 26% to 27% (35% to 39%
39 for the drought period). Frequency of exceedance comparisons to the No Action Alternative yield
40 similar trends, but with slightly smaller 16-year hydrologic period and drought period changes.
41 Overall, modeling results for the SWP/CVP Export Service Areas predict a slight long-term
42 improvement in Export Service Areas water quality respective to DOC. This improvement is
43 principally obtained through overall lower long-term average DOC concentrations at Banks and
44 Jones.

1 Similar to the discussion pertaining to the No Action Alternative, maintenance of SWP and CVP
2 facilities under Alternative 5 would not be expected to create new sources of DOC or contribute
3 towards a substantial change in existing sources of DOC in the affected area. Maintenance activities
4 would not be expected to cause any substantial change in long-term average DOC concentrations
5 such that MUN beneficial uses, or any other beneficial use, would be adversely affected.

6 **NEPA Effects:** In summary, Alternative 5, relative to the No Action Alternative, would not cause a
7 substantial long-term change in DOC concentrations in the water bodies upstream of the Delta.
8 Long-term average DOC concentrations at Banks and Jones pumping plants are predicted to
9 decrease by as much as 0.3 mg/L, while long-term average DOC concentrations for some Delta
10 interior locations, including Contra Costa PP #1, are predicted to increase by as much as 0.2 mg/L.
11 The increase in long-term average DOC concentration that could occur within the Delta interior
12 would not be of sufficient magnitude to adversely affect the MUN beneficial use, or any other
13 beneficial uses, of Delta waters. The effect of Alternative 1A operations and maintenance (CM1) on
14 DOC is determined not to be adverse.

15 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
16 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
17 purpose of making the CEQA impact determination for this constituent. For additional details on the
18 effects assessment findings that support this CEQA impact determination, see the effects assessment
19 discussion that immediately precedes this conclusion.

20 While greater water demands under the Alternative 5 would alter the magnitude and timing of
21 reservoir releases north, south and east of the Delta, these activities would have no substantial effect
22 on the various watershed sources of DOC. Moreover, long-term average flow and DOC at Sacramento
23 River at Hood and San Joaquin River at Vernalis are poorly correlated; therefore, changes in river
24 flows would not be expected to cause a substantial long-term change in DOC concentrations
25 upstream of the Delta.

26 Relative to Existing Conditions, Alternative 5 would result in relatively small increases (i.e., $\leq 8\%$) in
27 long-term average DOC concentrations at some Delta interior locations, including Franks Tract, Rock
28 Slough, and Contra Costa PP No. 1. However, these increases would not substantially increase the
29 frequency with which long-term average DOC concentrations exceeds 2, 3, or 4 mg/L. While
30 Alternative 5 would generally lead to slightly higher long-term average DOC concentrations (≤ 0.3
31 mg/L) within the Delta interior and some municipal water intakes, the predicted change would not
32 be expected to adversely affect MUN beneficial uses, or any other beneficial use.

33 The assessment of Alternative 5 effects on DOC in the SWP/CVP Export Service Areas is based on
34 assessment of changes in DOC concentrations at Banks and Jones pumping plants. Relative to the
35 existing condition, long-term average DOC concentrations would decrease by as much as 0.3 mg/L at
36 Banks and Jones pumping plants, although slightly more frequent export of >3 mg/L DOC water is
37 predicted. Nevertheless, an overall improvement in DOC-related water quality would be predicted in
38 the SWP/CVP Export Service Areas.

39 Based on the above, Alternative 5 operation and maintenance would not result in any substantial
40 change in long-term average DOC concentration upstream of the Delta or result in substantial
41 increase in the frequency with which long-term average DOC concentrations exceeds 2, 3, or 4 mg/L
42 levels at the 11 assessment locations analyzed for the Delta. Modeled long-term average DOC
43 concentrations would increase by no more than 0.3 mg/L at any single Delta assessment location
44 (i.e., $\leq 8\%$ relative increase), with long-term average concentrations estimated to remain at or below

1 4.0 mg/L at all Delta locations assessed, with the exception of Buckley Cove on the San Joaquin River
2 during the drought period modeled. Nevertheless, long-term average concentrations at Buckley
3 Cove are expected to decrease slightly during the drought period, relative to Existing Conditions.
4 The increases in long-term average DOC concentration that could occur within the Delta would not
5 be of sufficient magnitude to adversely affect the MUN beneficial use, or any other beneficial uses, of
6 Delta waters or waters of the SWP/CVP Service Area. Because DOC is not bioaccumulative, the
7 increases in long-term average DOC concentrations would not directly cause bioaccumulative
8 problems in aquatic life or humans. Finally, DOC is not causing beneficial use impairments and thus
9 is not 303(d) listed for any water body within the affected environment. Thus, the increases in long-
10 term average DOC that could occur at various locations would not make any beneficial use
11 impairment measurably worse. Because long-term average DOC concentrations are not expected to
12 increase substantially, no long-term water quality degradation with respect to DOC is expected to
13 occur and, thus, no adverse effects on beneficial uses would occur This impact is considered to be
14 less than significant. No mitigation is required.

15 **Impact WQ-18: Effects on Dissolved Organic Carbon Concentrations Resulting from**
16 **Implementation of CM2–CM22**

17 **NEPA Effects:** Conservation Measures 2–22 proposed under Alternative 5 would be the same as
18 those proposed under Alternative 1A, except that 25,000 rather than 65,000 acres of tidal habitat
19 would be restored. Effects on DOC resulting from the implementation of CM2–CM22 would be
20 similar to that previously discussed for Alternative 1A, except that the reduced acreage of proposed
21 tidal habitat would reduce the overall Alternative 5 related DOC loading to the Delta. While this
22 reduced acreage would result in reduced DOC loading relative to other action Alternatives, CM4–
23 CM7 and CM10 could still contribute substantial amounts of DOC to raw drinking water supplies,
24 largely depending on final design and operational criteria for the related wetland and riparian
25 habitat restoration activities. Substantially increased long-term average DOC in raw water supplies
26 could lead to a need for treatment plant upgrades in order to appropriately manage DBP formation
27 in treated drinking water. This potential for future DOC increases would lead to substantially greater
28 associated risk of long-term adverse effects on the MUN beneficial use.

29 In summary, the habitat restoration elements of CM4–CM7 and CM10 under Alternative 5 would
30 present new localized sources of DOC to the study area, and in some circumstances would substitute
31 for existing sources related to replaced agriculture. Depending on localized hydrodynamics and
32 proximity to municipal drinking water intakes, such restoration activities could contribute
33 substantial amounts of DOC to municipal raw water. Substantial increases in municipal raw water
34 DOC could necessitate changes in water treatment plant operations or require treatment plant
35 upgrades in order to maintain DBP compliance, and thus would constitute an adverse effect on
36 water quality. Mitigation Measure WQ-18 is available to reduce these effects.

37 **CEQA Conclusion:** Effects of CM4–CM7 and CM10 on DOC under Alternative 5 would be similar to
38 those discussed for Alternative 1A, although the overall magnitude of effect is expected to be less
39 due to the smaller acreage proposed for tidal habitat restoration. Regardless of the smaller proposed
40 acreage, these restoration activities could present a substantial source of DOC loading to the Delta.
41 Similar to Alternative 1A, this impact is considered to be significant and mitigation is required. It is
42 uncertain whether implementation of Mitigation Measure WQ-18 would reduce identified impacts
43 to a less-than-significant level. Hence, this impact remains significant and unavoidable.

1 In addition to and to supplement Mitigation Measure WQ-18, the BDCP proponents have
2 incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*, a
3 separate, non-environmental commitment to address the potential increased water treatment costs
4 that could result from DOC concentration effects on municipal and industrial water purveyor
5 operations. Potential options for making use of this financial commitment include funding or
6 providing other assistance towards implementing treatment for DOC and/or DBPs or DOC source
7 control strategies. Please refer to Appendix 3B, *Environmental Commitments*, for the full list of
8 potential actions that could be taken pursuant to this commitment in order to reduce the water
9 quality treatment costs associated with water quality effects relating to DOC.

10 **Mitigation Measure WQ-18: Design Wetland and Riparian Habitat Features to Minimize**
11 **Effects on Municipal Intakes**

12 Please see Mitigation Measure WQ-18 under Impact WQ-18 in the discussion of Alternative 1A.

13 **Impact WQ-19: Effects on Pathogens Resulting from Facilities Operations and Maintenance**
14 **(CM1)**

15 **NEPA Effects:** Effects of CM1 on pathogens under Alternative 5 are the same as those discussed for
16 Alternative 1A and are considered to not be adverse.

17 **CEQA Conclusion:** Effects of CM1 on pathogens under Alternative 5 are the same as those discussed
18 for Alternative 1A, and are summarized here, then compared to the CEQA thresholds of significance
19 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this
20 constituent. For additional details on the effects assessment findings that support this CEQA impact
21 determination, see the effects assessment discussion under Alternative 1A.

22 River flow rate and reservoir storage reductions that would occur due to implementation of CM1
23 (water facilities and operations) under Alternative 5, relative to Existing Conditions, would not be
24 expected to result in a substantial adverse change in pathogen concentrations in the reservoirs and
25 rivers upstream of the Delta, given the small magnitude of urban runoff contributions relative to the
26 magnitude of river flows, that pathogen concentrations in the rivers have a minimal relationship to
27 river flow rate, and the expected reduced pollutant loadings in response to NPDES stormwater-
28 related regulations.

29 It is expected there would be no substantial change in Delta pathogen concentrations in response to
30 a shift in the Delta source water percentages under this alternative or substantial degradation of
31 these water bodies, with regard to pathogens. This conclusion is based on the Pathogens Conceptual
32 Model, which found that pathogen sources in close proximity to a Delta site appear to have the
33 greatest influence on pathogen levels at the site, rather than the primary source(s) of water to the
34 site. In-Delta potential pathogen sources, including water-based recreation, tidal habitat, wildlife,
35 and livestock-related uses, would continue under this alternative.

36 In the SWP/CVP Export Service Areas waters, relative to Existing Conditions, an increased
37 proportion of water coming from the Sacramento River would not adversely affect beneficial uses in
38 the SWP/CVP Export Service Areas. The pathogen levels in the Sacramento River are similar to or
39 lower than the water diverted at the Delta export pumps. Further, it is localized sources of
40 pathogens that appear to have the greatest influence on concentrations. Thus, an increased
41 proportion of Sacramento River water diverted to the SWP/CVP Export Service Areas would result
42 in minimal changes in pathogen levels in the SWP/CVP Export Service Areas waters.

1 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
2 objectives by frequency, magnitude, and geographic extent that would cause adverse effects on any
3 beneficial uses of waters in the affected environment. Because pathogen concentrations are not
4 expected to increase substantially, no long-term water quality degradation for pathogens is
5 expected to occur and, thus, no adverse effects on beneficial uses would occur. The San Joaquin
6 River in the Stockton Deep Water Ship Channel is Clean Water Act section 303(d) listed for
7 pathogens. Because no measurable increase in Deep Water Ship Channel pathogen concentrations
8 are expected to occur on a long-term basis, further degradation and impairment of this area is not
9 expected to occur. Finally, pathogens are not bioaccumulative constituents. This impact is
10 considered to be less than significant. No mitigation is required.

11 **Impact WQ-20: Effects on Pathogens Resulting from Implementation of CM2–CM22**

12 **NEPA Effects:** Effects of CM2–CM22 on pathogens under Alternative 5 are the same as those
13 discussed for Alternative 1A and are considered to not be adverse.

14 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 5 would be similar to
15 those proposed under Alternative 1A. As such, effects on pathogens resulting from the
16 implementation of CM2–CM22 would be similar to that previously discussed for Alternative 1A. This
17 impact is considered to be less than significant. No mitigation is required.

18 **Impact WQ-21: Effects on Pesticide Concentrations Resulting from Facilities Operations and** 19 **Maintenance (CM1)**

20 ***Upstream of the Delta***

21 For the same reasons stated for the No Action Alternative, under Alternative 5 no specific operations
22 or maintenance activity of the SWP or CVP would substantially drive a change in pesticide use, and
23 thus pesticide sources would remain unaffected upstream of the Delta. Nevertheless, changes in the
24 timing and magnitude of reservoir releases could have an effect on available dilution capacity along
25 river segments such as the Sacramento, Feather, American, and San Joaquin Rivers.

26 Under Alternative 5, winter (November–March) and summer (April–October) season average flow
27 rates on the Sacramento River at Freeport, American River at Nimbus, Feather River at Thermalito
28 and the San Joaquin River at Vernalis would change. Relative to existing condition and the No Action
29 Alternative, seasonal average flow rates on the Sacramento would decrease no more than 3% during
30 the summer and 4% during the winter (Appendix 8L, Seasonal average flows Tables 1-4). On the
31 Feather River, average flow rates would decrease no more than 4% during the summer, but would
32 increase by as much as 5% in the winter. American River average flow rates would decrease by as
33 much as 15% in the summer and 1% in the winter. Seasonal average flow rates on the San Joaquin
34 River would decrease by as much as 12% in the summer, but increase by as much as 1% in the
35 winter. For the same reasons stated for the No Action Alternative, decreased seasonal average flow
36 of $\leq 15\%$ is not considered to be of sufficient magnitude to substantially increase pesticide
37 concentrations or alter the long-term risk of pesticide-related toxicity to aquatic life, nor adversely
38 affect other beneficial uses of water bodies upstream of the Delta.

1 Delta

2 Sources of diuron, OP and pyrethroid insecticides to the Plan Area include direct input of surface
3 runoff from in-Delta agriculture and Delta urbanized areas as well as inputs from rivers upstream of
4 the Delta. Similar to Upstream of the Delta, CVP/SWP operations would not affect these sources.

5 Under Alternative 5, the distribution and mixing of Delta source waters would change. Percent
6 change in monthly average source water fraction were evaluated for the modeled 16-year (1976–
7 1991) hydrologic period and a representative drought period (1987–1991), with special attention
8 given to changes in San Joaquin River, Sacramento River and Delta Agriculture sources water
9 fractions. Relative to Existing Conditions, under Alternative 5 modeled San Joaquin River fractions
10 would increase greater than 10% (excluding Banks and Jones pumping plants) at Rock Slough and
11 Contra Costa PP No. 1 (Appendix 8D, Source Water Fingerprinting). At Rock Slough, modeled San
12 Joaquin River source water fractions would increase 16% during November (13% for the modeled
13 drought period), while at Contra Costa PP No. 1 San Joaquin River source water fractions would
14 increase 15% during November and 12% during March. Corresponding increases for the modeled
15 drought period would not be greater than 8% at Contra Costa PP No. 1. Relative to Existing
16 Conditions, there would be no modeled increases in Sacramento River fractions greater than 14%
17 (with exception to Banks and Jones which are discussed below) and Delta agricultural fractions
18 greater than 7%. These modeled changes in the source water fractions of Sacramento, San Joaquin
19 and Delta agriculture water are not of sufficient magnitude to substantially alter the long-term risk
20 of pesticide-related toxicity to aquatic life, nor adversely affect other beneficial uses of the Delta.

21 When compared to the No Action Alternative, changes in source water fractions would be similar in
22 season, geographic extent, and magnitude to those discussed for Existing Conditions with exception
23 to Buckley Cove. Relative to the No Action Alternative, on a source water basis Buckley Cove is
24 comprised predominantly of water of San Joaquin River origin (i.e., typically >80% San Joaquin
25 River) for all months of the year but July and August. In July and August, the combined operational
26 effects on Delta hydrodynamics of the Delta Cross Channel being open, the absence of a barrier at
27 Head of Old River, and seasonally high exports from south Delta pumps results in substantially
28 lower San Joaquin River source water fraction at Buckley Cove relative to all other months of the
29 year. Under the operational scenarios of Alternative 2A, however, modeled July and August San
30 Joaquin River fractions at Buckley Cove would increase relative to the No Action Alternative, with
31 increases of 12% in July (25% for the modeled drought period) and 22% in August (43% for the
32 modeled drought period) (Appendix 8D, Source Water Fingerprinting). Despite these San Joaquin
33 River increases, the resulting net San Joaquin River source water fraction for July and August would
34 remain less than all other months. As a result, these modeled changes in the source water fractions
35 are not of sufficient magnitude to substantially alter the long-term risk of pesticide-related toxicity
36 to aquatic life, nor adversely affect other beneficial uses of the Delta.

37 SWP/CVP Export Service Areas

38 Assessment of effects in SWP/CVP Export Service Areas is based on effects seen in the Plan Area at
39 the Banks and Jones pumping plants. Under Alternative 5, Sacramento River source water fractions
40 would increase substantially at both Banks and Jones pumping plants relative to Existing Conditions
41 and the No Action Alternative (Appendix 8D, Source Water Fingerprinting). At Banks pumping plant,
42 Sacramento source water fractions would generally increase from 14–28% for March through June
43 (17% for April of the modeled drought period) and at Jones pumping plant Sacramento source water
44 fractions would generally increase from 12–24% for January through June (15–27% for March

1 through May of the modeled drought period). These increases in Sacramento source water fraction
2 would primarily balance through equivalent decreases in San Joaquin River water. Based on the
3 general observation that San Joaquin River, in comparison to the Sacramento River, is a greater
4 contributor of OP insecticides in terms of greater frequency of incidence and presence at
5 concentrations exceeding water quality benchmarks, modeled increases in Sacramento River
6 fraction at Banks and Jones would generally represent an improvement in export water quality
7 respective to pesticides.

8 **NEPA Effects:** In summary, the changes in long-term average flows on the Sacramento, Feather,
9 American, and San Joaquin Rivers, under Alternative 5 relative to the No Action Alternative, are of
10 insufficient magnitude to substantially increase the long-term risk of pesticide-related water quality
11 degradation and related toxicity to aquatic life in these water bodies upstream of the Delta.
12 Similarly, modeled changes in source water fractions to the Delta are of insufficient magnitude to
13 substantially alter the long-term risk of pesticide-related water quality degradation and related
14 toxicity to aquatic life in the Delta or CVP/SWP export service areas. The effects on pesticides from
15 operations and maintenance (CM1) are determined not to be adverse.

16 **CEQA Conclusion:** Key findings discussed in the effects assessment relative to Existing Conditions is
17 provided above are summarized here, and are then compared to the CEQA thresholds of significance
18 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this
19 constituent. For additional details on the effects assessment findings that support this CEQA impact
20 determination, see the effects assessment discussion that immediately precedes this conclusion.

21 Sources of pesticides upstream of the Delta include direct input of pesticide containing surface
22 runoff from agriculture and urbanized areas. Flows in rivers receiving these discharges dilute these
23 pesticide inputs. Relative to Existing Conditions, however, modeled changes in long-term average
24 flows on the Sacramento, Feather, American, and San Joaquin Rivers are of insufficient magnitude to
25 substantially increase the long-term risk of pesticide-related water quality degradation and related
26 toxicity to aquatic life in these water bodies upstream of the Delta.

27 In the Delta, sources of pesticides include direct input of surface runoff from Delta agriculture and
28 Delta urbanized areas as well as inputs from rivers upstream of the Delta. While facilities operations
29 and maintenance activities would not affect these sources, changes in Delta source water fraction
30 could change the relative risk associated with pesticide related toxicity to aquatic life. Under
31 Alternative 5, however, modeled changes in source water fractions relative to Existing Conditions
32 are of insufficient magnitude to substantially alter the long-term risk of pesticide-related toxicity to
33 aquatic life within the Delta, nor would such changes result in adverse pesticide-related effects on
34 any other beneficial uses of Delta waters.

35 The assessment of Alternative 5 effects on pesticides in the SWP/CVP Export Service Areas is based
36 on assessment of changes predicted at Banks and Jones pumping plants. As just discussed regarding
37 effects to pesticides in the Delta, modeled changes in source water fractions at the Banks and Jones
38 pumping plants are of insufficient magnitude to substantially alter the long-term risk of pesticide-
39 related toxicity to aquatic life beneficial uses, or any other beneficial uses, in water bodies of the
40 SWP and CVP export service area.

41 Based on the above, Alternative 5 would not result in any substantial change in long-term average
42 pesticide concentration or result in substantial increase in the anticipated frequency with which
43 long-term average pesticide concentrations would exceed aquatic life toxicity thresholds or other
44 beneficial use effect thresholds upstream of the Delta, at the 11 assessment locations analyzed for

1 the Delta, or the SWP/CVP service area. Numerous pesticides are currently used throughout the
 2 affected environment, and while some of these pesticides may be bioaccumulative, those present-
 3 use pesticides for which there is sufficient evidence for their presence in waters affected by SWP
 4 and CVP operations (i.e., diazinon, chlorpyrifos, diuron, and pyrethroids) are not considered
 5 bioaccumulative, and thus changes in their concentrations would not directly cause bioaccumulative
 6 problems in aquatic life or humans. Furthermore, while there are numerous 303(d) listings
 7 throughout the affected environment that name pesticides as the cause for beneficial use
 8 impairment, the modeled changes in upstream river flows and Delta source water fractions would
 9 not be expected to make any of these beneficial use impairments measurably worse. Because long-
 10 term average pesticide concentrations are not expected to increase substantially, no long-term
 11 water quality degradation with respect to pesticides is expected to occur and, thus, no adverse
 12 effects on beneficial uses would occur. This impact is considered to be less than significant. No
 13 mitigation is required.

14 **Impact WQ-22: Effects on Pesticide Concentrations Resulting from Implementation of CM2-
 15 CM22**

16 **NEPA Effects:** Conservation Measures 2-22 proposed under Alternative 5 would be the same as
 17 those proposed under Alternative 1A, except that 25,000 rather than 65,000 acres of tidal habitat
 18 would be restored. As such, effects on pesticides resulting from the implementation of CM2-CM22
 19 would be similar to that previously discussed for Alternative 1A, except that the likely overall use of
 20 herbicides to control invasive aquatic vegetation would likely be reduced commensurate with the
 21 reduction in restored acres of tidal habitat. Nevertheless, herbicides directly applied to water could
 22 include adverse effects on non-target aquatic life, such as aquatic invertebrates and beneficial
 23 aquatic plants. As such, aquatic life toxicity objectives could be exceeded with sufficient frequency
 24 and magnitude such that beneficial uses would be impacted, thus constituting an adverse effect on
 25 water quality.

26 In summary, based on the discussion above, the effects on pesticides from implementing CM2-CM22
 27 are considered to be adverse. Mitigation Measure WQ-22 would be available to reduce this adverse
 28 effect.

29 **CEQA Conclusion:** Effects of CM2-CM22 on pesticides under Alternative 5 are similar to those
 30 discussed for Alternative 1A. Potential environmental effects related only to CM13 are considered to
 31 be significant. Mitigation is required. While Mitigation Measure WQ-22 is available to partially
 32 reduce this impact of pesticides, no feasible mitigation is available that would reduce it to a level
 33 that would be less than significant.

34 **Mitigation Measure WQ-22: Implement Least Toxic Integrated Pest Management
 35 Strategies**

36 Please see Mitigation Measure WQ-22 under Impact WQ-22 in the discussion of Alternative 1A.

37 **Impact WQ-23: Effects on Phosphorus Concentrations Resulting from Facilities Operations
 38 and Maintenance (CM1)**

39 **NEPA Effects:** Effects of water facilities and operations (CM1) on phosphorus levels in water bodies
 40 of the affected environment under Alternative 5 would be very similar (i.e., nearly the same) to
 41 those discussed for Alternative 1A. Consequently, the environmental consequences to phosphorus

1 levels discussed in detail for Alternative 1A also adequately represent the effects under Alternative
2 5, which are considered to be not adverse.

3 **CEQA Conclusion:** Key findings discussed in the effects assessment relative to Existing Conditions is
4 provided above are summarized here, and are then compared to the CEQA thresholds of significance
5 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this
6 constituent. For additional details on the effects assessment findings that support this CEQA impact
7 determination, see the effects assessment discussion that immediately precedes this conclusion.

8 Because phosphorus loading to waters upstream of the Delta is not anticipated to change, and
9 because changes in flows do not necessarily result in changes in concentrations or loading of
10 phosphorus to these water bodies, substantial changes in phosphorus concentration upstream of the
11 Delta are not anticipated for Alternative 5, relative to Existing Conditions.

12 Because phosphorus concentrations in the major source waters to the Delta are similar for much of
13 the year, phosphorus concentrations in the Delta are not anticipated to change substantially on a
14 long term-average basis under Alternative 5, relative to Existing Conditions. Algal growth rates are
15 limited by availability of light in the Delta, and therefore any minor increases in phosphorus levels
16 that may occur at some locations and times within the Delta would be expected to have little effect
17 on primary productivity in the Delta.

18 The assessment of effects of phosphorus under Alternative 5 in the SWP and CVP Export Service
19 Areas is based on effects on phosphorus at the Banks and Jones pumping plants. As noted above,
20 phosphorus concentrations in the Delta (including Banks and Jones pumping plants) are not
21 anticipated to change substantially on a long term-average basis.

22 Based on the above, there would be no substantial, long-term increase in phosphorus concentrations
23 in the rivers and reservoirs upstream of the Delta, in the Delta Region, or the waters exported to the
24 CVP and SWP service areas under Alternative 5 relative to Existing Conditions. As such, this
25 alternative is not expected to cause additional exceedance of applicable water quality
26 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
27 on any beneficial uses of waters in the affected environment. Because phosphorus concentrations
28 are not expected to increase substantially, no long-term water quality degradation is expected to
29 occur and, thus, no adverse effects to beneficial uses would occur. Phosphorus is not 303(d) listed
30 within the affected environment and thus any minor increases that may occur in some areas would
31 not make any existing phosphorus-related impairment measurably worse because no such
32 impairments currently exist. Because phosphorus is not bioaccumulative, minor increases that may
33 occur in some areas would not bioaccumulate to greater levels in aquatic organisms that would, in
34 turn, pose substantial health risks to fish, wildlife, or humans. This impact is considered to be less
35 than significant. No mitigation is required.

36 **Impact WQ-24: Effects on Phosphorus Concentrations Resulting from Implementation of**
37 **CM2–CM22**

38 **NEPA Effects:** Effects of CM2–CM22 on phosphorus levels in water bodies of the affected
39 environment under Alternative 5 would be very similar (i.e., nearly the same) to those discussed for
40 Alternative 1A. Consequently, the environmental consequences to phosphorus levels from
41 implementing CM2–CM22 discussed in detail for Alternative 1A also adequately represent the
42 effects of these same actions under Alternative 5, which are considered to be not adverse.

1 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 5 would be similar to
2 those proposed under Alternative 1A. As such, effects on phosphorus resulting from the
3 implementation of CM2–CM22 would be similar to that previously discussed for Alternative 1A. This
4 impact is considered to be less than significant. No mitigation is required.

5 **Impact WQ-25: Effects on Selenium Concentrations Resulting from Facilities Operations and** 6 **Maintenance (CM1)**

7 ***Upstream of the Delta***

8 For the same reasons stated for the No Action Alternative, Alternative 5 would have negligible, if
9 any, effect on selenium concentrations in the rivers and reservoirs upstream of the Delta relative to
10 Existing Conditions and the No Action Alternative. Any negligible increases in selenium
11 concentrations that could occur in the water bodies of the affected environment located upstream of
12 the Delta would not be of frequency, magnitude and geographic extent that would adversely affect
13 any beneficial uses or substantially degrade the quality of these water bodies, with regard to
14 selenium.

15 ***Delta***

16 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
17 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
18 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
19 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
20 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
21 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

22 Alternative 5 would result in small changes in average selenium concentrations in water at all
23 modeled Delta assessment locations relative to Existing Conditions and the No Action Alternative
24 (Appendix 8M, Table M-10A). These small changes in selenium concentrations in water are reflected
25 in small percent changes (10% or less) in available assimilative capacity for selenium (based on 2
26 µg/L ecological risk benchmark) for all years. Relative to Existing Conditions, Alternative 5 would
27 result in the largest modeled increase in assimilative capacity at Buckley Cove (3%) and the largest
28 decrease at Contra Costa PP (1%) (Figure 8-59). Relative to the No Action Alternative, the largest
29 modeled increase in assimilative capacity would be at Staten Island (0.5%) and the largest decrease
30 would be at Buckley Cove (3%) (Figure 8-60). Although some small negative changes in selenium
31 concentrations in water are expected to occur, the effect of Alternative 5 would generally be
32 minimal for the Delta locations. Furthermore, the ranges of modeled selenium concentrations in
33 water (Appendix 8M, Table M-10A) for Alternative 5 (range 0.21–0.73 µg/L), Existing Conditions
34 (range 0.21–0.76 µg/L), and the No Action Alternative (range 0.21–0.69 µg/L) are similar and would
35 be well below the ecological risk benchmark (2 µg/L).

36 Relative to Existing Conditions and the No Action Alternative, Alternative 5 would result in small
37 changes in estimated selenium concentrations in biota (whole-body fish, bird eggs [invertebrate
38 diet], bird eggs [fish diet], and fish fillets) (Appendix 8M, Table M-16 and Addendum M.A to
39 Appendix 8M, Table M.A-2). Relative to Existing Conditions, the largest increase of selenium
40 concentrations in biota would be at Barker Slough PP for drought years (except for bird eggs
41 [assuming a fish diet] at Contra Costa PP for all years) and in sturgeon at the two western Delta
42 locations in all years, and the largest decrease would be at Buckley Cove for drought years. Relative
43 to the No Action Alternative, the largest increase would be at Buckley Cove for drought years (except

1 for bird eggs [assuming a fish diet] at Buckley Cove for all years) and in sturgeon at the two western
 2 Delta locations in all years; the largest decrease would be at Staten Island for drought years. Except
 3 for sturgeon in the western Delta, concentrations of selenium in whole-body fish and bird eggs
 4 (invert and fish diets) would exceed only the lower benchmarks (4 and 6 mg/kg dry weight,
 5 respectively, indicating a low potential for effects), under drought conditions, at Buckley Cove for
 6 Existing Conditions and the No Action Alternative and Alternative 5 (Figures 8-61 through 8-63).
 7 However, Exceedance Quotients for these exceedances of the lower benchmarks are between 1.0
 8 and 1.5, indicating a low risk to biota in the Delta and no substantial difference from Existing
 9 Conditions and the No Action Alternative. Selenium concentrations in fish fillets would not exceed
 10 the screening value for protection of human health (Figure 8-64). For sturgeon in the western Delta,
 11 whole-body selenium concentrations would increase from 12.3 mg/kg under Existing Conditions
 12 and the No Action Alternative to 12.7 mg/kg under Alternative 5, a 3% increase (Table M.A-2).
 13 Although all of these values exceed both the low and high toxicity benchmarks, it is unlikely that the
 14 modeled increases in whole-body selenium for sturgeon would be measurable in the environment
 15 (see also the discussion of results provided in Addendum M.A to Appendix 8M).

16 Relative to Existing Conditions and the No Action Alternative, Alternative 5 would result in
 17 effectively no change in selenium concentrations throughout the Delta. Alternative 5 would not be
 18 expected to substantially increase the frequency with which applicable benchmarks would be
 19 exceeded in the Delta or substantially degrade the quality of water in the Delta, with regard to
 20 selenium.

21 ***SWP/CVP Export Service Areas***

22 Alternative 5 would result in small changes in average selenium concentrations in water at the two
 23 modeled Export Service Area assessment locations relative to Existing Conditions and the No Action
 24 Alternative (Appendix 8M, Table M-10A). These small changes are reflected in small percent
 25 changes (10% or less) in available assimilative capacity for selenium for all years. Relative to
 26 Existing Conditions and the No Action Alternative, Alternative 5 would result in modeled increases
 27 in assimilative capacity at Jones PP (3% and 4%, respectively) and at Banks PP (2%, Existing
 28 Conditions and the No Action Alternative) (Figures 8-59 and 8-60) and generally have a small
 29 positive effect on the Export Service Area locations. The ranges of modeled selenium concentrations
 30 in water (Appendix 8M, Table M-10) for Alternative 5 (range 0.37–0.53 µg/L), Existing Conditions
 31 (range 0.37–0.58 µg/L), and the No Action Alternative (range 0.37–0.59 µg/L) are similar, and all
 32 would be well below the ecological risk benchmark (2 µg/L).

33 Relative to Existing Conditions and the No Action Alternative, Alternative 5 would result in small
 34 changes in estimated selenium concentrations in biota (Appendix 8M, Table M-16). Relative to
 35 Existing Conditions, the largest increase of selenium concentrations in biota would be at Barker
 36 Slough PP for drought years (except for bird eggs [assuming a fish diet] at Barker Slough PP for all
 37 years), and the largest decrease would be at Jones PP for all years (except for bird eggs [assuming a
 38 fish diet] at Jones PP for drought years). Relative to the No Action Alternative, the largest increase of
 39 selenium in biota would be at Barker Slough PP for drought years (except for bird eggs [assuming a
 40 fish diet] at Barker Slough PP for all years), and the largest decrease would be at Jones PP for
 41 drought years. Concentrations in biota would not exceed any benchmarks for Alternative 5 (Figures
 42 8-61 through 8-64).

43 Thus, relative to Existing Conditions and the No Action Alternative, Alternative 5 would result in
 44 small changes in selenium concentrations at the Export Service Area locations. Selenium

1 concentrations in water and biota would generally decrease for Alternative 5 and would not exceed
2 ecological benchmarks at either location, whereas the lower benchmark for bird eggs (fish diet)
3 would be exceeded under Existing Conditions and the No Action Alternative at Jones PP for drought
4 years. This small positive change in selenium concentrations under Alternative 5 would be expected
5 to slightly decrease the frequency with which applicable benchmarks would be exceeded or slightly
6 improve the quality of water at the Export Service Area locations, with regard to selenium.

7 **NEPA Effects:** Based on the discussion above, the effects on selenium (both as waterborne and as
8 bioaccumulated in biota) from Alternative 5 are not considered to be adverse.

9 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
10 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
11 purpose of making the CEQA impact determination for selenium. For additional details on the effects
12 assessment findings that support this CEQA impact determination, see the effects assessment
13 discussion that immediately precedes this conclusion.

14 There are no substantial point sources of selenium in watersheds upstream of the Delta, and no
15 substantial nonpoint sources of selenium in the watersheds of the Sacramento River and the eastern
16 tributaries. Nonpoint sources in the San Joaquin Valley that contribute selenium to the Delta will be
17 controlled through a TMDL developed by the Central Valley Water Board (2001) for the lower San
18 Joaquin River, established limits for the Grassland Bypass Project, and Basin Plan objectives (Central
19 Valley Water Board 2010c) and State Water Board (2010d, 2010e) that are expected to result in
20 decreasing discharges of selenium from the San Joaquin River to the Delta. Consequently, any
21 modified reservoir operations and subsequent changes in river flows under Alternative 5, relative to
22 Existing Conditions, are expected to cause negligible changes in selenium concentrations in water.
23 Any negligible changes in selenium concentrations that may occur in the water bodies of the affected
24 environment located upstream of the Delta would not be of frequency, magnitude, and geographic
25 extent that would adversely affect any beneficial uses or substantially degrade the quality of these
26 water bodies as related to selenium.

27 Relative to Existing Conditions, modeling estimates indicate that Alternative 5 would result in
28 essentially no change in selenium concentrations throughout the Delta.

29 Assessment of effects of selenium in the SWP and CVP Export Service Areas is based on effects on
30 selenium concentrations at the Banks and Jones pumping plants. Relative to Existing Conditions,
31 Alternative 5 would slightly decrease the frequency with which applicable benchmarks would be
32 exceeded or slightly improve the quality of water in selenium concentrations at the Banks and Jones
33 pumping plants locations.

34 Based on the above, selenium concentrations that would occur in water under Alternative 5 would
35 not cause additional exceedances of applicable state or federal numeric or narrative water quality
36 objectives/criteria, or other relevant water quality effects thresholds identified for this assessment
37 (Table 8-54), by frequency, magnitude, and geographic extent that would result in adverse effects to
38 one or more beneficial uses within affected water bodies. In comparison to Existing Conditions and
39 the No Action Alternative, water quality conditions under this alternative would not increase levels
40 of selenium by frequency, magnitude, and geographic extent such that the affected environment
41 would be expected to have measurably higher body burdens of selenium in aquatic organisms,
42 thereby substantially increasing the health risks to wildlife (including fish) or humans consuming
43 those organisms. Water quality conditions under this alternative with respect to selenium would not
44 cause long-term degradation of water quality in the affected environment, and therefore would not

1 result in use of available assimilative capacity such that exceedances of water quality
2 objectives/criteria would be likely and would result in substantially increased risk for adverse
3 effects to one or more beneficial uses. This alternative would not further degrade water quality by
4 measurable levels, on a long-term basis, for selenium and, thus, cause the 303(d)-listed impairment
5 of beneficial use to be made discernibly worse. This impact is considered to be less than significant.
6 No mitigation is required.

7 **Impact WQ-26: Effects on Selenium Concentrations Resulting from Implementation of CM2–**
8 **CM22**

9 **NEPA Effects:** In general, with the possible exception of changes in Delta hydrodynamics resulting
10 from habitat restoration, CM2–CM11 would not substantially increase selenium concentrations in
11 the water bodies of the affected environment. Modeling scenarios included assumptions regarding
12 how certain habitat restoration activities (CM2 and CM4) would affect Delta hydrodynamics, and
13 thus such effects of these restoration measures were included in the assessment of CM1 facilities
14 operations and maintenance (see Impact WQ-25).

15 However, implementation of these conservation measures may increase water residence time
16 within the restoration areas. Increased restoration area water residence times could potentially
17 increase the bioaccumulation of selenium in biota, thereby potentially increasing fish tissue and bird
18 egg concentrations of selenium, but models are not available to quantitatively estimate the level of
19 changes in residence time and the associated selenium bioavailability. If increases in fish tissue or
20 bird egg selenium were to occur, the increases would likely be of concern only where fish tissues or
21 bird eggs are already elevated in selenium to near or above thresholds of concern. That is, where
22 biota concentrations are currently low and not approaching thresholds of concern, changes in
23 residence time alone would not be expected to cause them to then approach or exceed thresholds of
24 concern. In consideration of this factor, although the Delta as a whole is a 303(d)-listed water body
25 for selenium, and although monitoring data of fish tissue or bird eggs in the Delta are sparse, the
26 most likely areas in which biota tissues would be at levels high enough that additional
27 bioaccumulation due to increased residence time from restoration areas would be a concern are the
28 western Delta and Suisun Bay, and the South Delta in areas that receive San Joaquin River water.

29 The western Delta and Suisun Bay receive elevated selenium loads from North San Francisco Bay
30 (including San Pablo Bay, Carquinez Strait, and Suisun Bay) and from the San Joaquin River. Point
31 sources of selenium in North San Francisco Bay (i.e., refineries) that contribute selenium to Suisun
32 Bay are expected to be reduced through a TMDL under development by the San Francisco Bay Water
33 Board (San Francisco Bay Water Board 2012) that is expected to result in decreasing discharges of
34 selenium. Nonpoint sources of selenium in the San Joaquin Valley that contribute selenium to the
35 San Joaquin River, and thus the Delta and Suisun Bay, will be controlled through a TMDL developed
36 by the Central Valley Water Board (2001) for the lower San Joaquin River, established limits for the
37 Grassland Bypass Project, and Basin Plan objectives (Central Valley Water Board 2010c, d) that are
38 expected to result in decreasing discharges of selenium from the San Joaquin River to the Delta. If
39 selenium levels are not sufficiently reduced via these efforts, it is expected that the State Water
40 Board and the San Francisco Bay and Central Valley Water Boards would initiate additional actions
41 to further control sources of selenium.

42 The South Delta receives elevated selenium loads from the San Joaquin River. In contrast to Suisun
43 Bay and possibly the western Delta in the future, the South Delta lacks the overbite clam (*Corbula*
44 [*Potamocorbula*] *amurensis*), which is considered a key driver of selenium bioaccumulation in

1 Suisun Bay, due to its high bioaccumulation of selenium and its role in the benthic food web that
2 includes long-lived sturgeon. The South Delta does have *Corbicula fluminea*, another bivalve that
3 bioaccumulates selenium, but it is not as invasive as the overbite clam and thus likely makes up a
4 smaller fraction of sturgeon diet. Also, as mentioned above, nonpoint sources of selenium in the San
5 Joaquin Valley that contribute selenium to the Delta will be controlled through a TMDL developed by
6 the Central Valley Water Board (2001) for the lower San Joaquin River, established limits for the
7 Grassland Bypass Project, and Basin Plan objectives (Central Valley Water Board 2010c, d) that are
8 expected to result in decreasing discharges of selenium from the San Joaquin River to the Delta.
9 Further, if selenium levels in the San Joaquin River are not sufficiently reduced via these efforts, it is
10 expected that the State Water Board and Central Valley Water Board would initiate additional
11 TMDLs to further control nonpoint sources of selenium.

12 Wetland restoration areas will not be designed such that water flows in and does not flow out.
13 Exchange of water between the restoration areas and existing Delta channels is an important design
14 factor, since one goal of the restoration areas is to export food produced in these areas to the rest of
15 the Delta (see BDCP Chapter 3, *Conservation Strategy*, Section 3.3, Biological Goals and Objectives).
16 Thus, these areas can be thought of as “flow-through” systems. Consequently, although water
17 residence times associated with BDCP restoration could increase, they are not expected to increase
18 without bound. and selenium concentrations in the water column would not continue to build up
19 and be recycled in sediments and organisms as may be the case within a closed system.

20 However, because increases in bioavailable selenium in the habitat restoration areas are uncertain,
21 proposed avoidance and minimization measures would require evaluating risks of selenium
22 exposure at a project level for each restoration area, minimizing to the extent practicable potential
23 risk of additional bioaccumulation, and monitoring selenium levels in fish and/or wildlife to
24 establish whether, or to what extent, additional bioaccumulation is occurring. See Appendix 3B,
25 *Environmental Commitments* for a description of the environmental commitment BDCP proponents
26 are making with respect to Selenium Management; and Appendix 3.C. of the BDCP for additional
27 detail on this avoidance and minimization measure (AMM27). Data generated as part of the
28 avoidance and minimization measures will assist the State and Regional Water Boards in
29 determining whether beneficial uses are being impacted by selenium, and thus will provide the data
30 necessary to support regulatory actions (including additional TMDL development), should such
31 actions be warranted.

32 Given the factors discussed in the assessment above, any increases in bioaccumulation rates from
33 water-borne selenium that could occur in some areas as a result of increased water residence time
34 would not be of sufficient magnitude and geographic extent that any portion of the Delta would be
35 expected to have measurably higher body burdens of selenium in aquatic organisms and, therefore,
36 would not substantially increase risk for adverse effects to beneficial uses. Furthermore, although
37 the Delta is a 303(d)-listed water body for selenium, given the discussion in the assessment above, it
38 is unlikely that restoration areas would result in measurable increases in selenium in fish tissues or
39 bird eggs such that the beneficial use impairment would be made discernibly worse.

40 Because it is unlikely that substantial increases in selenium in fish tissues or bird eggs would occur
41 such that effects on aquatic life beneficial uses would be anticipated, and because of the avoidance
42 and minimization measures that are designed to further minimize and evaluate the risk of such
43 increases, the effects of WQ-26 are considered not adverse.

1 **CEQA Conclusion:** There would be no substantial, long-term increase in selenium concentrations in
2 water in the rivers and reservoirs upstream of the Delta, water in the Delta, or the waters exported
3 to the CVP and SWP service areas due to implementation of CM2–CM22 relative to Existing
4 Conditions. Waterborne selenium concentrations under this alternative would not exceed applicable
5 water quality objectives/criteria.

6 Given the factors discussed in the assessment above, any increases in bioaccumulation rates from
7 water-borne selenium that could occur in some areas as a result of increased water residence times
8 would not be of sufficient magnitude and geographic extent that any portion of the Delta would be
9 expected to have measurably higher body burdens of selenium in aquatic organisms, and therefore
10 would not substantially increase risk for adverse effects to beneficial uses. CM2-22 would not cause
11 long-term degradation of water quality resulting in sufficient use of available assimilative capacity
12 such that occasionally exceeding water quality objectives/criteria would be likely. Also, CM2-22
13 would not result in substantially increased risk for adverse effects to any beneficial uses.

14 Furthermore, although the Delta is a 303(d)-listed water body for selenium, given the discussion in
15 the assessment above, it is unlikely that restoration areas would result in measurable increases in
16 selenium in fish tissues or bird eggs such that the beneficial use impairment would be made
17 discernibly worse.

18 Since it is unlikely that substantial increases in selenium in fish tissues or bird eggs would occur
19 such that effects on aquatic life beneficial uses would be anticipated, and because of the avoidance
20 and minimization measures that are designed to further minimize and evaluate the risk of such
21 increases (see Appendix 3.C. of the BDCP for more detail on AMM27) as well as the Selenium
22 Management environmental commitment (see Appendix 3B, *Environmental Commitments*), this
23 impact is considered less than significant. No mitigation is required.

24 **Impact WQ-27: Effects on Trace Metal Concentrations Resulting from Facilities Operations** 25 **and Maintenance (CM1)**

26 ***Upstream of the Delta***

27 For the same reasons stated for the No Action Alternative, Alternative 5 would result in negligible,
28 and likely immeasurable, increases in trace metal concentrations in the rivers and reservoirs
29 upstream of the Delta, relative to Existing Conditions and the No Action Alternative. Effects due to
30 the operation and maintenance of the conveyance facilities are expected to be immeasurable, on an
31 annual and long-term average basis. As such, Alternative 5 would not be expected to substantially
32 increase the frequency with which applicable Basin Plan objectives or CTR criteria would be
33 exceeded in water bodies of the affected environment located upstream of the Delta or substantially
34 degrade the quality of these water bodies, with regard to trace metals.

35 ***Delta***

36 For the same reasons stated for the No Action Alternative, Alternative 5 would not result in
37 substantial increases in trace metal concentrations in the Delta relative to Existing Conditions and
38 the No Action Alternative. Effects due to the operation and maintenance of the conveyance facilities
39 are expected to be negligible, on a long-term average basis. As such, Alternative 5 would not be
40 expected to substantially increase the frequency with which applicable Basin Plan objectives or CTR
41 criteria would be exceeded in the Delta or substantially degrade the quality of Delta waters, with
42 regard to trace metals.

1 **SWP/CVP Export Service Areas**

2 For the same reasons stated for the No Action Alternative, Alternative 5 would not result in
3 substantial increases in trace metal concentrations in the water exported from the Delta or diverted
4 from the Sacramento River through the proposed conveyance facilities. As such, there is not
5 expected to be substantial changes in trace metal concentrations in the SWP/CVP export service
6 area waters under Alternative 5, relative to Existing Conditions and the No Action Alternative. As
7 such, Alternative 5 would not be expected to substantially increase the frequency with which
8 applicable Basin Plan objectives or CTR criteria would be exceeded in the water bodies of the
9 affected environment in the SWP and CVP Service Area or substantially degrade the quality of these
10 water bodies, with regard to trace metals.

11 **NEPA Effects:** In summary, Alternative 5, relative to the No Action Alternative, would not cause a
12 substantial increase in long-term average trace metals concentrations within the affected
13 environment, nor would it cause an increased frequency of water quality objective/criteria
14 exceedances within the affected environment. The effect on trace metals is determined not to be
15 adverse.

16 **CEQA Conclusion:** Effects of CM1 on trace metals under Alternative 5 would be similar to those
17 discussed for Alternative 1A, and are summarized here, then compared to the CEQA thresholds of
18 significance (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for
19 this constituent. For additional details on the effects assessment findings that support this CEQA
20 impact determination, see the effects assessment discussion under Alternative 1A.

21 While greater water demands under the Alternative 5 would alter the magnitude and timing of
22 reservoir releases north, south and east of the Delta, these activities would have no substantial effect
23 on the various watershed sources of trace metals. Moreover, long-term average flow and trace
24 metals at Sacramento River at Hood and San Joaquin River at Vernalis are poorly correlated;
25 therefore, changes in river flows would not be expected to cause a substantial long-term change in
26 trace metal concentrations upstream of the Delta.

27 Average and 95th percentile trace metal concentrations are very similar across the primary source
28 waters to the Delta. Given this similarity, very large changes in source water fraction would be
29 necessary to effect a relatively small change in trace metal concentration at a particular Delta
30 location. Moreover, average and 95th percentile trace metal concentrations for these primary source
31 waters are all below their respective water quality criteria, including those that are hardness-based
32 without a WER adjustment. No mixing of these three source waters could result in a metal
33 concentration greater than the highest source water concentration, and given that trace metals do
34 not already exceed water quality criteria, more frequent exceedances of criteria in the Delta would
35 not be expected to occur under the Alternative 5.

36 The assessment of the Alternative 5 effects on trace metals in the SWP/CVP Export Service Areas is
37 based on assessment of changes in trace metal concentrations at Banks and Jones pumping plants.
38 As just discussed regarding similarities in Delta source water trace metal concentrations, the
39 Alternative 5 is not expected to result in substantial changes in trace metal concentrations in Delta
40 waters, including Banks and Jones pumping plants, therefore effects on trace metal concentrations
41 in the SWP/CVP Export Service Area are expected to be negligible.

42 Based on the above, there would be no substantial long-term increase in trace metal concentrations
43 in the rivers and reservoirs upstream of the Delta, in the Delta Region, or the SWP/CVP export

1 service area waters under Alternative 5 relative to Existing Conditions. As such, this alternative is
 2 not expected to cause additional exceedance of applicable water quality objectives by frequency,
 3 magnitude, and geographic extent that would cause adverse effects on any beneficial uses of waters
 4 in the affected environment. Because trace metal concentrations are not expected to increase
 5 substantially, no long-term water quality degradation for trace metals is expected to occur and, thus,
 6 no adverse effects to beneficial uses would occur. Furthermore, any negligible changes in long-term
 7 trace metal concentrations that may occur in water bodies of the affected environment would not be
 8 expected to make any existing beneficial use impairments measurably worse. The trace metals
 9 discussed in this assessment are not considered bioaccumulative, and thus would not directly cause
 10 bioaccumulative problems in aquatic life or humans. This impact is considered to be less than
 11 significant. No mitigation is required.

12 **Impact WQ-28: Effects on Trace Metal Concentrations Resulting from Implementation of**
 13 **CM2–CM22**

14 **NEPA Effects:** Conservation Measures 2–22 proposed under Alternative 5 would be the same as
 15 those proposed under Alternative 1A, except that 25,000 rather than 65,000 acres of tidal habitat
 16 would be restored. Effects on trace metals resulting from the implementation of CM2–CM22 would
 17 be similar to that previously discussed for Alternative 1A. As they pertain to trace metals,
 18 implementation of CM2–CM22 would not be expected to adversely affect beneficial uses of the
 19 affected environment or substantially degrade water quality with respect to trace metals.

20 In summary, implementation of CM2–CM22 under Alternative 5, relative to the No Action
 21 Alternative, would have negligible, if any, effect on trace metals concentrations. The effect on trace
 22 metals from implementing CM2–CM22 is determined not to be adverse.

23 **CEQA Conclusion:** Implementation of CM2–CM22 under Alternative 5 would not cause substantial
 24 long-term increase in trace metal concentrations in the rivers and reservoirs upstream of the Delta,
 25 in the Delta Region, or the SWP/CVP export service area. As such, this alternative is not expected to
 26 cause additional exceedance of applicable water quality objectives by frequency, magnitude, and
 27 geographic extent that would cause adverse effects on any beneficial uses of waters in the affected
 28 environment. Because trace metal concentrations are not expected to increase substantially, no
 29 long-term water quality degradation for trace metals is expected to occur and, thus, no adverse
 30 effects to beneficial uses would occur. Furthermore, any negligible changes in long-term trace metal
 31 concentrations that may occur throughout the affected environment would not be expected to make
 32 any existing beneficial use impairments measurably worse. The trace metals discussed in this
 33 assessment are not considered bioaccumulative, and thus would not directly cause bioaccumulative
 34 problems in aquatic life or humans. This impact is considered to be less than significant. No
 35 mitigation is required.

36 **Impact WQ-29: Effects on TSS and Turbidity Resulting from Facilities Operations and**
 37 **Maintenance (CM1)**

38 **NEPA Effects:** Effects of CM1 on TSS and turbidity under Alternative 5 are the same as those
 39 discussed for Alternative 1A. The effects on TSS and turbidity from implementing CM1 is determined
 40 to not be adverse.

41 **CEQA Conclusion:** Effects of CM1 on TSS and turbidity under Alternative 5 would be similar to those
 42 discussed for Alternative 1A, and are summarized here, then compared to the CEQA thresholds of
 43 significance (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for

1 this constituent. For additional details on the effects assessment findings that support this CEQA
2 impact determination, see the effects assessment discussion under Alternative 1A.

3 Changes river flow rate and reservoir storage that would occur under Alternative 5, relative to
4 Existing Conditions, would not be expected to result in a substantial adverse change in TSS
5 concentrations and turbidity levels in the reservoirs and rivers upstream of the Delta, given that
6 suspended sediment concentrations are more affected by season than flow. Site-specific and
7 temporal exceptions may occur due to localized temporary construction activities, dredging
8 activities, development, or other land use changes would be site-specific and temporal, which would
9 be regulated to limit both their short-term and long-term effects on TSS and turbidity levels to less
10 than substantial levels.

11 Within the Delta, geomorphic changes associated with sediment transport and deposition are
12 usually gradual, occurring over years, and high storm event inflows would not be substantially
13 affected. Thus, it is expected that the TSS concentrations and turbidity levels in the affected channels
14 would not be substantially different from the levels under Existing Conditions. Consequently, this
15 alternative is expected to have minimal effect on TSS concentrations and turbidity levels in the Delta
16 region, relative to Existing Conditions.

17 There is not expected to be substantial, if even measurable, changes in TSS concentrations and
18 turbidity levels in the SWP/CVP Export Service Areas waters under Alternative 5, relative to Existing
19 Conditions, because as stated above, this alternative is not expected to result in substantial changes
20 in TSS concentrations and turbidity levels at the south Delta export pumps, relative to Existing
21 Conditions.

22 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
23 objectives where such objectives are not exceeded under Existing Conditions. Because TSS
24 concentrations and turbidity levels are not expected to be substantially different, long-term water
25 quality degradation is not expected, and, thus, beneficial uses are not expected to be adversely
26 affected. Finally, TSS and turbidity are neither bioaccumulative nor Clean Water Act section 303(d)
27 listed constituents. This impact is considered to be less than significant. No mitigation is required.

28 **Impact WQ-30: Effects on TSS and Turbidity Resulting from Implementation of CM2–CM22**

29 **NEPA Effects:** Effects of CM2–CM22 on TSS and turbidity under Alternative 5 are the same as those
30 discussed for Alternative 1A. The effects on TSS and turbidity from implementing CM2–CM22 is
31 determined to not be adverse.

32 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 5 would be similar to
33 those proposed under Alternative 1A. As such, effects on TSS and turbidity resulting from the
34 implementation of CM2–CM22 would be similar to that previously discussed for Alternative 1A. This
35 impact is considered to be less than significant. No mitigation is required.

36 **Impact WQ-31: Water Quality Effects Resulting from Construction-Related Activities (CM1– 37 CM22)**

38 The conveyance features for CM1 under Alternative 5 would be very similar to those discussed for
39 Alternative 1A. The primary difference between Alternative 5 and Alternative 1A is that under
40 Alternative 5, there would be four fewer number intakes and four fewer pumping plant locations,
41 which would result in a reduced level of construction activity. However, construction techniques
42 and locations of major features of the conveyance system within the Delta would be similar. The

1 remainder of the facilities constructed under Alternative 5, including CM2–CM22, would be very
 2 similar to, or the same as, those to be constructed for Alternative 1A. However, under Alternative 5,
 3 there would only be up to 25,000 acres of tidal marsh habitat restored (as opposed to 65,000 acres
 4 under the majority of the other alternatives), thus resulting in less in-water construction-related
 5 disturbances.

6 **NEPA Effects:** The types of potential construction-related water quality effects associated with
 7 implementation of CM1–CM22 under Alternative 5 would be very similar to the effects discussed for
 8 Alternative 1A, and the effects anticipated with implementation of CM2–CM22 would be essentially
 9 identical. However, the construction of fewer intakes and smaller conveyance features for CM1, and
 10 less tidal marsh habitat restoration, under Alternative 5 would be anticipated to result in a lower
 11 magnitude of construction-related activities. Nevertheless, the construction of CM1, and any
 12 individual components necessitated by CM2, and CM4–CM10, with the implementation of the BMPs
 13 specified in Appendix 3B, *Environmental Commitments*, and other agency permitted construction
 14 requirements would result in the potential water quality effects being largely avoided and
 15 minimized. The specific environmental commitments that would be implemented under Alternative
 16 5 would be similar to those described for Alternative 1A. Consequently, relative to Existing
 17 Conditions, Alternative 5 would not be expected to cause exceedance of applicable water quality
 18 objectives/criteria or substantial water quality degradation with respect to constituents of concern,
 19 and thus would not adversely affect any beneficial uses upstream of the Delta, in the Delta, or in the
 20 SWP and CVP service area.

21 In summary, with implementation of environmental commitments in Appendix 3B, the potential
 22 construction-related water quality effects are considered to be not adverse.

23 **CEQA Conclusion:** Because environmental commitments would be implemented under Alternative 5
 24 for construction-related activities along with agency-issued permits that also contain construction
 25 requirements to protect water quality, the construction-related effects, relative to Existing
 26 Conditions, would not be expected to cause or contribute to substantial alteration of existing
 27 drainage patterns which would result in substantial erosion or siltation on- or off-site, substantial
 28 increased frequency of exceedances of water quality objectives/criteria, or substantially degrade
 29 water quality with respect to the constituents of concern on a long-term average basis, and thus
 30 would not adversely affect any beneficial uses in water bodies upstream of the Delta, within the
 31 Delta, or in the SWP and CVP service area. Moreover, because the construction-related activities
 32 would be temporary and intermittent in nature, the construction would involve negligible
 33 discharges, if any, of bioaccumulative or 303(d) listed constituents to water bodies of the affected
 34 environment. As such, construction activities would not contribute measurably to bioaccumulation
 35 of contaminants in organisms or humans or cause 303(d) impairments to be discernibly worse.
 36 Based on these findings, this impact is determined to be less than significant. No mitigation is
 37 required.

38 **8.4.3.11 Alternative 6A—Isolated Conveyance with Pipeline/Tunnel and** 39 **Intakes 1–5 (15,000 cfs; Operational Scenario D)**

40 Alternative 6A would comprise physical/structural components similar to those under Alternative
 41 1A with the principal exception that Alternative 6A would be an “isolated” conveyance, no longer
 42 involving operation of the existing SWP and CVP south Delta export facilities for Clifton Court
 43 Forebay and Jones Pumping Plant. Alternative 6A would convey up to 15,000 cfs of water from the
 44 north Delta to the south Delta through pipelines/tunnels from five screened intakes (i.e., Intakes 1

1 through 5) on the east bank of the Sacramento River between Clarksburg and Walnut Grove.
 2 Alternative 6A would include a 750 acre intermediate forebay and pumping plant. A new 600 acre
 3 Byron Tract Forebay, adjacent to and south of Clifton Court Forebay, would be constructed which
 4 would provide water to the south Delta pumping plants. However, this. Water supply and
 5 conveyance operations would follow the guidelines described as Scenario D, which includes fall X2.
 6 CM2–CM22 would be implemented under this alternative, and would be the same as those under
 7 Alternative 1A. See Chapter 3, *Description of Alternatives*, Section 3.5.11, for additional details on
 8 Alternative 6A.

9 **Effects of the Alternative on Delta Hydrodynamics**

10 Under the No Action Alternative and Alternatives 1–9, the following two primary factors can
 11 substantially affect water quality within the Delta:

- 12 • Within the south, west, and interior Delta, a decrease in the percentage of Sacramento River-
 13 sourced water and a concurrent increase in San Joaquin River-sourced water can increase the
 14 concentrations of numerous constituents (e.g., boron, bromide, chloride, electrical conductivity,
 15 nitrate, organic carbon, some pesticides, selenium). This source water replacement is caused by
 16 decreased exports of San Joaquin River water (due to increased Sacramento River water
 17 exports), or effects of climate change on timing of flows in the rivers. Changes in channel flows
 18 also can affect water residence time and many related physical, chemical, and biological
 19 variables.
- 20 • Particularly in the west Delta, sea water intrusion as a result of sea level rise or decreased Delta
 21 outflow can increase the concentration of salts (bromide, chloride) and levels of electrical
 22 conductivity. Conversely, increased Delta outflow (e.g., as a result of Fall X2 operations in wet
 23 and above normal water years) will decrease levels of these constituents, particularly in the
 24 west Delta.

25 The primary differences between Alternative 6A and Alternative 1A are that all of the Delta exports
 26 would be via the north Delta diversion intakes, with none through the existing south Delta intakes,
 27 and operations include the meeting of Fall X2.

28 Under Alternative 6A, over the long term, average annual delta exports are anticipated to decrease
 29 by 1,386 TAF relative to Existing Conditions, and by 682 TAF relative to the No Action Alternative.
 30 All of the exported water will be from the new north Delta intakes, and none of the diversions would
 31 be from the existing south Delta intakes (see Chapter 5, *Water Supply*, for more information). The
 32 result of this is greatly increased San Joaquin River water influence throughout the south, west, and
 33 interior Delta, and a corresponding decrease in Sacramento River water influence. This can be seen,
 34 for example, in Appendix 8D, ALT 6–Old River at Rock Slough for ALL years (1976–1991), which
 35 shows increased San Joaquin River (SJR) percentage and decreased Sacramento River (SAC)
 36 percentage under the alternative, relative to Existing Conditions and the No Action Alternative.

37 Under Alternative 6A, long-term average annual Delta outflow is anticipated to increase 1,383 TAF
 38 relative to Existing Conditions, due to both changes in operations (including north Delta intake
 39 capacity of 15,000 cfs and numerous other operational components of Scenario D) and climate
 40 change/sea level rise (see Chapter 5, *Water Supply*, for more information). The result of this is
 41 decreased sea water intrusion in the west Delta. The decrease of sea water intrusion in the west
 42 Delta under Alternative 6A is greater relative to the Existing Conditions because it does not include
 43 operations to meet Fall X2, whereas the No Action alternative and Alternative 6A do. Long-term

1 average annual Delta outflow is anticipated to increase under Alternative 6A by 633 TAF relative to
 2 the No Action Alternative, due only to changes in operations. The decreases in sea water intrusion
 3 (represented by an decrease in San Francisco Bay (BAY) percentage) can be seen, for example, in
 4 Appendix 8D, ALT 6A–Sacramento River at Mallard Island for ALL years (1976–1991).

5 **Impact WQ-1: Effects on Ammonia Concentrations Resulting from Facilities Operations and** 6 **Maintenance (CM1)**

7 ***Upstream of the Delta***

8 For the same reasons stated for the No Action Alternative, Alternative 6A would have negligible, if
 9 any, effect on ammonia concentrations in the rivers and reservoirs upstream of the Delta relative to
 10 Existing Conditions and the No Action Alternative. Any negligible increases in ammonia-N
 11 concentrations that could occur in the water bodies of the affected environment located upstream of
 12 the Delta would not be of frequency, magnitude and geographic extent that would adversely affect
 13 any beneficial uses or substantially degrade the quality of these water bodies, with regard to
 14 ammonia.

15 ***Delta***

16 Assessment of effects of ammonia under Alternative 6A is the same as discussed under Alternative
 17 1A, except that because flows in the Sacramento River at Freeport are different between the two
 18 alternatives, estimated monthly average and long term annual average predicted ammonia-N
 19 concentrations in the Sacramento River downstream of Freeport are different.

20 As Table 8-69 shows, estimated ammonia-N concentrations in the Sacramento River downstream of
 21 Freeport (upon full mixing of the SRWTP discharge with river water) under Alternative 6A and the
 22 No Action Alternative are expected to be similar. Minor increases in ammonia-N concentrations
 23 would occur during January through April, and July through December, and remaining months
 24 would be unchanged. A minor increase in the annual average concentration would occur under
 25 Alternative 6A, compared to the No Action Alternative. Moreover, the estimated concentrations
 26 downstream of Freeport under Alternative 6A would be similar to existing source water
 27 concentrations for the San Francisco Bay and San Joaquin River. Consequently, changes in source
 28 water fraction anticipated under Alternative 6A, relative to the No Action Alternative, are not
 29 expected to substantially increase ammonia concentrations at any Delta locations.

30 **Table 8-69. Estimated Ammonia-N (mg-L as N) Concentrations in the Sacramento River Downstream of**
 31 **the Sacramento Regional Wastewater Treatment Plant for the No Action Alternative and Alternative**
 32 **6A**

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual Average
No Action Alternative	0.074	0.084	0.069	0.060	0.057	0.060	0.058	0.064	0.067	0.060	0.067	0.064	0.065
Alternative 6A	0.075	0.086	0.070	0.061	0.058	0.061	0.059	0.064	0.067	0.062	0.068	0.066	0.066

33
 34 Any negligible increases in ammonia-N concentrations that could occur at certain locations in the
 35 Delta would not be of frequency, magnitude and geographic extent that would adversely affect any

1 beneficial uses or substantially degrade the water quality at these locations, with regards to
2 ammonia.

3 ***SWP/CVP Export Service Areas***

4 The assessment of effects on ammonia in the SWP/CVP Export Service Area is based on assessment
5 of ammonia-N concentrations at Banks and Jones pumping plants. Similar to the discussion for
6 Alternative 1A, under Alternative 6A for areas of the Delta that are influenced by Sacramento River
7 water, including Banks and Jones pumping plants, ammonia-N concentrations are expected to
8 decrease, relative to Existing Conditions (in association with diversion of water not influenced by
9 the SRWTP). This decrease in ammonia-N concentrations for water exported via the south Delta
10 pumps is not expected to result in adverse effects on beneficial uses or substantially degrade water
11 quality of exported water, with regards to ammonia.

12 Furthermore, as discussed above for the Plan Area, for all areas of the Delta, including Banks and
13 Jones pumping plants, ammonia-N concentrations are not expected to be substantially different
14 under Alternative 6A, relative to No Action Alternative. Any negligible increases in ammonia-N
15 concentrations that could occur at Banks and Jones pumping plants would not be of frequency,
16 magnitude and geographic extent that would adversely affect any beneficial uses or substantially
17 degrade the water quality at these locations, with regards to ammonia.

18 ***NEPA Effects:*** In summary, based on the discussion above, effects on ammonia from implementation
19 of CM1 are considered to be not adverse.

20 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
21 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
22 purpose of making the CEQA impact determination for this constituent. For additional details on the
23 effects assessment findings that support this CEQA impact determination, see the effects assessment
24 discussion that immediately precedes this conclusion.

25 Ammonia-N concentrations are generally low in the reservoirs and rivers of the watersheds, owing
26 to the lack of substantial point and nonpoint sources of ammonia-N upstream of the SRWTP in the
27 Sacramento River watershed, in the watersheds of the eastern tributaries (Cosumnes, Mokelumne,
28 and Calaveras Rivers), or upstream of the Delta in the San Joaquin River watershed. Consequently,
29 any modified reservoir operations and subsequent changes in river flows under Alternative 6A,
30 relative to Existing Conditions, are expected to have negligible, if any, effects on reservoir and river
31 ammonia-N concentrations upstream of Freeport in the Sacramento River watershed and upstream
32 of the Delta in the San Joaquin River watershed.

33 Ammonia-N concentrations in the Sacramento River downstream of the SRWTP would be
34 substantially lower under Alternative 6A, relative to Existing Conditions, due to upgrades to the
35 SRWTP that are assumed to be in place, and thus, ammonia concentrations for all areas of the Delta
36 that are influenced by Sacramento River water are expected to decrease. At locations which are not
37 influenced notably by Sacramento River water, concentrations are expected to remain relatively
38 unchanged, due to the similarity in SJR and BAY concentrations and the lack of expected changes in
39 either of these concentrations.

40 The assessment of effects on ammonia in the SWP/CVP Export Service Areas is based on assessment
41 of ammonia-N concentrations at Banks and Jones pumping plants. As discussed above for the Plan
42 Area, for areas of the Delta that are influenced by Sacramento River water, including Banks and

1 Jones pumping plants, ammonia-N concentrations are expected to decrease under Alternative 6A,
2 relative to Existing Conditions.

3 Based on the above, there would be no substantial, long-term increase in ammonia-N concentrations
4 in the rivers and reservoirs upstream of the Delta, in the Plan Area, or the waters exported to the
5 CVP and SWP service areas under Alternative 6A relative to Existing Conditions. As such, this
6 alternative is not expected to cause additional exceedance of applicable water quality
7 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
8 on any beneficial uses of waters in the affected environment. Because ammonia concentrations are
9 not expected to increase substantially, no long-term water quality degradation is expected to occur
10 and, thus, no adverse effects on beneficial uses would occur. Ammonia is not 303(d) listed within the
11 affected environment and thus any minor increases that could occur in some areas would not make
12 any existing ammonia-related impairment measurably worse because no such impairments
13 currently exist. Because ammonia-N is not bioaccumulative, minor increases that could occur in
14 some areas would not bioaccumulate to greater levels in aquatic organisms that would, in turn, pose
15 substantial health risks to fish, wildlife, or humans. This impact is considered to be less than
16 significant. No mitigation is required.

17 **Impact WQ-2: Effects on Ammonia Concentrations Resulting from Implementation of CM2-**
18 **CM22**

19 **NEPA Effects:** Effects of CM2–CM22 on ammonia under Alternative 6A are the same as those
20 discussed for Alternative 1A and are considered to be not adverse.

21 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 6A would be similar to
22 those proposed under Alternative 1A. As such, effects on ammonia resulting from the
23 implementation of CM2–CM22 would be similar to that previously discussed for Alternative 1A. This
24 impact is considered to be less than significant. No mitigation is required.

25 **Impact WQ-3: Effects on Boron Concentrations Resulting from Facilities Operations and**
26 **Maintenance (CM1)**

27 ***Upstream of the Delta***

28 Effects of CM1 on boron under Alternative 6A in areas upstream of the Delta would be very similar
29 to the effects discussed for Alternative 1A. There would be no expected change to the sources of
30 boron in the Sacramento and east-side tributary watersheds, and resultant changes in flows from
31 altered system-wide operations would have negligible, if any, effects on the concentration of boron
32 in the rivers and reservoirs of these watersheds. The modeled long-term annual average lower San
33 Joaquin River flow at Vernalis would decrease slightly compared to Existing Conditions (in
34 association with project operations, climate change, and increased water demands) and would be
35 similar compared to the No Action Alternative considering only changes due to Alternative 6A
36 operations. The reduced flow would result in possible increases in long-term average boron
37 concentrations of up to about 3% relative to the Existing Conditions (Appendix 8F, Table 24). The
38 increased boron concentrations would not increase the frequency of exceedances of any applicable
39 objectives or criteria and would not be expected to cause further degradation at measurable levels
40 in the lower San Joaquin River, and thus would not cause the existing impairment there to be
41 discernibly worse. Consequently, Alternative 6A would not be expected to cause exceedance of
42 boron objectives/criteria or substantially degrade water quality with respect to boron, and thus

1 would not adversely affect any beneficial uses of the Sacramento River, the east-side tributaries,
2 associated reservoirs upstream of the Delta, or the San Joaquin River.

3 ***Delta***

4 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
5 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
6 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
7 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
8 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
9 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

10 Relative to the Existing Conditions and No Action Alternative, Alternative 6A would result in
11 generally widespread increased long-term average boron concentrations for the 16-year period
12 modeled at the interior and western Delta locations (by as much as 14% at the SF Mokelumne River
13 at Staten Island, 4% at the San Joaquin River at Buckley Cove, 43% at Franks Tract, and 74% at Old
14 River at Rock Slough) (Appendix 8F, Table Bo-16). The comparison to Existing Conditions reflects
15 changes due to both Alternative 6A operations (including north Delta intake capacity of 15,000 cfs
16 and numerous other operational components of Scenario D) and climate change/sea level rise. The
17 comparison to the No Action Alternative reflects changes due only to operations.

18 Implementation of tidal habitat restoration under CM4 also may contribute to increased boron
19 concentrations at western Delta assessment locations (more discussion of this phenomenon is
20 included in Section 8.3.1.3), and thus would not be anticipated to substantially affect agricultural
21 diversions which occur primarily at interior Delta locations. The long-term annual average and
22 monthly average boron concentrations, for either the 16-year period or drought period modeled,
23 would never exceed the 2,000 µg/L human health advisory objective (i.e., for children) or 500 µg/L
24 agricultural objective at any of the eleven Delta assessment locations, which represents no change
25 from the Existing Conditions and No Action Alternative (Appendix 8F, Table Bo-3A). The increased
26 concentrations at interior Delta locations would result in moderate reductions in the long-term
27 average assimilative capacity of up to 21% at Franks Tract and up to 43% at Old River at Rock
28 Slough locations (Appendix 8F, Table Bo-17). However, because the absolute boron concentrations
29 would still be well below the lowest 500 µg/L objective for the protection of the agricultural
30 beneficial use under Alternative 6A, the levels of boron degradation would not be of sufficient
31 magnitude to substantially increase the risk of exceeding objectives or cause adverse effects to
32 municipal and agricultural water supply beneficial uses, or any other beneficial uses, in the Delta
33 (Appendix 8F, Figure Bo-4).

34 ***SWP/CVP Export Service Areas***

35 Effects of CM1 on boron under Alternative 6A in the Delta would be similar to the effects discussed
36 for Alternative 1A. Under Alternative 6A, long-term average boron concentrations would decrease
37 by as much as 56% at the Banks Pumping Plant and by as much 63% at Jones Pumping Plant relative
38 to Existing Conditions and No Action Alternative (Appendix 8F, Table Bo-16) as a result of export of
39 a greater proportion of low-boron Sacramento River water. Commensurate with the decrease in
40 exported boron concentrations, boron concentrations in the lower San Joaquin River may be
41 reduced and would likely alleviate or lessen any expected increase in boron concentrations at
42 Vernalis associated with flow reductions (see discussion of Upstream of the Delta), as well as
43 locations in the Delta receiving a large fraction of San Joaquin River water. Reduced export boron

1 concentrations also may contribute to reducing the existing 303(d) impairment in the lower San
2 Joaquin River and associated TMDL actions for reducing boron loading.

3 Maintenance of SWP and CVP facilities under Alternative 6A would not be expected to create new
4 sources of boron or contribute towards a substantial change in existing sources of boron in the
5 affected environment. Maintenance activities would not be expected to cause any substantial
6 increases in boron concentrations or degradation with respect to boron such that objectives would
7 be exceeded more frequently, or any beneficial uses would be adversely affected anywhere in the
8 affected environment.

9 **NEPA Effects:** In summary, relative to the No Action Alternative conditions, Alternative 6 would
10 result in relatively small long-term average increases in boron levels in the San Joaquin River and
11 moderate increases in the interior and western Delta locations Delta. However, the predicted
12 changes in the Delta would not be expected to result in exceedances of applicable objectives or
13 further water quality degradation such that objectives would likely be exceeded or there would be
14 substantially increased risk of adverse effects on water quality.

15 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
16 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
17 purpose of making the CEQA impact determination for this constituent. For additional details on the
18 effects assessment findings that support this CEQA impact determination, see the effects assessment
19 discussion that immediately precedes this conclusion.

20 Boron is not a constituent of concern in the Sacramento River watershed upstream of the Delta, thus
21 river flow rate and reservoir storage reductions that would occur under the Alternative 6, relative to
22 Existing Conditions, would not be expected to result in a substantial adverse change in boron levels.
23 Additionally, relative to Existing Conditions, Alternative 6A would not result in reductions in river
24 flow rates (i.e., less dilution) or increased boron loading such that there would be any substantial
25 increases in boron concentration upstream of the Delta in the San Joaquin River watershed.

26 Moderate increased boron levels (i.e., up to 75% increased concentration) and degradation
27 predicted for interior and western Delta locations in response to a shift in the Delta source water
28 percentages and tidal habitat restoration under this alternative would not be expected to cause
29 exceedances of objectives. Alternative 6A maintenance also would not result in any substantial
30 increases in boron concentrations in the affected environment. Boron concentrations would be
31 reduced in water exported from the Delta to the CVP/SWP Export Service Areas, thus reflecting a
32 potential improvement to boron loading in the lower San Joaquin River.

33 Boron is not a bioaccumulative constituent, thus any increased concentrations under Alternative 6A
34 would not result in adverse boron bioaccumulation effects to aquatic life or humans. Relative to
35 Existing Conditions, Alternative 6A would not result in substantially increased boron concentrations
36 such that frequency of exceedances of municipal and agricultural water supply objectives would
37 increase. The levels of boron degradation that may occur under Alternative 6A, while widespread in
38 particular at interior Delta locations, would not be of sufficient magnitude to cause substantially
39 increased risk for adverse effects to municipal or agricultural beneficial uses within the affected
40 environment. Long-term average boron concentrations would decrease in Delta water exports to the
41 SWP and CVP service area, which may contribute to reducing the existing 303(d) impairment of
42 agricultural beneficial uses in the lower San Joaquin River. Consequently, Alternative 6A would not
43 be expected to cause any substantial increases in boron concentrations or degradation with respect
44 to boron such that objectives would be exceeded more frequently, or any beneficial uses would be

1 adversely affected anywhere in the affected environment. Based on these findings, this impact is
2 determined to be less than significant. No mitigation is required.

3 **Impact WQ-4: Effects on Boron Concentrations Resulting from Implementation of CM2–CM22**

4 **NEPA Effects:** Effects of CM2–CM22 on boron under Alternative 6A are the same as those discussed
5 for Alternative 1A and are determined to be not adverse.

6 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 6A would be similar to
7 those proposed under Alternative 1A. As such, effects on boron resulting from the implementation
8 of CM2–CM22 would be similar to that previously discussed for Alternative 1A. This impact is
9 considered to be less than significant. No mitigation is required.

10 **Impact WQ-5: Effects on Bromide Concentrations Resulting from Facilities Operations and** 11 **Maintenance (CM1)**

12 ***Upstream of the Delta***

13 Under Alternative 6A there would be no expected change to the sources of bromide in the
14 Sacramento and eastside tributary watersheds. Bromide loading in these watersheds would remain
15 unchanged and resultant changes in flows from altered system-wide operations under Alternative
16 6A would have negligible, if any, effects on the concentration of bromide in the rivers and reservoirs
17 of these watersheds. Consequently, Alternative 6A would not be expected to adversely affect the
18 MUN beneficial use, or any other beneficial uses, of the Sacramento River, the eastside tributaries, or
19 their associated reservoirs upstream of the Delta.

20 Under Alternative 6A, modeling indicates that long-term annual average flows on the San Joaquin
21 River would decrease by 6%, relative to Existing Conditions and would remain virtually the same
22 relative to the No Action Alternative (Appendix 5A). These decreases in flow would result in
23 possible increases in long-term average bromide concentrations of about 3%, relative to Existing
24 Conditions and less than <1% relative to the No Action Alternative (Appendix 8E, Bromide Table
25 22). The small increases in lower San Joaquin River bromide levels that could occur under
26 Alternative 6A, relative to existing and the No Action Alternative conditions would not be expected
27 to adversely affect the MUN beneficial use, or any other beneficial uses, of the lower San Joaquin
28 River.

29 ***Delta***

30 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
31 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
32 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
33 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
34 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
35 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

36 Using the mass-balance modeling approach for bromide (see Section 8.3.1.3), relative to Existing
37 Conditions, Alternative 6A would result in increases in long-term average bromide concentrations at
38 Staten Island and Barker Slough, while long-term average concentrations would decrease at the
39 other assessment locations (Appendix 8E, *Bromide*, Table 14). At Barker Slough, predicted long-term
40 average bromide concentrations would increase from 51 µg/L to 61 µg/L (19% relative increase)
41 for the modeled 16-year hydrologic period and would increase from 54 µg/L to 92 µg/L (73%

1 relative increase) for the modeled drought period. At Barker Slough, the predicted 50 µg/L
2 exceedance frequency would decrease from 49% under Existing Conditions to 38% under
3 Alternative 6A, but would increase from 55% to 63% during the drought period. At Barker Slough,
4 the predicted 100 µg/L exceedance frequency would increase from 0% under Existing Conditions to
5 17% under Alternative 6A, and would increase from 0% to 37% during the drought period. At
6 Staten Island, predicted long-term average bromide concentrations would increase from 50 µg/L to
7 70 µg/L (41% relative increase) for the modeled 16-year hydrologic period and would increase
8 from 51 µg/L to 70 µg/L (37% relative increase) for the modeled drought period. At Staten Island,
9 increases in average bromide concentrations would correspond to an increased frequency of 50 µg/l
10 threshold exceedance, from 47% under Existing Conditions to 85% under Alternative 6A (52% to
11 88% for the modeled drought period), and an increase from 1% to 10% (0% to 5% for the modeled
12 drought period) for the 100 µg/L threshold. Changes in exceedance frequency of the 50 µg/L and
13 100 µg/L concentration thresholds at other assessment locations would be less considerable. This
14 comparison to Existing Conditions reflects changes in bromide due to both Alternative 6A
15 operations (including north Delta intake capacity of 15,000 cfs and numerous other operational
16 components of Scenario D) and climate change/sea level rise.

17 Due to the relatively small differences between modeled Existing Conditions and No Action
18 baselines, changes in long-term average bromide concentrations and changes in exceedance
19 frequencies relative to the No Action Alternative are generally of similar magnitude to those
20 previously described for the existing condition comparison (Appendix 8E, *Bromide*, Table 14).
21 Modeled long-term average bromide concentration increases at Barker Slough are predicted to
22 increase by 22% (72% for the modeled drought period) relative to the No Action Alternative.
23 Modeled long-term average bromide concentration increases at Staten Island are predicted to
24 increase by 45% (41% for the modeled drought period) relative to the No Action Alternative.
25 However, unlike the Existing Conditions comparison, long-term average bromide concentrations at
26 Buckley Cove would increase relative to the No Action Alternative, although the increases would be
27 relatively small ($\leq 4\%$). Unlike the comparison to Existing Conditions, this comparison to the No
28 Action Alternative reflects changes in bromide due only to Alternative 6A operations.

29 At Barker Slough, modeled long-term average bromide concentrations for the two baseline
30 conditions are very similar (Appendix 8E, *Bromide*, Table 14). Such similarity demonstrates that the
31 modeled Alternative 6A change in bromide is almost entirely due to Alternative 6A operations, and
32 not climate change/sea level rise. Therefore, operations are the primary driver of effects on bromide
33 at Barker Slough, regardless whether Alternative 6A is compared to Existing Conditions, or
34 compared to the No Action Alternative.

35 Results of the modeling approach which used relationships between EC and chloride and between
36 chloride and bromide (see Section 8.3.1.3) differed somewhat from what is presented above for the
37 mass-balance approach (see Appendix 8E, Table 15). For most locations, the frequency of
38 exceedance of the 50 µg/L and 100 µg/L were similar. The greatest difference between the methods
39 was predicted for Barker Slough. The increases in frequency of exceedance of the 100 µg/L
40 threshold, relative to Existing Conditions and the No Action Alternative, were not as great using this
41 alternative EC to chloride and chloride to bromide relationship modeling approach as compared to
42 that presented above from the mass-balance modeling approach. However, there were still
43 substantial increases, resulting in 6% exceedance over the modeled period under Alternative 6A, as
44 compared to 1% under Existing Conditions and 2% under the No Action Alternative. For the drought
45 period, exceedance frequency increased from 0% under Existing Conditions and the No Action

1 Alternative, to 17% under Alternative 6A. Because the mass-balance approach predicts a greater
2 level of impact at Barker Slough, determination of impacts was based on the mass-balance results.

3 The increase in long-term average bromide concentrations predicted at Barker Slough, principally
4 the relative increase in 100 µg/L exceedance frequency, would result in a substantial change in
5 source water quality for existing drinking water treatment plants drawing water from the North Bay
6 Aqueduct. As discussed for Alternative 1A, drinking water treatment plants obtaining water via the
7 North Bay Aqueduct utilize a variety of conventional and enhanced treatment technologies in order
8 to achieve DBP drinking water criteria. While the implications of such a modeled change in bromide
9 at Barker Slough are difficult to predict, the substantial modeled increases could lead to adverse
10 changes in the formation of disinfection byproducts such that considerable treatment plant
11 upgrades may be necessary in order to achieve equivalent levels of health protection. Increases at
12 Staten Island are also considerable, although there are no existing or foreseeable municipal intakes
13 in the immediate vicinity. Because many of the other modeled locations already frequently exceed
14 the 100 µg/L threshold under Existing Conditions and the No Action Alternative, these locations
15 likely already require treatment plant technologies to achieve equivalent levels of health protection,
16 and thus no additional treatment technologies would be triggered by the small increases in the
17 frequency of exceeding the 100 µg/L threshold. Hence, no further impact on the drinking water
18 beneficial use would be expected at these locations.

19 The seasonal intakes at Mallard Slough and City of Antioch are infrequently used due to water
20 quality constraints related to sea water intrusion. On a long-term average basis, bromide at these
21 locations is in excess of 3,000 µg/L, but during seasonal periods of high Delta outflow can be <300
22 µg/L. Based on modeling using the mass-balance approach, use of the seasonal intakes at Mallard
23 Slough and City of Antioch under Alternative 6A would experience a period average increase in
24 bromide during the months when these intakes would most likely be utilized. For those wet and
25 above normal water year types where mass balance modeling would predict water quality typically
26 suitable for diversion, predicted long-term average bromide would increase from 103 µg/L to 162
27 µg/L (58% increase) at City of Antioch and would increase from 150 µg/L to 199 µg/L (33%
28 increase) at Mallard Slough relative to Existing Conditions (Appendix 8E, *Bromide*, Table 23).
29 Increases would be similar for the No Action Alternative comparison. Modeling results using the EC
30 to chloride and chloride to bromide relationships show increases during these months, but the
31 relative magnitude of the increases is much lower (Appendix 8E, *Bromide* Table 24). Regardless of
32 the differences in the data between the two modeling approaches, the decisions surrounding the use
33 of these seasonal intakes is largely driven by acceptable water quality, and thus have historically
34 been opportunistic. Opportunity to use these intakes would remain, and the predicted increases in
35 bromide concentrations at the City of Antioch and Mallard Slough intake would not be expected to
36 adversely affect MUN beneficial uses, or any other beneficial use, at these locations.

37 Based on modeling using the mass-balance approach, relative to existing and No Action Alternative
38 conditions, Alternative 6A would lead to predicted improvements in long-term average bromide
39 concentrations at Franks Tract, Rock Slough, and Contra Costa PP No. 1, in addition to Banks and
40 Jones (discussed below). At these locations, long-term average bromide concentrations would be
41 predicted to decrease by as much as 41–61%, depending on baseline comparison. Modeling results
42 using the EC to chloride and chloride to bromide relationships generally do not show similar
43 decreases for Rock Slough and Contra Costa PP No. 1, but rather, predict small increases. Based on
44 the small magnitude of increases predicted, these increases would not adversely affect beneficial
45 uses at those locations.

1 **SWP/CVP Export Service Areas**

2 Under Alternative 6A, improvement in long-term average bromide concentrations would occur at
3 the Banks and Jones pumping plants. Long-term average bromide concentrations for the modeled
4 16-year hydrologic period at these locations would decrease by as much as 96% relative to Existing
5 Conditions and the No Action Alternative (Appendix 8E, *Bromide*, Table 14). As a result, exceedances
6 of the 50 µg/L and 100 µg/L assessment thresholds would be completely eliminated, resulting in
7 considerable overall improvement in Export Service Areas water quality respective to bromide.
8 Commensurate with the decrease in exported bromide, an improvement in lower San Joaquin River
9 bromide would also be observed since bromide in the lower San Joaquin River is principally related
10 to irrigation water deliveries from the Delta. While the magnitude of this expected lower San
11 Joaquin River improvement in bromide is difficult to predict, the relative decrease in overall loading
12 of bromide to the Export Service Areas would likely alleviate or lessen any expected increase in
13 bromide concentrations at Vernalis (see discussion of Upstream of the Delta) as well as locations in
14 the Delta receiving a large fraction of San Joaquin River water, such as much of the south Delta.

15 The discussion above is based on results of the mass-balance modeling approach. Results of the
16 modeling approach which used relationships between EC and chloride and between chloride and
17 bromide (see Section 8.3.1.3) were consistent with the discussion above, and assessment of bromide
18 using these data results in the same conclusions as are presented above for the mass-balance
19 approach (see Appendix 8E, Table 15).

20 Similar to the discussion pertaining to the No Action Alternative, maintenance of SWP and CVP
21 facilities under Alternative 6A would not be expected to create new sources of bromide or
22 contribute towards a substantial change in existing sources of bromide in the affected environment.
23 Maintenance activities would not be expected to cause any substantial change in bromide such that
24 MUN beneficial uses, or any other beneficial use, would be adversely affected anywhere in the
25 affected environment.

26 **NEPA Effects:** In summary, Alternative 6A operations and maintenance, relative to the No Action
27 Alternative, would result in small increases (i.e., <1%) in long-term average bromide concentrations
28 at Vernalis related to relatively small declines in long-term average flow on the San Joaquin River.
29 However, Alternative 6A operation and maintenance activities would cause substantial degradation
30 to water quality with respect to bromide at Barker Slough, source of the North Bay Aqueduct.
31 Resultant substantial change in long-term average bromide at Barker Slough could necessitate
32 changes in water treatment plant operations or require treatment plant upgrades in order to
33 maintain DBP compliance, and thus would constitute an adverse effect on water quality. Mitigation
34 Measure WQ-5 is available to reduce these effects (implementation of this measure along with a
35 separate, non-environmental commitment as set forth in EIR/EIS Appendix 3B, *Environmental*
36 *Commitments*, relating to the potential increased treatment costs associated with bromide-related
37 changes would reduce these effects).

38 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
39 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
40 purpose of making the CEQA impact determination for this constituent. For additional details on the
41 effects assessment findings that support this CEQA impact determination, see the effects assessment
42 discussion that immediately precedes this conclusion.

43 Under Alternative 6A there would be no expected change to the sources of bromide in the
44 Sacramento and eastside tributary watersheds. Bromide loading in these watersheds would remain

1 unchanged and resultant changes in flows from altered system-wide operations under Alternative
2 6A would have negligible, if any, effects on the concentration of bromide in the rivers and reservoirs
3 of these watersheds. However, south of the Delta, the San Joaquin River is a substantial source of
4 bromide, primarily due to the use of irrigation water imported from the southern Delta.
5 Concentrations of bromide at Vernalis are inversely correlated to net river flow. Under Alternative
6 6A, long-term average flows at Vernalis would decrease only slightly, resulting in less than
7 substantial predicted increases in long-term average bromide of about 3% relative to Existing
8 Conditions.

9 Relative to Existing Conditions, Alternative 6A would result in substantial increases in long-term
10 average bromide concentration at Barker Slough and Staten Island. There are no existing or
11 foreseeable municipal drinking water intakes in the vicinity of Staten Island, but Barker Slough is
12 the source of the North Bay Aqueduct. The increase in long-term average bromide concentrations
13 predicted for Barker Slough would result in a substantial change in source water quality to existing
14 drinking water treatment plants drawing water from the North Bay Aqueduct. These modeled
15 increases in bromide at Barker Slough could lead to adverse changes in the formation of disinfection
16 byproducts at drinking water treatment plants such that considerable water treatment plant
17 upgrades would be necessary in order to achieve equivalent levels of drinking water health
18 protection.

19 The assessment of effects on bromide in the SWP/CVP Export Service Areas is based on assessment
20 of changes in bromide concentrations at Banks and Jones pumping plants. Under Alternative 6A,
21 substantial improvement would occur at the Banks and Jones pumping plants, where predicted
22 long-term average bromide concentrations are predicted to decrease by as much as 96% relative to
23 Existing Conditions. An overall improvement in bromide-related water quality would be predicted
24 in the SWP/CVP Export Service Areas.

25 Based on the above, Alternative 6A operation and maintenance would not result in any substantial
26 change in long-term average bromide concentration upstream of the Delta. Furthermore, under
27 Alternative 6A, water exported from the Delta to the SWP/CVP service area would be substantially
28 improved relative to bromide. Bromide is not bioaccumulative, therefore change in long-term
29 average bromide concentrations would not directly cause bioaccumulative problems in aquatic life
30 or humans. Additionally, bromide is not a constituent related to any 303(d) listings. Alternative 6A
31 operation and maintenance activities would not cause substantial long-term degradation to water
32 quality respective to bromide with the exception of water quality at Barker Slough and at Staten
33 Island in the eastern Delta. There are no existing or foreseeable municipal intakes in the vicinity of
34 Staten Island, but Barker Slough is the source of the North Bay Aqueduct. At Barker Slough, modeled
35 long-term annual average concentrations of bromide would increase by 19%, and 73% during the
36 modeled drought period. For the modeled 16-year hydrologic period the frequency of predicted
37 bromide concentrations exceeding 100 µg/L would increase from 0% under Existing Conditions to
38 17% under Alternative 6A, while for the modeled drought period, the frequency would increase
39 from 0% to 37%. Substantial changes in long-term average bromide could necessitate changes in
40 treatment plant operation or require treatment plant upgrades in order to maintain DBP
41 compliance. The model predicted change at Barker Slough is substantial and, therefore, would
42 represent a substantially increased risk for adverse effects on existing MUN beneficial uses should
43 treatment upgrades not be undertaken. The impact is considered significant.

44 Implementation of Mitigation Measure WQ-5 along with a separate, non-environmental
45 commitment relating to the potential increased treatment costs associated with bromide-related

1 changes would reduce these effects. While mitigation measures to reduce these water quality effects
 2 in affected water bodies to less than significant levels are not available, implementation of
 3 Mitigation Measure WQ-5 is recommended to attempt to reduce the effect that increased bromide
 4 concentrations may have on Delta beneficial uses. However, because the effectiveness of this
 5 mitigation measure to result in feasible measures for reducing water quality effects is uncertain, this
 6 impact is considered to remain significant and unavoidable. Please see Mitigation Measure WQ-5
 7 under Impact WQ-5 in the discussion of Alternative 1A.

8 In addition to and to supplement Mitigation Measure WQ-5, the BDCP proponents have incorporated
 9 into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*, a separate, non-
 10 environmental commitment to address the potential increased water treatment costs that could
 11 result from bromide-related concentration effects on municipal water purveyor operations.
 12 Potential options for making use of this financial commitment include funding or providing other
 13 assistance towards implementation of the North Bay Aqueduct AIP, acquiring alternative water
 14 supplies, or other actions to indirectly reduce the effects of elevated bromide and DOC in existing
 15 water supply diversion facilities. Please refer to Appendix 3B, *Environmental Commitments*, for the
 16 full list of potential actions that could be taken pursuant to this commitment in order to reduce the
 17 water quality treatment costs associated with water quality effects relating to chloride, electrical
 18 conductivity, and bromide.

19 **Mitigation Measure WQ-5: Avoid, Minimize, or Offset, as Feasible, Adverse Water Quality**
 20 **Conditions**

21 Please see Mitigation Measure WQ-5 under Impact WQ-5 in the discussion of Alternative 1A.

22 **Impact WQ-6: Effects on Bromide Concentrations Resulting from Implementation of CM2–**
 23 **CM22**

24 **NEPA Effects:** Conservation Measures 2–22 proposed under Alternative 6A would be the same as
 25 those proposed under Alternative 1A. As discussed for Alternative 1A, implementation of the CM2–
 26 CM22 would not present new or substantially changed sources of bromide to the study area. Some
 27 conservation measures may replace or substitute for existing irrigated agriculture in the Delta. This
 28 replacement or substitution is not expected to substantially increase or present new sources of
 29 bromide. CM2–CM22 would not be expected to cause any substantial change in bromide such that
 30 MUN beneficial uses, or any other beneficial use, would be adversely affected anywhere in the
 31 affected environment.

32 In summary, implementation of CM2–CM22 under Alternative 6A, relative to the No Action
 33 Alternative, would have negligible, if any, effects on bromide concentrations. The effects on bromide
 34 from implementing CM2–CM22 are determined to not be adverse.

35 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 6A would be similar to
 36 those proposed under Alternative 1A. As such, effects on bromide resulting from the
 37 implementation of CM2–CM22 would be similar to that previously discussed for Alternative 1A. This
 38 impact is considered to be less than significant. No mitigation is required.

1 **Impact WQ-7: Effects on Chloride Concentrations Resulting from Facilities Operations and**
2 **Maintenance (CM1)**

3 ***Upstream of the Delta***

4 Under Alternative 6A there would be no expected change to the sources of chloride in the
5 Sacramento and eastside tributary watersheds. Chloride loading in these watersheds would remain
6 unchanged and resultant changes in flows from altered system-wide operations would have
7 negligible, if any, effects on the concentration of chloride in the rivers and reservoirs of these
8 watersheds. The modeled long-term annual average flows on the lower San Joaquin River at Vernalis
9 would decrease slightly compared to Existing Conditions and be similar compared to the No Action
10 Alternative (as a result of climate change). The reduced flow would result in possible increases in
11 long-term average chloride concentrations of about 2%, relative to the Existing Conditions and no
12 change relative to No Action Alternative (Appendix 8G, Table CI-62). Consequently, Alternative 6A
13 would not be expected to cause exceedance of chloride objectives/criteria or substantially degrade
14 water quality with respect to chloride, and thus would not adversely affect any beneficial uses of the
15 Sacramento River, the eastside tributaries, associated reservoirs upstream of the Delta, or the San
16 Joaquin River.

17 ***Delta***

18 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
19 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
20 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
21 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
22 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
23 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

24 Relative to the Existing Conditions and No Action Alternative, the predicted long-term average
25 chloride concentrations under Alternative 6A for the 16-year period modeled would be substantially
26 reduced at most of the assessment locations (Appendix 8G, *Chloride*, Table CI-37 and Table CI-38).
27 Moreover, the direction and magnitude of predicted changes for Alternative 6A are similar between
28 the alternatives, thus, the effects relative to Existing Conditions and the No Action Alternative are
29 discussed together. Depending on the modeling approach (see Section 8.3.1.3), the average chloride
30 concentrations would be increased at the North Bay Aqueduct at Barker Slough (i.e., ≤15%) and San
31 Joaquin River at Staten Island (i.e., ≤37%). Additionally, implementation of tidal habitat restoration
32 under CM4 would increase the tidal exchange volume in the Delta, and thus may contribute to
33 increased chloride concentrations in the Bay source water as a result of increased salinity intrusion.
34 More discussion of this phenomenon is included in Section 8.3.1.3. Consequently, while uncertain,
35 the magnitude of chloride increases may be greater than indicated herein and would affect the
36 western Delta assessment locations the most which are influenced to the greatest extent by the Bay
37 source water. The comparison to Existing Conditions reflects changes in chloride due to both
38 Alternative 6A operations (including north Delta intake capacity of 15,000 cfs and numerous other
39 operational components of Scenario D) and climate change/sea level rise. The comparison to the No
40 Action Alternative reflects changes in chloride due only to operations. The following outlines the
41 modeled chloride changes relative to the applicable objectives and beneficial uses of Delta waters.

1 *Municipal Beneficial Uses*

2 Estimates of chloride concentrations generated using EC-chloride relationships and DSM2 EC output
3 (see Section 8.3.1.3) were used to evaluate the 150 mg/L Bay-Delta WQCP objective for municipal
4 and industrial beneficial uses on a basis of the percent of years the chloride objective is exceeded for
5 the modeled 16-year period. The objective is exceeded if chloride concentrations exceed 150 mg/L
6 for a specified number of days in a given water year at both the Antioch and Contra Costa Pumping
7 Plant #1 locations. For Alternative 6A, the modeled frequency of objective exceedance would
8 increase from 6% of years under Existing Conditions and 6% under the No Action Alternative to
9 13% of years under Alternative 6A (Appendix 8G, Table CI-64).

10 Similarly, estimates of chloride concentrations generated using EC-chloride relationships and DSM2
11 EC output (see Section 8.3.1.3) were also used to evaluate the 250 mg/L Bay-Delta WQCP objective
12 for chloride at Contra Costa Pumping Plant #1 where daily average objectives apply. The basis for
13 the evaluation was the predicted number of days the objective was exceeded for the modeled 16-
14 year period. For Alternative 6A, the modeled frequency of objective exceedance would be
15 eliminated, from 6% of modeled days under Existing Conditions and 5% under the No Action
16 Alternative to 0% of modeled days under Alternative 6A (Appendix 8G, Table CI-63).

17 Given the limitations inherent to estimating future chloride concentrations (see Section 8.3.1.3),
18 estimation of chloride concentrations through both a mass balance approach and an EC-chloride
19 relationship approach was used to evaluate the 250 mg/L Bay-Delta WQCP objectives in terms of
20 both frequency of exceedance and use of assimilative capacity. When utilizing the mass balance
21 approach to model monthly average chloride concentrations for the 16-year period, the predicted
22 frequency of exceeding the 250 mg/L objective would be eliminated at the Contra Costa Canal at
23 Pumping Plant #1 (24% for Existing Conditions to 0% for Alternative 6A), thus indicating complete
24 compliance with this objective would be achieved (Appendix 8G, Table CI-39 and Figure CI-9). The
25 frequency of exceedances at the San Joaquin River at Antioch also would decrease compared to all of
26 the alternative scenarios (i.e., 9% from 66% for Existing Conditions to 57%) with no substantial
27 change predicted for Mallard Island (i.e., maximum increase of 1%) (Appendix 8G, Table CI-39).
28 However, available assimilative capacity would be reduced relative to Existing Conditions in April
29 (i.e., up to 21%) (Appendix 8G, Table CI-41) reflecting substantial degradation during a month when
30 average concentrations would be near, or exceed, the objective.

31 In comparison, when utilizing the chloride-EC relationship to model monthly average chloride
32 concentrations for the 16-year period, trends in frequency of exceedance generally agreed, but use
33 of assimilative capacity were predicted to be larger at some locations (Appendix 8G, Table CI-40 and
34 Table CI-42). Specifically, while the model predicted exceedance frequency would decrease at the
35 Contra Costa Canal at Pumping Plant #1 and Rock Slough locations, use of assimilative capacity
36 would increase substantially for the months of February through June. (i.e., maximum of 81% in
37 March for the modeled drought period). Due to such seasonal long-term average water quality
38 degradation at these locations, the potential exists for substantial adverse effects on the municipal
39 and industrial beneficial uses through reduced opportunity for diversion of water with acceptable
40 chloride levels. Moreover, due to the increased frequency of exceeding the 150 mg/L Bay-Delta
41 WQCP objective, the potential exists for additional adverse effects on the municipal and industrial
42 beneficial uses at Contra Costa Pumping Plant #1 and Antioch.

1 303(d) Listed Water Bodies

2 With respect to the 303(d) listing for chloride in Tom Paine Slough, the monthly average chloride
3 concentrations for the 16-year period modeled at Old River at Tracy Road would generally be
4 similar compared to Existing Conditions, and thus, would not be further degraded on a long-term
5 basis (Appendix 8G, Figure Cl-10). With respect to Suisun Marsh, the monthly average chloride
6 concentrations for the 16-year period modeled would generally increase compared to Existing
7 Conditions and No Action Alternative in some months during October through May at the
8 Sacramento River at Collinsville (Appendix 8G, Figure Cl-11), Mallard Island (Appendix 8G, Figure
9 Cl-9), and increase substantially at Montezuma Slough at Beldon's Landing (i.e., over a doubling of
10 concentration in December through February) (Appendix 8G, Figure Cl-12), thereby contributing to
11 additional, measureable long-term degradation that potentially would adversely affect the necessary
12 actions to reduce chloride loading for any TMDL that is developed.

13 SWP/CVP Export Service Areas

14 Under Alternative 6A, long-term average chloride concentrations based on the mass balance
15 analysis of modeling results for the 16-year period modeled at the Banks and Jones pumping plants
16 would decrease by approximately 95% relative to Existing Conditions and No Action Alternative
17 (Appendix 8G, *Chloride*, Table Cl-37). The modeled low-frequency exceedances of objectives present
18 under the Existing Conditions and No Action Alternative would be eliminated under Alternative 6A
19 (Appendix 8G, *Chloride*, Table Cl-39). Consequently, water exported into the SWP/CVP service area
20 would generally be improved with regards to chloride relative to Existing Conditions and No Action
21 Alternative conditions.

22 Results of the modeling approach which used relationships between EC and chloride (see Section
23 8.3.1.3) were consistent with the discussion above, and assessment of chloride using these data
24 results in the same conclusions as are presented above for the mass-balance approach (Appendix
25 8G, Table Cl-38 and Table Cl-40).

26 Commensurate with the reduced chloride concentrations in water exported to the service area,
27 reduced chloride loading in the lower San Joaquin River would be anticipated which would likely
28 alleviate or lessen any expected increase in chloride at Vernalis related to decreased annual average
29 San Joaquin River flows (see discussion of Upstream of the Delta).

30 Maintenance of SWP and CVP facilities would not be expected to create new sources of chloride or
31 contribute towards a substantial change in existing sources of chloride in the affected environment.
32 Maintenance activities would not be expected to cause any substantial change in chloride such that
33 any long-term water quality degradation would occur, thus, beneficial uses would not be adversely
34 affected anywhere in the affected environment.

35 **NEPA Effects:** In summary, relative to the No Action Alternative conditions, Alternative 6A would
36 result in increased frequency of exceedance of the 150 mg/L Bay-Delta WCCP objective at Contra
37 Costa Pumping Plant #1 and Antioch, substantial seasonal use of assimilative capacity at Contra
38 Costa Pumping Plant #1, Antioch, and Rock Slough, and increased concentrations with respect to the
39 303(d) impairment in Suisun Marsh. The predicted chloride increases constitute an adverse effect
40 on water quality (see Mitigation Measure WQ-7 below; implementation of this measure along with a
41 separate, non-environmental commitment relating to the potential increased chloride treatment
42 costs would reduce these effects). Additionally, the predicted changes relative to the No Action
43 Alternative conditions indicate that in addition to the effects of climate change/sea level rise,

1 implementation of CM1 and CM4 under Alternative 6A would contribute substantially to the adverse
2 water quality effects.

3 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
4 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
5 purpose of making the CEQA impact determination for this constituent. For additional details on the
6 effects assessment findings that support this CEQA impact determination, see the effects assessment
7 discussion that immediately precedes this conclusion.

8 Chloride is not a constituent of concern in the Sacramento River watershed upstream of the Delta,
9 thus river flow rate and reservoir storage reductions that would occur under the Alternative 6A,
10 relative to Existing Conditions, would not be expected to result in a substantial adverse change in
11 chloride levels. Additionally, relative to Existing Conditions, the Alternative 6A would not result in
12 reductions in river flow rates (i.e., less dilution) or increased chloride loading such that there would
13 be any substantial increase in chloride concentrations upstream of the Delta in the San Joaquin River
14 watershed.

15 Relative to Existing Conditions, Alternative 6A operations would result in substantially reduced
16 chloride concentrations in the Delta such that exceedances of the 250 mg/L Bay-Delta WQCP
17 objective at the San Joaquin River at Antioch and Mallard Slough would be reduced. Nevertheless,
18 due to the predicted increased frequency of exceeding the 150 mg/L Bay-Delta WQCP objective at
19 Contra Costa Pumping Plant #1 and Antioch, and the substantial seasonal use of assimilative
20 capacity at Contra Costa Pumping Plant #1 and Rock Slough, the potential exists for adverse effects
21 on the municipal and industrial beneficial uses at these locations (see Mitigation Measure WQ-7
22 below; implementation of this measure along with a separate, non-environmental commitment
23 relating to the potential increased chloride treatment costs would reduce these effects). Moreover,
24 the modeled increased chloride concentrations and degradation in the western Delta could still
25 occur and further contribute, at measurable levels (i.e., over a doubling of concentration), to the
26 existing 303(d) listed impairment due to chloride in Suisun Marsh for the protection of fish and
27 wildlife. Based on these findings, this impact is determined to be significant due to increased
28 frequency of exceedance of the 150 mg/L Bay-Delta WQCP objective as well as potential adverse
29 effects on fish and wildlife beneficial uses in Suisun Marsh.

30 Chloride concentrations would be reduced in water exported from the Delta to the CVP/SWP Export
31 Service Areas, thus reflecting a potential improvement to chloride loading in the lower San Joaquin
32 River.

33 Chloride is not a bioaccumulative constituent, thus any increased concentrations under Alternative
34 6A would not result in substantial chloride bioaccumulation impacts on aquatic life or humans.
35 Alternative 6A maintenance would not result in any substantial changes in chloride concentration
36 upstream of the Delta or in the SWP/CVP Export Service Areas. However, based on these findings,
37 this impact is determined to be significant due to increased chloride concentrations and degradation
38 in Suisun Marsh and its effects on fish and wildlife beneficial uses.

39 While mitigation measures to reduce these water quality effects in affected water bodies to less than
40 significant levels are not available, implementation of Mitigation Measure WQ-7 is recommended to
41 attempt to reduce the effect that increased chloride concentrations may have on Delta beneficial
42 uses. However, because the effectiveness of this mitigation measure to result in feasible measures
43 for reducing water quality effects is uncertain, this impact is considered to remain significant and

1 unavoidable. Please see Mitigation Measure WQ-7 under Impact WQ-7 in the discussion of
2 Alternative 1A.

3 In addition to and to supplement Mitigation Measure WQ-7, the BDCP proponents have incorporated
4 into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*, a separate, non-
5 environmental commitment to address the potential increased water treatment costs that could
6 result from chloride concentration effects on municipal, industrial and agricultural water purveyor
7 operations. Potential options for making use of this financial commitment include funding or
8 providing other assistance towards acquiring alternative water supplies or towards modifying
9 existing operations when chloride concentrations at a particular location reduce opportunities to
10 operate existing water supply diversion facilities. Please refer to Appendix 3B, *Environmental*
11 *Commitments*, for the full list of potential actions that could be taken pursuant to this commitment in
12 order to reduce the water quality treatment costs associated with water quality effects relating to
13 chloride, electrical conductivity, and bromide.

14 **Mitigation Measure WQ-7: Conduct Additional Evaluation and Modeling of Increased**
15 **Chloride Levels and Develop and Implement Phased Mitigation Actions**

16 Please see Mitigation Measure WQ-7 under Impact WQ-7 in the discussion of Alternative 1A.

17 **Impact WQ-8: Effects on Chloride Concentrations Resulting from Implementation of CM2-**
18 **CM22**

19 **NEPA Effects:** Under Alternative 6A, the types and geographic extent of effects on chloride
20 concentrations in the Delta as a result of implementation of the other conservation measures (i.e.,
21 CM2–CM22) would be similar to, and undistinguishable from, those effects previously described for
22 Alternative 1A. The conservation measures would present no new direct sources of chloride to the
23 affected environment. Moreover, some habitat restoration conservation measures (CM4–10) would
24 occur on lands within the Delta currently used for irrigated agriculture, thus replacing agricultural
25 land uses with restored tidal wetlands, floodplain, and related channel margin and off-channel
26 habitats. The potential reduction in irrigated lands within the Delta may result in reduced
27 discharges of agricultural field drainage with elevated chloride concentrations, which would be
28 considered an improvement compared to No Action Alternative conditions.

29 In summary, based on the discussion above, the effects on chloride from implementing CM2-CM22
30 are considered to be not adverse.

31 **CEQA Conclusion:** Implementation of the CM2–CM22 for Alternative 6A would not present new or
32 substantially changed sources of chloride to the affected environment upstream of the Delta, within
33 Delta, or in the SWP/CVP service area. Replacement of irrigated agricultural land uses in the Delta
34 with habitat restoration conservation measures may result in some reduction in discharge of
35 agricultural field drainage with elevated chloride concentrations, thus resulting in improved water
36 quality conditions. Based on these findings, this impact is considered to be less than significant. No
37 mitigation is required.

38 **Impact WQ-9: Effects on Dissolved Oxygen Resulting from Facilities Operations and**
39 **Maintenance (CM1)**

40 **NEPA Effects:** Effects of CM1 on dissolved oxygen under Alternative 6A are the same as those
41 discussed for Alternative 1A and are considered to not be adverse.

1 **CEQA Conclusion:** Effects of CM1 on DO under Alternative 6A would be similar to those discussed
2 for Alternative 1A, and are summarized here, then compared to the CEQA thresholds of significance
3 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this
4 constituent. For additional details on the effects assessment findings that support this CEQA impact
5 determination, see the effects assessment discussion under the Alternative 1A.

6 River flow rate and reservoir storage reductions that would occur under Alternative 6A, relative to
7 Existing Conditions, would not be expected to result in a substantial adverse change in DO levels in
8 the reservoirs and rivers upstream of the Delta, given that mean monthly flows would remain within
9 the ranges historically seen under Existing Conditions and the affected river are large and turbulent.
10 Any reduced DO saturation level that may be caused by increased water temperature would not be
11 expected to cause DO levels to be outside of the range seen historically. Finally, amounts of oxygen
12 demanding substances and salinity would not be expected to change sufficiently to affect DO levels.

13 It is expected there would be no substantial change in Delta DO levels in response to a shift in the
14 Delta source water percentages under this alternative or substantial degradation of these water
15 bodies, with regard to DO. DO levels would be affected by nutrient loading, which the state has
16 begun to aggressively regulate the discharges of, and this loading would not be expected to lower DO
17 levels relative to Existing Conditions based on historical DO levels. Further, the anticipated changes
18 in salinity would have relatively minor effects on DO levels, and tidal exchange, which contribute to
19 the reaeration of Delta waters would not be expected to change substantially.

20 There is not expected to be substantial, if even measurable, changes in DO levels in the SWP/CVP
21 Export Service Areas waters under Alternative 6A, relative to Existing Conditions, because the
22 biochemical oxygen demand of the exported water would not be expected to substantially differ
23 from that under Existing Conditions (due to ever increasing water quality regulations), canal
24 turbulence and exposure of the water to the atmosphere and the algal communities that exist within
25 the canals would establish an equilibrium for DO levels within the canals. The same would occur in
26 downstream reservoirs.

27 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
28 objectives by frequency, magnitude, and geographic extent that would result in significant impacts
29 on any beneficial uses within affected water bodies. Because no substantial changes in DO levels are
30 expected, long-term water quality degradation would not be expected to occur, and, thus, beneficial
31 uses would not be adversely affected. Various Delta waterways are 303(d)-listed for low DO, but
32 because no substantial decreases in DO levels would be expected, greater degradation and DO-
33 related impairment of these areas would not be expected. This impact would be less than significant.
34 No mitigation is required.

35 **Impact WQ-10: Effects on Dissolved Oxygen Resulting from Implementation of CM2–CM22**

36 **NEPA Effects:** Effects of CM2–CM22 on DO under Alternative 6A are the same as those discussed for
37 Alternative 1A and are considered to not be adverse.

38 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 6A would be similar to
39 those proposed under Alternative 1A. As such, effects on DO resulting from the implementation of
40 CM2–CM22 would be similar to that previously discussed for Alternative 1A. This impact is
41 considered to be less than significant. No mitigation is required.

1 **Impact WQ-11: Effects on Electrical Conductivity Concentrations Resulting from Facilities**
2 **Operations and Maintenance (CM1)**

3 ***Upstream of the Delta***

4 For the same reasons stated for the No Action Alternative, EC levels (highs, lows, typical conditions)
5 in the Sacramento River and its tributaries, the eastside tributaries, their associated reservoirs, and
6 the San Joaquin River upstream of the Delta under Alternative 6A are not expected to be outside the
7 ranges occurring under Existing Conditions or would occur under the No Action Alternative. Any
8 minor changes in EC levels that could occur under Alternative 6A in water bodies upstream of the
9 Delta would not be of sufficient magnitude, frequency and geographic extent that would cause
10 adverse effects on beneficial uses or substantially degrade water quality with regard to EC.

11 ***Delta***

12 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
13 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
14 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
15 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
16 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
17 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

18 Relative to Existing Conditions, Alternative 6A would result in an increase in the number of days the
19 Bay-Delta WQCP EC objectives for fish and wildlife protection (which apply during April and May)
20 would be exceeded in the San Joaquin River at Jersey Point and Prisoners Point (Appendix 8H, Table
21 EC-6), and an increase in exceedance of the agricultural EC objective for the Sacramento River at
22 Emmaton. The percent of days the EC objective would be exceeded at Jersey Point for the entire
23 period modeled (1976–1991) would increase from 0% under Existing Conditions to 3% under
24 Alternative 6A, and the percent of days out of compliance with the EC objective would increase from
25 0% under Existing Conditions to 5% under Alternative 6A. The percent of days the EC objective
26 would be exceeded at Prisoners Point for the entire period modeled would increase from 6% under
27 Existing Conditions to 34% under Alternative 6A, and the percent of days out of compliance with the
28 EC objective would increase from 10% under Existing Conditions to 34% under Alternative 6A. At
29 Emmaton, the percent of days the EC objective would be exceeded would increase from 6% under
30 Existing Conditions to 28% under Alternative 6A, and the percent of days out of compliance would
31 increase from 11% under Existing Conditions to 40% under Alternative 6A. Average EC levels at the
32 western and southern Delta compliance locations and San Joaquin River at San Andreas Landing (an
33 interior Delta location) would decrease from 2–56% for the entire period modeled and 3–52%
34 during the drought period modeled (1987–1991) (Appendix 8H, Table EC-17). In the S. Fork
35 Mokelumne River at Terminous, average EC would increase 7% for the entire period modeled and
36 6% during the drought period modeled. Average EC in the S. Fork Mokelumne River at Terminous
37 (an interior Delta location) would increase during all months (Appendix 8H, Table EC-17). The
38 western Delta is Clean Water Act section 303(d) listed as impaired due to elevated EC and there
39 would be an increased exceedance of the EC objective at Emmaton, Thus, relative to Existing
40 Conditions, Alternative 6A could contribute to additional impairment of section 303(d) listed
41 waters. The comparison to Existing Conditions reflects changes in EC due to both Alternative 6A
42 operations (including north Delta intake capacity of 15,000 cfs and numerous other operational
43 components of Scenario D) and climate change/sea level rise.

1 Relative to the No Action Alternative, the change in percent compliance with Bay-Delta WQCP EC
2 objectives under Alternative 6A would be similar to that described above relative to Existing
3 Conditions for the Sacramento River at Emmaton, and the San Joaquin River at Jersey Point and
4 Prisoners Point. In addition, there would also be a slight increase (<1%) in the percent of days the
5 EC objective would be exceeded in Old River at Tracy Bridge for the entire period modeled. For the
6 entire period modeled, average EC levels would increase at: S. Fork Mokelumne River at Terminous;
7 San Joaquin River at Brandt Bridge and Prisoners Point; and Old River at Tracy Bridge. The greatest
8 average EC increase would occur in the S. Fork Mokelumne River at Terminous (8%); the average EC
9 increase at the other locations would be <1–3% (Appendix 8H, Table EC-17). During the drought
10 period modeled, average EC would increase at the same locations, except San Joaquin River at
11 Prisoners Point. The greatest average EC increase during the drought period modeled would occur
12 in the S. Fork Mokelumne River at Terminous (7%); the increase at the other locations would be 1–
13 2% (Appendix 8H, Table EC-17). Given that the western and southern Delta are Clean Water Act
14 section 303(d) listed as impaired due to elevated EC, the increase in the incidence of exceedance of
15 EC objectives and increase in long-term and drought period average EC under Alternative 6A at
16 southern Delta compliance locations and increase in exceedance of EC objectives at Emmaton,
17 relative to the No Action Alternative, has the potential to contribute to additional impairment and
18 potentially adversely affect beneficial uses. The comparison to the No Action Alternative reflects
19 changes in EC due only to Alternative 6A operations (including north Delta intake capacity of 15,000
20 cfs and numerous other operational components of Scenario D).

21 For Suisun Marsh, October–May is the period when Bay-Delta WQCP EC objectives for protection of
22 fish and wildlife apply. Long-term average EC would increase under Alternative 6A, relative to
23 Existing Conditions, during the months of April and May by 0.2–0.4 mS/cm in the Sacramento River
24 at Collinsville (Appendix 8H, Table EC-21). Long-term average EC would decrease relative to
25 Existing Conditions in Montezuma Slough at National Steel during October–May (Appendix 8H,
26 Table EC-22). The most substantial increase would occur near Beldon Landing, with long-term
27 average EC levels increasing by 0.8–2.2 mS/cm, depending on the month, nearly doubling during
28 some months the long-term average EC relative to Existing Conditions (Appendix 8H, Table EC-23).
29 Sunrise Duck Club and Volanti Slough also would have long-term average EC increases during
30 February–May of 0.4–1.7 mS/cm (Appendix 8H, Tables EC-24 and EC-25). The degree to which the
31 long-term average EC increases would cause exceedance of Bay-Delta WQCP objectives is unknown,
32 because objectives are expressed as a monthly average of daily high tide EC, which does not have to
33 be met if it can be demonstrated “equivalent or better protection will be provided at the location”
34 (State Water Resources Control Board 2006:14). The described long-term average EC increase may,
35 or may not, contribute to adverse effects on beneficial uses, depending on how and when wetlands
36 are flooded, soil leaching cycles, and how agricultural use of water is managed, and future actions
37 taken with respect to the marsh. However, the EC increases at certain locations would be substantial
38 and it is uncertain the degree to which current management plans for the Suisun Marsh would be
39 able to address these substantially higher EC levels and protect beneficial uses. Thus, these
40 increased EC levels in Suisun Marsh are considered to have a potentially adverse effect on marsh
41 beneficial uses. Long-term average EC increases in Suisun Marsh under Alternative 6A relative to the
42 No Action Alternative would be similar to the increases relative to Existing Conditions. Suisun Marsh
43 also is section 303(d) listed as impaired due to elevated EC, and the potential increases in long-term
44 average EC concentrations could contribute to additional impairment, because the increases would
45 be double that relative to Existing Conditions and the No Action Alternative.

1 **SWP/CVP Export Service Areas**

2 At the Banks and Jones pumping plants, Alternative 6A would result in no exceedances of the Bay-Delta WQCP's 1,000 $\mu\text{mhos/cm}$ EC objective for the entire period modeled (Appendix 8H, Table EC-10). Thus, there would be no adverse effect on the beneficial uses in the SWP/CVP Export Service Areas using water pumped at this location under the Alternative 6A.

6 At the Banks pumping plant, relative to Existing Conditions, average EC levels under Alternative 6A would decrease substantially on average: 67% for the entire period modeled and 73% during the drought period modeled. Relative to the No Action Alternative, average EC levels would decrease by 64% for the entire period modeled and 71% during the drought period modeled. (Appendix 8H, Table EC-17)

11 At the Jones pumping plant, relative to Existing Conditions, average EC levels under Alternative 6A would also decrease substantially: 68% for the entire period modeled and 74% during the drought period modeled. Relative to the No Action Alternative, average EC levels would decrease by 67% for the entire period modeled and 73% during the drought period modeled. (Appendix 8H, Table EC-17)

15 Based on the decreases in long-term average EC levels that would occur at the Banks and Jones pumping plants, Alternative 6A would not cause degradation of water quality with respect to EC in the SWP/CVP Export Service Areas; rather, Alternative 6A would improve long-term average EC conditions in the SWP/CVP Export Service Areas.

19 Commensurate with the EC decrease in exported waters, an improvement in lower San Joaquin River average EC levels would be expected since EC in the lower San Joaquin River is, in part, related to irrigation water deliveries from the Delta. While the magnitude of this expected lower San Joaquin River improvement in EC is difficult to predict, the relative decrease in overall loading of EC-elevating constituents to the Export Service Areas would likely alleviate or lessen any expected increase in EC at Vernalis related to decreased annual average San Joaquin River flows (see EC impact discussion under the No Action Alternative).

26 The export area of the Delta is listed on the state's CWA Section 303(d) list as impaired due to elevated EC. Alternative 6A would result in lower average EC levels relative to Existing Conditions and the No Action Alternative and, thus, would not contribute to additional beneficial use impairment related to elevated EC in the SWP/CVP Export Service Areas waters.

30 **NEPA Effects:** In summary, the increased frequency of exceedance of EC objectives and increased long-term and drought period average EC levels that would occur at southern Delta compliance locations, and increased exceedance of objectives in the western Delta under Alternative 6A, relative to the No Action Alternative, would contribute to adverse effects on the agricultural beneficial uses. In addition, the increased frequency of exceedance of the San Joaquin River at Prisoners Point and Jersey Point EC objectives and long-term and drought period average EC at Prisoners Point could contribute to adverse effects on fish and wildlife beneficial uses. Given that the western and southern Delta are Clean Water Act section 303(d) listed as impaired due to elevated EC, the increase in the incidence of exceedance of EC objectives and long-term average and drought period average EC in these portions of the Delta has the potential to contribute to additional beneficial use impairment. The increases in long-term average EC levels that would occur in Suisun Marsh would further degrade existing EC levels and could contribute additional to adverse effects on the fish and wildlife beneficial uses. Suisun Marsh is section 303(d) listed as impaired due to elevated EC, and the potential increases in long-term average EC levels could contribute to additional beneficial use

1 impairment. These increases in EC constitute an adverse effect on water quality. Mitigation Measure
2 WQ-11 would be available to reduce these effects (implementation of this measure along with a
3 separate, non-environmental commitment as set forth in EIR/EIS Appendix 3B, *Environmental*
4 *Commitments*, relating to the potential EC-related changes would reduce these effects).

5 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
6 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
7 purpose of making the CEQA impact determination for this constituent. For additional details on the
8 effects assessment findings that support this CEQA impact determination, see the effects assessment
9 discussion that immediately precedes this conclusion.

10 River flow rate and reservoir storage reductions that would occur under Alternative 6A, relative to
11 Existing Conditions, would not be expected to result in a substantial adverse change in EC levels in
12 the reservoirs and rivers upstream of the Delta, given that: changes in the quality of watershed
13 runoff and reservoir inflows would not be expected to occur in the future; the state's aggressive
14 regulation of point-source discharge effects on Delta salinity-elevating parameters and the expected
15 further regulation as salt management plans are developed; the salt-related TMDLs adopted and
16 being developed for the San Joaquin River; and the expected improvement in lower San Joaquin
17 River average EC levels commensurate with the lower EC of the irrigation water deliveries from the
18 Delta.

19 Relative to Existing Conditions, Alternative 6A would not result in any substantial increases in long-
20 term average EC levels in the SWP/CVP Export Service Areas. There would be no exceedance of the
21 EC objective at the Jones and Banks pumping plants. Average EC levels for the entire period modeled
22 would decrease at both plants and, thus, this alternative would not contribute to additional
23 beneficial use impairment related to elevated EC in the SWP/CVP Export Service Areas waters.
24 Rather, this alternative would improve long-term EC levels in the SWP/CVP Export Service Areas,
25 relative to Existing Conditions.

26 Alternative 6A would result in an increase in the frequency with which Bay-Delta WQCP EC
27 objectives for fish and wildlife protection are exceeded in the San Joaquin River at Jersey Point (from
28 0% under Existing Conditions to 3% under Alternative 6A) and Prisoners Point (from 6% under
29 Existing Conditions to 34% under Alternative 6A), and an increase in the EC agricultural objectives
30 at Emmaton for the entire period modeled (1976–1991). Because EC is not bioaccumulative, the
31 increases in long-term average EC levels would not directly cause bioaccumulative problems in
32 aquatic life or humans. Portions of the Delta on the Clean Water Act section 303(d) list as impaired
33 due to elevated EC would not have increased long-term average EC levels relative to Existing
34 Conditions. However, at Emmaton, which is in the western Delta, there would be an increased
35 frequency of exceedance of the EC objective. Thus, Alternative 6A could contribute to additional
36 impairment of section 303(d) listed waters. The increased frequency of exceedance of fish and
37 wildlife EC objectives at Prisoners Point and Jersey Point could adversely affect aquatic life
38 beneficial uses. This impact is considered to be significant.

39 Further, relative to Existing Conditions, Alternative 6A would result in substantial increases in long-
40 term average EC during the months of October through May in Suisun Marsh, such that EC levels
41 would nearly double that relative to Existing Conditions. The increases in long-term average EC
42 levels that would occur in Suisun Marsh could further degrade existing EC levels and thus contribute
43 additionally to adverse effects on the fish and wildlife beneficial uses. Because EC is not
44 bioaccumulative, the increases in long-term average EC levels would not directly cause

1 bioaccumulative problems in wildlife. Suisun Marsh is Clean Water Act section 303(d) listed for
 2 elevated EC and the increases in long-term average EC that would occur in the marsh could make
 3 beneficial use impairment measurably worse. This impact is considered to be significant.

4 Implementation of Mitigation Measure WQ-11 along with a separate, non-environmental
 5 commitment relating to the potential increased costs associated with EC-related changes would
 6 reduce these effects. While mitigation measures to reduce these water quality effects in affected
 7 water bodies to less than significant levels are not available, implementation of Mitigation Measure
 8 WQ-11 is recommended to attempt to reduce the effect that increased EC concentrations may have
 9 on Delta beneficial uses. However, because the effectiveness of this mitigation measure to result in
 10 feasible measures for reducing water quality effects is uncertain, this impact is considered to remain
 11 significant and unavoidable. Please see Mitigation Measure WQ-11 under Impact WQ-11 in the
 12 discussion of Alternative 1A.

13 In addition to and to supplement Mitigation Measure WQ-11, the BDCP proponents have
 14 incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*, a
 15 separate, non-environmental commitment to address the potential increased water treatment costs
 16 that could result from EC concentration effects on municipal, industrial and agricultural water
 17 purveyor operations. Potential options for making use of this financial commitment include funding
 18 or providing other assistance towards acquiring alternative water supplies or towards modifying
 19 existing operations when EC concentrations at a particular location reduce opportunities to operate
 20 existing water supply diversion facilities. Please refer to Appendix 3B, *Environmental Commitments*,
 21 for the full list of potential actions that could be taken pursuant to this commitment in order to
 22 reduce the water quality treatment costs associated with water quality effects relating to chloride,
 23 electrical conductivity, and bromide.

24 **Mitigation Measure WQ-11: Avoid, Minimize, or Offset, as Feasible, Reduced Water**
 25 **Quality Conditions**

26 Please see Mitigation Measure WQ-11 under Impact WQ-11 in the discussion of Alternative 1A.

27 **Impact WQ-12: Effects on Electrical Conductivity Resulting from Implementation of CM2-**
 28 **CM22**

29 **NEPA Effects:** Effects of CM2–CM22 on EC under Alternative 6 are the same as those discussed for
 30 Alternative 1A and are considered not to be adverse.

31 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 6A would be similar to
 32 those proposed under Alternative 1A. As such, effects on EC resulting from the implementation of
 33 CM2–CM22 would be similar to that previously discussed for Alternative 1A. This impact is
 34 considered to be less than significant. No mitigation is required.

35 **Impact WQ-13: Effects on Mercury Concentrations Resulting from Facilities Operations and**
 36 **Maintenance (CM1)**

37 ***Upstream of the Delta***

38 Under the Alternative 6A, the magnitude and timing of reservoir releases and river flows upstream
 39 of the Delta in the Sacramento River watershed and east-side tributaries would be altered, relative
 40 to Existing Conditions and the No Action Alternative.

1 The Sacramento River at Freeport and San Joaquin River at Vernalis (as summarized for water
2 quality average concentrations in Tables 8-48 and 8-49) were examined for flow/concentration
3 relationships for mercury and methylmercury. No significant, predictive regression relationships
4 were discovered for mercury or methylmercury, except for total mercury with flow at Freeport
5 (monthly or annual)(Figures 8I-10 through 8I-13, Appendix 8I). Such a positive relationship
6 between total mercury and flow is to be expected based on the association of mercury with
7 suspended sediment and the mobilization of sediments during storm flows. However, the changes in
8 flow in the Sacramento River under Alternative 6A relative to Existing Conditions and the No Action
9 Alternative are not of the magnitude of storm flows, in which substantial sediment-associated
10 mercury is mobilized. Therefore mercury loading should not be substantially different due to
11 changes in flow. In addition, even though it may be flow-affected, total mercury concentrations
12 remain well below criteria at upstream locations. Any negligible changes in mercury concentrations
13 that may occur in the water bodies of the affected environment located upstream of the Delta would
14 not be of frequency, magnitude, and geographic extent that would adversely affect any beneficial
15 uses or substantially degrade the quality of these water bodies as related to mercury. Both
16 waterborne methylmercury concentrations and largemouth bass fillet mercury concentrations are
17 expected to remain above guidance levels at upstream of Delta locations, but will not change
18 substantially relative to Existing Conditions or the No Action Alternative due to changes in flows
19 under Alternative 6A.

20 The upstream of Delta areas in the north will benefit from the implementation of the Cache Creek,
21 Sulfur Creek, Harley Gulch, and Clear Lake Mercury TMDLs and the American River methylmercury
22 TMDL. These projects will target specific sources of mercury and methylation upstream of the Delta
23 and could result in net improvement to Delta mercury loading in the future. The implementation of
24 these projects could help to ensure that upstream of Delta environments will not be substantially
25 degraded for water quality with respect to mercury or methylmercury.

26 ***Delta***

27 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
28 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
29 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
30 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
31 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
32 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

33 The water quality impacts of waterborne concentrations of mercury and methylmercury and fish
34 tissue mercury concentrations were evaluated for 9 Delta locations. The analysis of percentage
35 change in assimilative capacity of waterborne total mercury of Alternative 6A relative to the 25 ng/L
36 ecological risk benchmark as compared to Existing Conditions showed the greatest decrease to be
37 9.2% at the Contra Costa Pumping Plant, 9.1% at the Contra Costa Pumping Plant relative to the No
38 Action Alternative (Figures 8-53 and 8-54). These changes are not expected to result in adverse
39 effects to beneficial use. Similarly, changes in methylmercury concentration are expected to be
40 relatively small. The greatest annual average methylmercury concentration for drought conditions
41 was 0.165 ng/L for the San Joaquin River at Buckley Cove which was slightly higher than Existing
42 Conditions (0.161 ng/L) and slightly lower than the No Action Alternative (0.167 ng/L) (Appendix
43 8I, Table I-6). All modeled input concentrations exceeded the methylmercury TMDL guidance
44 objective of 0.06 ng/L, therefore percentage change in assimilative capacity was not evaluated for
45 methylmercury.

1 Fish tissue estimates show substantial percentage increases in concentration and exceedance
2 quotients for mercury at some Delta locations. The greatest increases in exceedance quotients
3 (ranging from 33 to 64%) are expected for Franks Tract and Old River at Rock Slough relative to
4 Existing Conditions and the No Action Alternative (Figure 8-55, Appendix 8I, Table I-13b).

5 ***SWP/CVP Export Service Areas***

6 The analysis of mercury and methylmercury in the SWP/CVP Export Service Areas was based on
7 concentrations estimated at the Banks and Jones pumping plants. Both waterborne total and
8 methylmercury concentrations for Alternative 6A are projected to be lower than Existing Conditions
9 and the No Action Alternative (Appendix 8I, Figures 8I-4 and 8I-5). Therefore, mercury shows an
10 increased assimilative capacity at these locations (Figures 8-53 and 8-54).

11 The largest improvements in bass tissue mercury concentrations and exceedance quotients for
12 Alternative 6A, relative to Existing Conditions and the No Action Alternative at any location within
13 the Delta are expected for the export pump locations (specifically, at Jones Pumping plant, 41%
14 improvement relative to Existing Conditions, 43% relative to the No Action Alternative) (Figure 8-
15 55, Appendix 8I, Table I-13b).

16 ***NEPA Effects:*** Based on the above discussion, the effects of mercury and methylmercury in
17 comparison of Alternative 6A to the No Action Alternative (as waterborne and bioaccumulated
18 forms) are considered to be adverse for the case of fish tissue bioaccumulation at some locations.

19 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
20 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
21 purpose of making the CEQA impact determination for this constituent. For additional details on the
22 effects assessment findings that support this CEQA impact determination, see the effects assessment
23 discussion that immediately precedes this conclusion.

24 Under Alternative 6A, greater water demands and climate change would alter the magnitude and
25 timing of reservoir releases and river flows upstream of the Delta in the Sacramento River
26 watershed and east-side tributaries, relative to Existing Conditions. Concentrations of mercury and
27 methylmercury upstream of the Delta will not be substantially different relative to Existing
28 Conditions due to the lack of important relationships between mercury/methylmercury
29 concentrations and flow for the major rivers.

30 Methylmercury concentrations exceed criteria at all locations in the Delta and no assimilative
31 capacity exists. However, monthly average waterborne concentrations of total and methylmercury,
32 over the period of record, are very similar to Existing Conditions. Similarly, estimates of fish tissue
33 mercury concentrations show almost no differences would occur among sites for Alternative 6A as
34 compared to Existing Conditions for Delta sites.

35 Assessment of effects of mercury in the SWP and CVP Export Service Areas were based on effects on
36 mercury concentrations and fish tissue mercury concentrations at the Banks and Jones pumping
37 plants. The Banks and Jones pumping plants are expected to show increased assimilative capacity
38 for waterborne mercury and decreased fish tissue concentrations of mercury for Alternative 6A as
39 compared to Existing Conditions.

40 As such, this alternative is not expected to cause additional exceedance of applicable water quality
41 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
42 on any beneficial uses of waters in the affected environment. However, increases in fish tissue

1 mercury concentrations are substantial, and changes in fish tissue mercury concentrations would
 2 make existing mercury-related impairment in the Delta measurably worse. In comparison to
 3 Existing Conditions, Alternative 6A would increase levels of mercury by frequency, magnitude, and
 4 geographic extent such that the affected environment would be expected to have measurably higher
 5 body burdens of mercury in aquatic organisms, thereby substantially increasing the health risks to
 6 wildlife (including fish) or humans consuming those organisms. This impact is considered to be
 7 significant. Feasible or effective actions to reduce the effects on mercury resulting from CM1 are
 8 unknown. General mercury management measures through CM12, or actions taken by other entities
 9 or programs such as TMDL implementation, may minimize or reduce sources and inputs of mercury
 10 to the Delta and methylmercury formation. However, it is uncertain whether this impact would be
 11 reduced to a level that would be less than significant as a result of CM12 or other future actions.
 12 Therefore, the impact would be significant and unavoidable.

13 **Impact WQ-14: Effects on Mercury Concentrations Resulting from Implementation of CM2–**
 14 **CM22**

15 **NEPA Effects:** Some habitat restoration activities under Alternative 6A would occur on lands in the
 16 Delta formerly used for irrigated agriculture. Tidal and other restoration proposed under
 17 Alternative 6A have the potential to increase water residence times and increase accumulation of
 18 organic sediments that are known to enhance methylmercury bioaccumulation in biota in the
 19 restored habitat. Therefore, increases in mercury methylation in the habitat restoration areas is
 20 possible but uncertain depending on the specific restoration design implemented at a particular
 21 Delta location. Models to estimate the potential for methylmercury formation in restored areas are
 22 not currently available. However, DSM2 modeling for Alternative 6A operations does incorporate
 23 assumptions for certain habitat restoration activities proposed under CM2 and CM4 (see Section
 24 8.3.1.3) that result in changes to Delta hydrodynamics compared to the No Action Alternative. These
 25 modeled restoration assumptions provide some insight into potential hydrodynamic changes that
 26 could be expected related to implementing CM2 and CM4 and are considered in the evaluation of the
 27 potential for increased mercury and methylmercury concentrations under Alternative 6A.

28 BDCP Conservation Measure 12 (CM12) addresses the potential for methylmercury bioaccumulation
 29 associated with restoration activities and acknowledges the uncertainties associated with mitigating
 30 or minimizing this potential effect. CM12 proposes project-specific mercury management plans for
 31 restoration actions that will incorporate relevant approaches recommended in Phase 1
 32 Methylmercury TMDL control studies. Specific approaches recommended under CM12 that are
 33 intended to minimize or mitigate for potential increases in methylmercury bioaccumulation at
 34 future restoration sites include:

- 35 ● Characterizing mercury, methylmercury, organic carbon, iron, and sulfate concentrations to
 36 better inform restoration design,
- 37 ● Sequestering methylmercury at restoration sites using low intensity chemical dosing
 38 techniques,
- 39 ● Minimizing microbial methylation associated with anoxic conditions by reducing the amount of
 40 organic material at a restoration site,
- 41 ● Designing restoration sites to enhance photo degeneration that converts methylmercury into a
 42 biologically unavailable, inorganic form of mercury,
- 43 ● Remediating restoration site soils with iron to reduce methylation in sulfide rich soils, and

- 1 • Considering capping mercury laden sediments, where possible to reduce methylation potential
2 at a site.

3 Because of the uncertainties associated with site-specific estimates of methylmercury
4 concentrations and the uncertainties in source modeling and tissue modeling, the effectiveness of
5 methylmercury management proposed under CM12 to reduce methylmercury concentrations would
6 need to be evaluated separately for each restoration effort, as part of design and implementation.
7 Because of this uncertainty and the known potential for methylmercury creation in the Delta this
8 potential effect of implementing CM2–CM22 is considered adverse.

9 **CEQA Conclusion:** There would be no substantial, long-term increase in mercury or methylmercury
10 concentrations or loads in the rivers and reservoirs upstream of the Delta or the waters exported to
11 the CVP and SWP service areas due to implementation of CM2–CM22 relative to Existing Conditions.
12 However, uptake of mercury from water and/or methylation of inorganic mercury may increase to
13 an unquantified degree as part of the creation of new, marshy, shallow, or organic-rich restoration
14 areas. Methylmercury is 303(d)-listed within the affected environment, and therefore any potential
15 measurable increase in methylmercury concentrations would make existing mercury-related
16 impairment measurably worse. Because mercury is bioaccumulative, increases in water-borne
17 mercury or methylmercury that could occur in some areas could bioaccumulate to somewhat
18 greater levels in aquatic organisms and would, in turn, pose health risks to fish, wildlife, or humans.
19 Design of restoration sites under Alternative 6A would be guided by CM12 which requires
20 development of site specific mercury management plans as restoration actions are implemented.
21 The effectiveness of minimization and mitigation actions implemented according to the mercury
22 management plans is not known at this time although the potential to reduce methylmercury
23 concentrations exists based on current research. Although the BDCP will implement CM12 with the
24 goal to reduce this potential effect the uncertainties related to site specific restoration conditions
25 and the potential for increases in methylmercury concentrations in the Delta result in this potential
26 impact being considered significant. No mitigation measures would be available until specific
27 restoration actions are proposed. Therefore this programmatic impact is considered significant and
28 unavoidable.

29 **Impact WQ-15: Effects on Nitrate Concentrations Resulting from Facilities Operations and** 30 **Maintenance (CM1)**

31 ***Upstream of the Delta***

32 For the same reasons stated for the No Action Alternative, Alternative 6A would have negligible, if
33 any, impact on nitrate concentrations in the rivers and reservoirs upstream of the Delta in the
34 Sacramento River watershed relative to Existing Conditions and the No Action Alternative.

35 Under Alternative 6A, modeling indicates that long-term annual average flows on the San Joaquin
36 River would decrease by an estimated 6%, relative to Existing Conditions, and would remain
37 virtually the same relative to the No Action Alternative (Appendix 5A). Given these relatively small
38 decreases in flows and the weak correlation between nitrate and flows in the San Joaquin River (see
39 Nitrate Appendix 8J, Figure 2), it is expected that nitrate concentrations in the San Joaquin River
40 would be minimally affected, if at all, by changes in flow rates under Alternative 6A.

41 Any negligible changes in nitrate-N concentrations that may occur in the water bodies of the affected
42 environment located upstream of the Delta would not be of frequency, magnitude and geographic

1 extent that would adversely affect any beneficial uses or substantially degrade the quality of these
2 water bodies, with regards to nitrate.

3 **Delta**

4 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
5 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
6 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
7 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
8 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
9 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

10 Results of the mixing calculations indicate that under Alternative 6A, relative to Existing Conditions
11 and the No Action Alternative, nitrate concentrations throughout the Delta are anticipated to remain
12 low (<1.4 mg/L-N) relative to adopted objectives (Nitrate Appendix 8J, Table 22 and 23). Long-term
13 average nitrate concentrations are anticipated to increase at most locations in the Delta. The
14 increase would be greatest at Franks Tract, Old River at Rock Slough, and Contra Costa Pumping
15 Plant #1 (all >100% increase). Long-term average concentrations were estimated to increase to
16 0.78, 1.23 and 1.33 mg/L-N for Franks Tract, Old River at Rock Slough, and Contra Costa Pumping
17 Plant #1, respectively, due primarily to increased San Joaquin River water percentage at these
18 locations (see Fingerprinting Appendix 8D). Although changes at specific Delta locations and for
19 specific months may be substantial on a relative basis, the absolute concentration of nitrate in Delta
20 waters would remain low (<1.4 mg/L-N) in relation to the drinking water MCL of 10 mg/L-N, as well
21 as all other thresholds identified in Table 8-50. No additional exceedances of the MCL are
22 anticipated at any location (Nitrate Appendix 8J, Table 22). On a monthly average basis and on a
23 long term annual average basis, for all modeled years and for the drought period (1987–1991) only,
24 use of assimilative capacity available under Existing Conditions and the No Action Alternative,
25 relative to the drinking water MCL of 10 mg/L-N, was up to approximately 14% at Old River at Rock
26 Slough and Contra Costa Pumping Plant #1, and averaged approximately 8–9% on a long-term
27 average basis (Nitrate Appendix 8J, Table 24). Similarly, the use of available assimilative capacity at
28 Franks Tract was up to approximately 7%, and averaged 3–4% over the long term. The
29 concentrations estimated for these locations would not increase the likelihood of exceeding the 10
30 mg/L-N MCL, nor would they increase the risk for adverse effects to beneficial uses. At all other
31 locations, use of assimilative capacity was negligible (<5%), except San Joaquin River at Buckley
32 Cove in August, which showed a 7.3% use of the assimilative capacity that was available under the
33 No Action Alternative, for the drought period (1987–1991) (Nitrate Appendix 8J, Table 24).

34 Nitrate concentrations will likely be higher than the modeling results indicate in certain locations.
35 This includes in the Sacramento River between Freeport and Mallard Island and other areas in the
36 Delta downstream of Freeport that are influenced by Sacramento River water. These increases are
37 associated with ammonia and nitrate that are discharged from the SRWTP, which are not included in
38 the modeling.

- 39 • Under Existing Conditions, most of the ammonia discharged from the SRWTP is converted to
40 nitrate downstream of the facility's discharge at Freeport, and thus, nitrate concentrations
41 under Existing Conditions in these areas are expected to be higher than the modeling
42 predicts, the increase becoming greater with increasing distance downstream. However, the
43 increase in nitrate concentrations downstream of the SRWTP is expected to be small—the
44 existing increase appears to be from approximately 0.1 mg/L-N to approximately 0.4–0.5

1 mg/L-N over this reach, due to approximately a 1:1 conversion of ammonia-N to nitrate-N
2 (Central Valley Water Board 2010a:32).

- 3 • Under Alternative 6A, the planned upgrades to the SRWTP, which include
4 nitrification/partial denitrification, would substantially decrease ammonia concentrations
5 in the discharge, but would increase nitrate concentrations in the discharge up to 10 mg/L-
6 N, which is substantially higher than under Existing Conditions.
- 7 • Overall, under Alternative 6A, the nitrogen load from the SRWTP discharge is expected to
8 decrease (by up to 50%), relative to Existing Conditions, due to nitrification/partial
9 denitrification upgrades at the SRWTP facility. Thus, while concentrations of nitrate
10 downstream of the facility are expected to be higher than modeling results indicate for both
11 Existing Conditions and Alternative 6A, the increase is expected to be greater under Existing
12 Conditions than for Alternative 6A due to the upgrades that are assumed under Alternative
13 6A.

14 The other areas in which nitrate concentrations will be higher than the modeling results indicate are
15 immediately downstream of other wastewater treatment plants that practice nitrification, but not
16 denitrification (e.g., City of Rio Vista Beach WWTF, Town of Discovery Bay WWTF, City of Stockton
17 RWCF). For all such facilities in the Delta, the Regional Water Boards have issued NPDES permits
18 that allow discharge of wastewater containing nitrate into the Delta, and under these permits, the
19 State has determined that no beneficial uses are adversely affected by the discharge, and that the
20 discharger's use of available assimilative capacity of the water body is acceptable. When dilution is
21 necessary in order for the discharge to be in compliance with the Basin Plans (which incorporate the
22 10 mg/L-N MCL by reference), not all of the assimilative capacity of the receiving water is granted to
23 the discharger. Thus, limited decreases in flows are not anticipated to result in systemic
24 exceedances of the MCLs by these POTWs. Furthermore, NPDES permits are renewed on a 5-year
25 basis, and thus, if under changes in flows, dilution was no longer sufficient to maintain nitrate below
26 the MCL in the receiving water, the NPDES permit renewal process would address such cases.

27 Therefore, any increases in nitrate-N concentrations that may occur at certain locations within the
28 Delta would not be of frequency, magnitude and geographic extent that would adversely affect any
29 beneficial uses or substantially degrade the water quality at these locations, with regards to nitrate.

30 ***SWP/CVP Export Service Areas***

31 Assessment of effects of nitrate in the SWP and CVP Export Service Areas is based on effects on
32 nitrate-N at the Banks and Jones pumping plants.

33 Results of the mixing calculations indicate that under Alternative 6A, relative to Existing Conditions
34 and the No Action Alternative, nitrate concentrations at Banks and Jones pumping plants are
35 anticipated to decrease on a long-term average annual basis, and on an average monthly basis for
36 every month of the year (Nitrate Appendix 8J, Table 22 and 23). No additional exceedances of the
37 MCL are anticipated (Nitrate Appendix 8J, Table 22). On a monthly average basis and on a long term
38 annual average basis, for all modeled years and for the drought period (1987–1991) only, there was
39 no use of assimilative capacity available under Existing Conditions and the No Action Alternative,
40 relative to the 10 mg/L-N MCL, for both Banks and Jones pumping plants (Nitrate Appendix 8J, Table
41 24).

1 Therefore, implementation of this alternative is not expected to result in adverse effects to beneficial
2 uses or substantially degrade the quality of exported water, with regards to nitrate.

3 **NEPA Effects:** In summary, based on the discussion above, the effects on nitrate from implementing
4 CM1 are considered to be not adverse.

5 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
6 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
7 purpose of making the CEQA impact determination for this constituent. For additional details on the
8 effects assessment findings that support this CEQA impact determination, see the effects assessment
9 discussion that immediately precedes this conclusion.

10 Nitrate-N concentrations are generally low in the reservoirs and rivers of the watersheds, owing to
11 substantial dilution available for point sources and the lack of substantial nonpoint sources of
12 nitrate-N upstream of the SRWTP in the Sacramento River watershed, and in the watersheds of the
13 eastern tributaries (Cosumnes, Mokelumne, and Calaveras Rivers). Although higher in the San
14 Joaquin River watershed, nitrate-N concentrations are not well-correlated with flow rates.
15 Consequently, any modified reservoir operations and subsequent changes in river flows under
16 Alternative 6A, relative to Existing Conditions, are expected to have negligible, if any, effects on
17 reservoir and river nitrate-N concentrations upstream of Freeport in the Sacramento River
18 watershed and upstream of the Delta in the San Joaquin River watershed.

19 In the Delta, results of the mixing calculations indicate that under Alternative 6A, relative to Existing
20 Conditions, nitrate concentrations throughout the Delta are anticipated to remain low (<1.4 mg/L-
21 N) relative to adopted objectives. No additional exceedances of the MCL are anticipated at any
22 location, and use of assimilative capacity available under Existing Conditions, relative to the
23 drinking water MCL of 10 mg/L-N, was not of sufficient magnitude to increase the risk of
24 substantially effecting beneficial uses.

25 Assessment of effects of nitrate in the SWP and CVP Export Service Areas is based on effects on
26 nitrate-N concentrations at the Banks and Jones pumping plants. Results of the mixing calculations
27 indicate that under Alternative 6A, relative to Existing Conditions, long-term average nitrate
28 concentrations at Banks and Jones pumping plants are anticipated to decrease. No additional
29 exceedances of the MCL are anticipated, and there was no use of assimilative capacity available
30 under Existing Conditions, relative to the MCL, for both Banks and Jones pumping plants for all
31 months.

32 Based on the above, this alternative is not expected to cause additional exceedance of applicable
33 water quality objectives/criteria by frequency, magnitude, and geographic extent that would cause
34 adverse effects on any beneficial uses of waters in the affected environment. No long-term water
35 quality degradation is expected to occur such that exceedance of criteria is more likely or such that
36 there is an increased risk of adverse impacts to beneficial uses. Nitrate is not 303(d) listed within
37 the affected environment and thus any increases that may occur in some areas and months would
38 not make any existing nitrate-related impairment measurably worse because no such impairments
39 currently exist. Because nitrate is not bioaccumulative, increases that may occur in some areas and
40 months would not bioaccumulate to greater levels in aquatic organisms that would, in turn, pose
41 substantial health risks to fish, wildlife, or humans. This impact is considered to be less than
42 significant. No mitigation is required.

1 **Impact WQ-16: Effects on Nitrate Concentrations Resulting from Implementation of CM2-**
2 **CM22**

3 **NEPA Effects:** Effects of CM2–CM22 on nitrate under Alternative 6A are the same as those discussed
4 for Alternative 1A and are considered not to be adverse.

5 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 6A would be similar to
6 those proposed under Alternative 1A. As such, effects on nitrate resulting from the implementation
7 of CM2–CM22 would be similar to that previously discussed for Alternative 1A. This impact is
8 considered to be less than significant. No mitigation is required.

9 **Impact WQ-17: Effects on Dissolved Organic Carbon Concentrations Resulting from Facilities**
10 **Operations and Maintenance (CM1)**

11 ***Upstream of the Delta***

12 Under Alternative 6A, there would be no substantial change to the sources of DOC within the
13 watersheds upstream of the Delta. Moreover, long-term average flow and DOC levels in the
14 Sacramento River at Hood and San Joaquin River at Vernalis are poorly correlated. Thus changes in
15 system operations and resulting reservoir storage levels and river flows would not be expected to
16 cause a substantial long-term change in DOC concentrations in the water bodies upstream of the
17 Delta. Any negligible changes in DOC levels in water bodies upstream of the Delta under Alternative
18 6A, relative to Existing Conditions and the No Action Alternative, would not be of sufficient
19 frequency, magnitude and geographic extent that would adversely affect any beneficial uses or
20 substantially degrade the quality of these water bodies, with regards to DOC.

21 ***Delta***

22 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
23 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
24 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
25 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
26 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
27 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

28 Under Alternative 6A, the geographic extent of effects pertaining to long-term average DOC
29 concentrations in the Delta would be similar to that previously described for Alternative 1A,
30 although the magnitude of predicted long-term increase and relative frequency of concentration
31 threshold exceedances would be substantially greater. Modeled effects would be greatest at Franks
32 Tract, Rock Slough, and Contra Costa PP No. 1., where for the 16-year hydrologic period and the
33 modeled drought period, long-term average concentration increases ranging from 1.0–1.6 mg/L
34 would be predicted ($\leq 46\%$ net increase) resulting in long-term average DOC concentrations greater
35 than 4 mg/L at all three Delta interior locations (Appendix 8K, DOC Table 7). Long-term average
36 increases of 0.2–0.6 mg/L ($\leq 20\%$ net increase) would also occur at Staten Island, Emmaton, Antioch
37 and Mallard Island. Increases in long-term average concentrations would correspond to more
38 frequent concentration threshold exceedances, with the greatest change occurring at Rock Slough
39 and Contra Costa PP No. 1 locations. For Rock Slough, long-term average DOC concentrations
40 exceeding 3 mg/L would increase from 52% under Existing Conditions to 100% under the
41 Alternative 6A (an increase from 47% to 100% for the drought period), and concentrations
42 exceeding 4 mg/L would increase from 30% to 79% (32% to 95% for the drought period). For

1 Contra Costa PP No. 1, long-term average DOC concentrations exceeding 3 mg/L would increase
 2 from 52% under Existing Conditions to 100% under Alternative 6A (45% to 100% for the drought
 3 period), and concentrations exceeding 4 mg/L would increase from 32% to 84% (35% to 95% for
 4 the drought period). Relative change in frequency of threshold exceedance for other assessment
 5 locations would be similar or less. This comparison to Existing Conditions reflects changes in DOC
 6 due to both Alternative 6A operations (including north Delta intake capacity of 15,000 cfs and
 7 numerous other operational components of Scenario D) and climate change/sea level rise.

8 In comparison, Alternative 6A relative to the No Action Alternative N would generally result in a
 9 similar magnitude of change to that discussed for the comparison to Existing Conditions. Maximum
 10 increases of 1.0 to 1.5 mg/L DOC (i.e., $\leq 41\%$) would be predicted at Franks Tract, Rock Slough, and
 11 Contra Costa PP No. 1 relative to the No Action Alternative (Appendix 8K, DOC Table 7). Threshold
 12 concentration exceedance frequency trends would also be similar to that discussed for the existing
 13 condition comparison, with exception to the predicted 4 mg/L exceedance frequency at Buckley
 14 Cove. In comparison to the No Action Alternative, the frequency which long-term average DOC
 15 concentrations exceeded 4 mg/L at Buckley Cove would increase from 27% to 30% (42% to 53% for
 16 the modeled drought period). Unlike the comparison to Existing Conditions, this comparison to the
 17 No Action Alternative reflects changes in DOC due only to Alternative 6A operations.

18 The increases in long-term average DOC concentrations estimated to occur at Franks Tract, Rock
 19 Slough, and Contra Costa PP No. 1 are considered substantial and could potentially trigger
 20 significant changes in drinking water treatment plant design or operations. In particular, assessment
 21 locations at Rock Slough and Contra Costa PP No. 1 represent municipal intakes servicing existing
 22 drinking water treatment plants. Under Alternative 6A, drinking water treatment plants obtaining
 23 water from these interior Delta locations would likely need to upgrade existing treatment systems in
 24 order to achieve EPA Stage 1 Disinfectants and Disinfection Byproduct Rule action thresholds. While
 25 treatment technologies sufficient to achieve the necessary DOC removals exist, implementation of
 26 such technologies would likely require substantial investment in new or modified infrastructure.

27 Relative to existing and No Action Alternative conditions, Alternative 6A would lead to predicted
 28 improvements in long-term average DOC concentrations at Barker Slough, as well as Banks and
 29 Jones pumping plants (discussed below). Predicted long-term average DOC concentrations at Barker
 30 Slough would decrease approximately 0.1 mg/L (including the drought period), depending on
 31 baseline conditions comparison and modeling period.

32 ***SWP/CVP Export Service Areas***

33 Under Alternative 6A, modeled long-term average DOC concentrations would decrease at Banks and
 34 Jones pumping plants for both the modeled 16-year hydrologic period and the modeled drought
 35 period. Modeled decreases would generally be similar between Existing Conditions and the No
 36 Action Alternative. Relative to Existing Conditions, long-term average DOC concentrations at Banks
 37 would be predicted to decrease by 1.5 mg/L (1.8 mg/L during drought period) (Appendix 8K, DOC
 38 Table 7). At Jones, long-term average DOC concentrations would be predicted to decrease by 1.5
 39 mg/L (1.7 mg/L during drought period). Such substantial improvement in long-term average DOC
 40 concentrations would include fewer exceedances of concentration thresholds. At both Banks and
 41 Jones, average DOC concentrations exceeding the 2 mg/L concentration threshold would decrease
 42 from 100% under Existing Conditions and the No Action Alternative to 39% under Alternative 6A
 43 (100% to 33% during the drought period), while concentrations exceeding 4 mg/L would nearly be

1 eliminated (i.e., $\leq 10\%$ exceedance frequency). Such modeled improvement would correspond to
2 substantial improvement in Export Service Areas water quality, respective to DOC.

3 Similar to the discussion pertaining to the No Action Alternative, maintenance of SWP and CVP
4 facilities under Alternative 6A would not be expected to create new sources of DOC or contribute
5 towards a substantial change in existing sources of DOC in the affected area. Maintenance activities
6 would not be expected to cause any substantial change in long-term average DOC concentrations
7 such that MUN beneficial uses, or any other beneficial use, would be adversely affected.

8 **NEPA Effects:** In summary, Alternative 6A, relative to the No Action Alternative, would not cause a
9 substantial long-term change in DOC concentrations in the water bodies upstream of the Delta.
10 Long-term average DOC concentrations at Banks and Jones pumping plants are predicted to
11 decrease by as much as 1.9 mg/L, while long-term average DOC concentrations for some Delta
12 interior locations, including Franks Tract, Rock Slough and Contra Costa PP #1, are predicted to
13 increase by as much as 1.5 mg/L. Resultant substantial changes in long-term average DOC at these
14 Delta interior locations could necessitate changes in water treatment plant operations or require
15 treatment plant upgrades in order to maintain DBP compliance, and thus would constitute an
16 adverse effect on water quality and MUN beneficial uses. Mitigation Measure WQ-17 is available to
17 reduce these effects.

18 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
19 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
20 purpose of making the CEQA impact determination for this constituent. For additional details on the
21 effects assessment findings that support this CEQA impact determination, see the effects assessment
22 discussion that immediately precedes this conclusion.

23 While greater water demands under the Alternative 6A would alter the magnitude and timing of
24 reservoir releases north, south and east of the Delta, these activities would have no substantial effect
25 on the various watershed sources of DOC. Moreover, long-term average flow and DOC at Sacramento
26 River at Hood and San Joaquin River at Vernalis are poorly correlated; therefore, changes in river
27 flows would not be expected to cause a substantial long-term change in DOC concentrations
28 upstream of the Delta.

29 Relative to Existing Conditions, Alternative 6A would result in substantial increases (i.e., 1.0–1.6
30 mg/L) in long-term average DOC concentrations at some Delta interior locations, and would be
31 greatest at Franks Tract, Rock Slough, and Contra Costa PP No. 1. At these locations the predicted
32 changes in DOC would substantially increase the frequency with which long-term average
33 concentrations exceeds 2, 3, or 4 mg/L. Drinking water treatment plants obtaining water from these
34 interior Delta locations would likely need to upgrade existing treatment systems in order to achieve
35 EPA Stage 1 Disinfectants and Disinfection Byproduct Rule action thresholds. Such predicted
36 magnitude change in long-term average DOC concentrations would represent a substantially
37 increased risk for adverse effects on existing MUN beneficial.

38 The assessment of Alternative 6A effects on DOC in the SWP/CVP Export Service Areas is based on
39 assessment of changes in DOC concentrations at Banks and Jones pumping plants. Relative to the
40 existing condition, long-term average DOC concentrations would decrease by as much as 1.8 mg/L at
41 Banks and Jones pumping plants. The frequency with which long-term average DOC concentrations
42 would exceed 2, 3, or 4 mg/L would be substantially reduced, where predicted exceedances of >4
43 mg/L would be nearly eliminated (i.e., $\leq 10\%$ exceedance frequency). As a result, substantial

1 improvement in DOC-related water quality would be predicted in the SWP/CVP Export Service
2 Areas.

3 Based on the above, Alternative 6A operation and maintenance would not result in any substantial
4 change in long-term average DOC concentration upstream of the Delta. Furthermore, under
5 Alternative 6A, water exported from the Delta to the SWP/CVP service area would be substantially
6 improved relative to DOC. DOC is not bioaccumulative, therefore change in long-term average DOC
7 concentrations would not directly cause bioaccumulative problems in aquatic life or humans.
8 Additionally, DOC is not a constituent related to any 303(d) listings. Nevertheless, new and modified
9 conveyance facilities proposed under Alternative 6A would result in a substantial increase in long-
10 term average DOC concentrations (i.e., 1.0–1.6 mg/L, equivalent to $\leq 46\%$ relative increase) at
11 Franks Tract, Rock Slough, and Contra Costa PP No. 1. In particular, under Alternative 6A, model
12 predicted long-term average DOC concentrations would be greater than 4 mg/L at Rock Slough and
13 Contra Costa PP No. 1 with commensurate substantial increases in the frequency with which
14 average DOC concentrations exceed 2, 3, and 4 mg/L levels. Drinking water treatment plants
15 obtaining water from these interior Delta locations would likely need to upgrade existing treatment
16 systems in order to achieve EPA Stage 1 Disinfectants and Disinfection Byproduct Rule action
17 thresholds. Therefore, such a magnitude change in long-term average DOC concentrations would
18 represent a substantially increased risk for adverse effects on existing MUN beneficial uses at Rock
19 Slough and Contra Costa PP No. 1 should such treatment upgrades not be undertaken. The impact is
20 considered significant and mitigation is required. While Mitigation Measure WQ-17 is available to
21 partially reduce this impact of DOC, the feasibility and effectiveness of this mitigation measure is
22 uncertain and therefore implementation would not necessarily reduce the identified impact to a
23 level that would be less than significant, and therefore it is significant and unavoidable.

24 **Mitigation Measure WQ-17: Consult with Delta Water Purveyors to Identify Means to**
25 **Avoid, Minimize, or Offset Increases in Long-Term Average DOC Concentrations**

26 To reduce the effect of CM1 operations on increased DOC concentrations specifically predicted
27 to occur at municipal water purveyors obtaining raw source water through south Delta intakes
28 at Rock Slough and those associated with Contra Costa PP No. 1, the BDCP proponents shall
29 consult with the purveyors (i.e., Contra Costa water district and entities to which they supply
30 raw water) to identify the means to either avoid, minimize, or offset increases in long-term
31 average DOC concentrations that affect the beneficial use of the water. The BDCP proponents
32 shall consult with these entities to determine existing DBP concentrations (as system-wide
33 running averages), and then implement any combination of measures sufficient to maintaining
34 these concentrations at existing levels in treated drinking water of affected water purveyors.
35 Such actions may include, but not be limited to: 1) upgrading and maintaining adequate drinking
36 water treatment systems, 2) developing or obtaining replacement surface water supplies from
37 other water rights holders, 3) developing replacement groundwater supplies, or 4) physically
38 routing a portion of the water diverted from the Sacramento River through the associated new
39 conveyance pipelines/tunnel to affected purveyors.

40 **Impact WQ-18: Effects on Dissolved Organic Carbon Concentrations Resulting from**
41 **Implementation of CM2–CM22**

42 **NEPA Effects:** Conservation Measures 2–22 proposed under Alternative 6A would be the same as
43 those proposed under Alternative 1A. As such, effects on DOC resulting from the implementation of
44 CM2–CM22 would be similar to that previously discussed for Alternative 1A, although the isolated

1 conveyance facilities of Alternative 6A would effectively isolate SWP and CVP export facilities in the
 2 southern Delta from the influence of potential new or modified sources of DOC relative to CM4–CM7
 3 and CM10. However, the potential for CM4–CM7 and CM10 to contribute substantial amounts of
 4 DOC to raw drinking water supplies to the other Delta municipal intakes would remain, and could
 5 possibly be measurably worse in actual comparison to the dual conveyance project alternatives.
 6 With relatively less low DOC Sacramento River water in the Delta, there effectively would be less
 7 dilution of interior Delta DOC sources, leading to effectively higher long-term average DOC
 8 concentrations. Substantially increased long-term average DOC in raw water supplies could lead to a
 9 need for treatment plant upgrades in order to appropriately manage DBP formation in treated
 10 drinking water. This potential for future DOC increases would lead to substantially greater
 11 associated risk of long-term adverse effects on the MUN beneficial use.

12 In summary, the habitat restoration elements of CM4–CM7 and CM10 under Alternative 6A would
 13 present new localized sources of DOC to the study area, and in some circumstances would substitute
 14 for existing sources related to replaced agriculture. Depending on localized hydrodynamics and
 15 proximity to municipal drinking water intakes, such restoration activities could contribute
 16 substantial amounts of DOC to municipal raw water. Substantial increases in municipal raw water
 17 DOC could necessitate changes in water treatment plant operations or require treatment plant
 18 upgrades in order to maintain DBP compliance, and thus would constitute an adverse effect on
 19 water quality. Mitigation Measure WQ-18 is available to reduce these effects.

20 **CEQA Conclusion:** Effects of CM4–CM7 and CM10 on DOC under Alternative 6A would be similar,
 21 and possibly greater, to those discussed for Alternative 1A, except that SWP and CVP export facilities
 22 would be isolated from these effects by Alternative 6A design. Similar to the discussion for
 23 Alternative 1A, this impact is considered to be significant and mitigation is required. It is uncertain
 24 whether implementation of Mitigation Measure WQ-18 would reduce identified impacts to a less-
 25 than-significant level. Hence, this impact remains significant and unavoidable.

26 In addition to and to supplement Mitigation Measure WQ-18, the BDCP proponents have
 27 incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*, a
 28 separate, non-environmental commitment to address the potential increased water treatment costs
 29 that could result from DOC concentration effects on municipal and industrial water purveyor
 30 operations. Potential options for making use of this financial commitment include funding or
 31 providing other assistance towards implementing treatment for DOC and/or DBPs or DOC source
 32 control strategies. Please refer to Appendix 3B, *Environmental Commitments*, for the full list of
 33 potential actions that could be taken pursuant to this commitment in order to reduce the water
 34 quality treatment costs associated with water quality effects relating to DOC.

35 **Mitigation Measure WQ-18: Design Wetland and Riparian Habitat Features to Minimize**
 36 **Effects on Municipal Intakes**

37 Please see Mitigation Measure WQ-18 under Impact WQ-18 in the discussion of Alternative 1A.

38 **Impact WQ-19: Effects on Pathogens Resulting from Facilities Operations and Maintenance**
 39 **(CM1)**

40 **NEPA Effects:** Effects of CM1 on pathogens under Alternative 6A are the same as those discussed for
 41 Alternative 1A and are considered to not be adverse.

1 **CEQA Conclusion:** Effects of CM1 on pathogens under Alternative 6A are the same as those
2 discussed for Alternative 1A, and are summarized here, then compared to the CEQA thresholds of
3 significance (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for
4 this constituent. For additional details on the effects assessment findings that support this CEQA
5 impact determination, see the effects assessment discussion under Alternative 1A.

6 River flow rate and reservoir storage reductions that would occur due to implementation of CM1
7 (water facilities and operations) under Alternative 6A, relative to Existing Conditions, would not be
8 expected to result in a substantial adverse change in pathogen concentrations in the reservoirs and
9 rivers upstream of the Delta, given the small magnitude of urban runoff contributions relative to the
10 magnitude of river flows, that pathogen concentrations in the rivers have a minimal relationship to
11 river flow rate, and the expected reduced pollutant loadings in response to NPDES stormwater-
12 related regulations.

13 It is expected there would be no substantial change in Delta pathogen concentrations in response to
14 a shift in the Delta source water percentages under this alternative or substantial degradation of
15 these water bodies, with regard to pathogens. This conclusion is based on the Pathogens Conceptual
16 Model, which found that pathogen sources in close proximity to a Delta site appear to have the
17 greatest influence on pathogen levels at the site, rather than the primary source(s) of water to the
18 site. In-Delta potential pathogen sources, including water-based recreation, tidal habitat, wildlife,
19 and livestock-related uses, would continue under this alternative.

20 In the SWP/CVP Export Service Areas waters, relative to Existing Conditions, an increased
21 proportion of water coming from the Sacramento River would not adversely affect beneficial uses in
22 the SWP/CVP Export Service Areas. The pathogen levels in the Sacramento River are similar to or
23 lower than the water diverted at the Delta export pumps. Further, it is localized sources of
24 pathogens that appear to have the greatest influence on concentrations. Thus, an increased
25 proportion of Sacramento River water diverted to the SWP/CVP Export Service Areas would result
26 in minimal changes in pathogen levels in the SWP/CVP Export Service Areas waters.

27 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
28 objectives by frequency, magnitude, and geographic extent that would cause adverse effects on any
29 beneficial uses of waters in the affected environment. Because pathogen concentrations are not
30 expected to increase substantially, no long-term water quality degradation for pathogens is
31 expected to occur and, thus, no adverse effects on beneficial uses would occur. The San Joaquin
32 River in the Stockton Deep Water Ship Channel is Clean Water Act section 303(d) listed for
33 pathogens. Because no measurable increase in Deep Water Ship Channel pathogen concentrations
34 are expected to occur on a long-term basis, further degradation and impairment of this area is not
35 expected to occur. Finally, pathogens are not bioaccumulative constituents. This impact is
36 considered to be less than significant. No mitigation is required.

37 **Impact WQ-20: Effects on Pathogens Resulting from Implementation of CM2–CM22**

38 **NEPA Effects:** Effects of CM2–CM22 on pathogens under Alternative 6A are the same as those
39 discussed for Alternative 1A and are considered to not be adverse.

40 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 6A would be similar to
41 those proposed under Alternative 1A. As such, effects on pathogens resulting from the
42 implementation of CM2–CM22 would be similar to that previously discussed for Alternative 1A. This
43 impact is considered to be less than significant. No mitigation is required.

1 **Impact WQ-21: Effects on Pesticide Concentrations Resulting from Facilities Operations and**
2 **Maintenance (CM1)**

3 ***Upstream of the Delta***

4 For the same reasons stated for the No Action Alternative, under Alternative 6A no specific
5 operations or maintenance activity of the SWP or CVP would substantially drive a change in
6 pesticide use, and thus pesticide sources would remain unaffected upstream of the Delta.
7 Nevertheless, changes in the timing and magnitude of reservoir releases could have an effect on
8 available dilution capacity along river segments such as the Sacramento, Feather, American, and San
9 Joaquin Rivers.

10 Under Alternative 6A, winter (November–March) and summer (April–October) season average flow
11 rates on the Sacramento River at Freeport, American River at Nimbus, Feather River at Thermalito
12 and the San Joaquin River at Vernalis would change. Relative to existing condition and the No Action
13 Alternative, seasonal average flow rates on the Sacramento would decrease no more than 6% during
14 the summer and 3% during the winter (Appendix 8L, Seasonal average flows Tables 1-4). On the
15 Feather River, average flow rates would decrease no more than 7% during the summer, but would
16 increase by as much as 9% in the winter. American River average flow rates would decrease by as
17 much as 17% in the summer but would increase by as much as 7% in the winter. Seasonal average
18 flow rates on the San Joaquin River would decrease by as much as 12% in the summer, but increase
19 by as much as 1% in the winter. For the same reasons stated for the No Action Alternative,
20 decreased seasonal average flow of $\leq 17\%$ is not considered to be of sufficient magnitude to
21 substantially increase pesticide concentrations or alter the long-term risk of pesticide-related
22 toxicity to aquatic life, nor adversely affect other beneficial uses of water bodies upstream of the
23 Delta.

24 ***Delta***

25 Sources of diuron, OP and pyrethroid insecticides to the Plan Area include direct input of surface
26 runoff from in-Delta agriculture and Delta urbanized areas as well as inputs from rivers upstream of
27 the Delta. Similar to Upstream of the Delta, CVP/SWP operations would not affect these sources.

28 Under Alternative 6A, the distribution and mixing of Delta source waters would change. Percent
29 change in monthly average source water fraction were evaluated for the modeled 16-year (1976–
30 1991) hydrologic period and a representative drought period (1987–1991), with special attention
31 given to changes in San Joaquin River, Sacramento River and Delta Agriculture sources water
32 fractions. Relative to Existing Conditions, under Alternative 6A modeled San Joaquin River fractions
33 would increase greater than 10% at Buckley Cove (drought period only), Franks Tract, Rock Slough,
34 Contra Costa PP No. 1, and the San Joaquin River at Antioch (Appendix 8D, Source Water
35 Fingerprinting). At Buckley Cove, San Joaquin River source water fractions when modeled for the
36 drought period would increase by 13% in July and 19% in August. At Antioch, San Joaquin River
37 source water fractions when modeled for the 16-year hydrologic period would increase by 11–19%
38 from October through June (11% for January through March of the modeled drought period). While
39 these changes at Buckley Cove and Antioch are not considered substantial, changes in San Joaquin
40 River source water fraction in the Delta interior would be considerable. At Franks Tract, modeled
41 San Joaquin River source water fractions would increase between 14–34% for the entire calendar
42 year of January through December (12–28% for October through June of the modeled drought
43 period). Changes at Rock Slough and Contra Costa PP No. 1 would be very similar, where modeled
44 San Joaquin River source water fractions would increase from 26–76% (11–74% for the modeled

1 drought period) for the entire calendar year. Relative to Existing Conditions, there would be no
2 modeled increases in Sacramento River fractions greater than 14% (with exception to Banks and
3 Jones which are discussed below) and Delta agricultural fractions greater than 19%. Increases in
4 San Joaquin River source water fraction at Franks Tract, Rock Slough, and Contra Costa PP No. 1
5 would primarily balance through decreases in Sacramento River water, and as a result the San
6 Joaquin River would account for greater than 50% of the total source water volume at Franks Tract
7 between March through May (<50% for all months during the modeled drought period), and would
8 be 50%, and as much as 80% during October through May at Rock Slough and Contra Costa PP No. 1
9 for both the modeled drought and 16-year hydrologic periods. While the source water and potential
10 pesticide related toxicity co-occurrence predictions do not mean adverse effects would occur, such
11 considerable modeled increases in early summer source water fraction at Franks Tract and winter
12 and summer source water fractions at Rock Slough and Contra Costa PP No. 1 could substantially
13 alter the long-term risk of pesticide-related toxicity to aquatic life, given the apparent greater
14 incidence of pesticides in the San Joaquin River.

15 When compared to the No Action Alternative, changes in source water fractions would be similar in
16 season, geographic extent, and magnitude to those discussed for Existing Conditions with exception
17 to Buckley Cove. Relative to the No Action Alternative, on a source water basis Buckley Cove is
18 comprised predominantly of water of San Joaquin River origin (i.e., typically >80% San Joaquin
19 River) for all months of the year but July and August. In July and August, the combined operational
20 effects on Delta hydrodynamics of the Delta Cross Channel being open, the absence of a barrier at
21 Head of Old River, and seasonally high exports from south Delta pumps results in substantially
22 lower San Joaquin River source water fraction at Buckley Cove relative to all other months of the
23 year. Under the operational scenarios of Alternative 2A, however, modeled July and August San
24 Joaquin River fractions at Buckley Cove would increase relative to the No Action Alternative, with
25 increases of 20% in July (36% for the modeled drought period) and 27% in August (52% for the
26 modeled drought period) (Appendix 8D, Source Water Fingerprinting). Despite these San Joaquin
27 River increases, the resulting net San Joaquin River source water fraction for July and August would
28 remain less than all other months. Although these modeled changes in the source water fractions at
29 Buckley Cover are not of sufficient magnitude to substantially alter the long-term risk of pesticide-
30 related toxicity to aquatic life, relative to the No Action Alternative, changes in source water
31 fractions at Rock Slough, Contra Costa PP No. 1 and Franks Tract could substantially alter the long-
32 term risk of pesticide-related toxicity to aquatic life, given the apparent greater incidence of
33 pesticides in the San Joaquin River.

34 These predicted adverse effects on pesticides at Delta interior locations relative to Existing
35 Conditions and the No Action Alternative fundamentally assume that the present pattern of
36 pesticide incidence in surface water will occur at similar levels into the future. In reality, however,
37 the makeup and character of the pesticide use market in the late long-term (i.e., the year 2060) will
38 not be exactly as it is today. Current use of chlorpyrifos and diazinon is on the decline with their
39 replacement by pyrethroids on the rise, yet in this assessment it is the apparent greater incidence of
40 diazinon and chlorpyrifos on the San Joaquin River that serves as the basis for concluding that
41 substantially increased San Joaquin River source water fraction would correspond to an increased
42 risk of pesticide-related toxicity to aquatic life. By 2060, however, alternative pesticides, such as
43 neonicotinoids and biologicals, will likely be a more substantial contributing part of the existing mix
44 of pesticides, and perhaps more prominent. The trend in the development of future-use pesticides is
45 towards reduced risk pesticides, including more biopesticides, with greater targeted specificity,
46 fewer residues, and lower overall non-target toxicity. By 2060 existing chlorpyrifos and diazinon

1 TMDLs for the Sacramento and San Joaquin Rivers will have been in effect for more than 50 years.
2 Moreover, it is reasonable to expect that CWA section 303(d) listings and future additional listings
3 will have developed TMDLs by 2060. To the extent these existing and future TMDL's address current
4 and future-use pesticides, a greater degree of pesticide related source control can be anticipated.
5 Nevertheless, forecasting whether these various efforts will ultimately be successful at resolving
6 current pesticide related impairments requires considerable speculation. While the fundamental
7 assumptions that have guided this assessment of pesticides may be somewhat altered by 2060,
8 these assumptions are informed by actual studies and monitoring data collected from the recent
9 past and, therefore, judging project alternative effects in the future remain most accurate through
10 use of these informed assumptions rather than based on assumptions founded upon future
11 speculative conditions.

12 ***SWP/CVP Export Service Areas***

13 Assessment of effects in SWP/CVP Export Service Areas is based on effects seen in the Plan Area at
14 the Banks and Jones pumping plants. Under Alternative 6A, Sacramento River source water fractions
15 would increase substantially at both Banks and Jones pumping plants relative to Existing Conditions
16 and the No Action Alternative (Appendix 8D, Source Water Fingerprinting). At Banks pumping plant,
17 Sacramento source water fractions would generally increase from 19–79% for the entire period of
18 January through December (12–56% for January through December of the modeled drought period)
19 and at Jones pumping plant Sacramento source water fractions would generally increase from 33–
20 96% for the entire period of January through December (17–89% for January through December of
21 the modeled drought period). These increases in Sacramento source water fraction would primarily
22 balance through equivalent decreases in San Joaquin River water. Based on the general observation
23 that San Joaquin River, in comparison to the Sacramento River, is a greater contributor of OP
24 insecticides in terms of greater frequency of incidence and presence at concentrations exceeding
25 water quality benchmarks, modeled increases in Sacramento River fraction at Banks and Jones
26 would generally represent an improvement in export water quality respective to pesticides.

27 ***NEPA Effects:*** In summary, the changes in long-term average flows on the Sacramento, Feather,
28 American, and San Joaquin Rivers, under Alternative 6A relative to the No Action Alternative, are of
29 insufficient magnitude to substantially increase the long-term risk of pesticide-related water quality
30 degradation and related toxicity to aquatic life in these water bodies upstream of the Delta.
31 However, modeled increases in San Joaquin River fraction at Franks Tract, Rock Slough, and Contra
32 Costa PP No. 1 are of sufficient magnitude to substantially alter the long-term risk of pesticide-
33 related water quality degradation and related toxicity to aquatic life in the Delta. The effects on
34 pesticides from operations and maintenance (CM1) are determined to be adverse and unavoidable.

35 ***CEQA Conclusion:*** Key findings discussed in the effects assessment relative to Existing Conditions is
36 provided above are summarized here, and are then compared to the CEQA thresholds of significance
37 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this
38 constituent. For additional details on the effects assessment findings that support this CEQA impact
39 determination, see the effects assessment discussion that immediately precedes this conclusion.

40 Sources of pesticides upstream of the Delta include direct input of pesticide containing surface
41 runoff from agriculture and urbanized areas. Flows in rivers receiving these discharges dilute these
42 pesticide inputs. Relative to Existing Conditions, however, modeled changes in long-term average
43 flows on the Sacramento, Feather, American, and San Joaquin Rivers are of insufficient magnitude to

1 substantially increase the long-term risk of pesticide-related water quality degradation and related
2 toxicity to aquatic life in these water bodies upstream of the Delta.

3 In the Delta, sources of pesticides include direct input of surface runoff from Delta agriculture and
4 Delta urbanized areas as well as inputs from rivers upstream of the Delta. While facilities operations
5 and maintenance activities would not affect these sources, changes in Delta source water fraction
6 could change the relative risk associated with pesticide related toxicity to aquatic life. Under
7 Alternative 6A, modeled long-term average San Joaquin River source water fractions at Franks
8 Tract, Rock Slough and Contra Costa PP No. 1 locations would increase considerably for some
9 months such that the long-term risk of pesticide-related toxicity to aquatic life could substantially
10 increase.

11 The assessment of Alternative 6A effects on pesticides in the SWP/CVP Export Service Areas is
12 based on assessment of changes predicted at Banks and Jones pumping plants. Sacramento River
13 source water fractions would increase substantially at both Banks and Jones pumping plants and
14 would generally represent an improvement in export water quality respective to pesticides.

15 Based on the above, Alternative 6A would not result in any substantial change in long-term average
16 pesticide concentration or result in substantial increase in the anticipated frequency with which
17 long-term average pesticide concentrations would exceed aquatic life toxicity thresholds or other
18 beneficial use effect thresholds upstream of the Delta or the SWP/CVP service area. Numerous
19 pesticides are currently used throughout the affected environment, and while some of these
20 pesticides may be bioaccumulative, those present-use pesticides for which there is sufficient
21 evidence for their presence in waters affected by SWP and CVP operations (i.e., diazinon,
22 chlorpyrifos, diuron, and pyrethroids) are not considered bioaccumulative, and thus changes in their
23 concentrations would not directly cause bioaccumulative problems in aquatic life or humans.
24 Furthermore, while there are numerous 303(d) listings throughout the affected environment that
25 name pesticides as the cause for beneficial use impairment, the modeled changes in upstream river
26 flows and Delta source water fractions would not be expected to make any of these beneficial use
27 impairments measurably worse, with principal exception to locations in the Delta that would receive
28 a substantially greater fraction San Joaquin River water under Alternative 6A. Long-term average
29 San Joaquin River source water fractions at Franks Tract, Rock Slough and Contra Costa PP No. 1
30 locations would change considerably for some months such that the long-term risk of pesticide-
31 related toxicity to aquatic life could substantially increase. Additionally, the potential for increased
32 incidence of pesticide related toxicity could include pesticides such as chlorpyrifos and diazinon for
33 which existing 303(d) listings exist for the Delta, and thus existing beneficial use impairment could
34 be made discernibly worse. The impact is considered to be significant and unavoidable. There is no
35 feasible mitigation available to reduce the effect of this significant impact.

36 **Impact WQ-22: Effects on Pesticide Concentrations Resulting from Implementation of CM2-** 37 **CM22**

38 **NEPA Effects:** Conservation Measures 2–22 proposed under Alternative 6A would be the same as
39 those proposed under Alternative 1A. As such, effects on pesticides resulting from the
40 implementation of CM2–CM22 would be similar to that previously discussed for Alternative 1A. In
41 summary, CM13 proposes the use of herbicides to control invasive aquatic vegetation around
42 habitat restoration sites. Herbicides directly applied to water could include adverse effects on non-
43 target aquatic life, such as aquatic invertebrates and beneficial aquatic plants. As such, aquatic life

1 toxicity objectives could be exceeded with sufficient frequency and magnitude such that beneficial
2 uses would be impacted, thus constituting an adverse effect on water quality.

3 In summary, based on the discussion above, the effects on pesticides from implementing CM2-CM22
4 are considered to be adverse. Mitigation Measure WQ-22 would be available to reduce this adverse
5 effect.

6 **CEQA Conclusion:** Effects of CM2–CM22 on pesticides under Alternative 6A are similar to those
7 discussed for Alternative 1A. Potential environmental effects related only to CM13 are considered to
8 be significant. Mitigation is required. While Mitigation Measure WQ-22 is available to partially
9 reduce this impact of pesticides, no feasible mitigation is available that would reduce it to a level
10 that would be less than significant.

11 **Mitigation Measure WQ-22: Implement Least Toxic Integrated Pest Management** 12 **Strategies**

13 Please see Mitigation Measure WQ-22 under Impact WQ-22 in the discussion of Alternative 1A.

14 **Impact WQ-23: Effects on Phosphorus Concentrations Resulting from Facilities Operations** 15 **and Maintenance (CM1)**

16 **NEPA Effects:** Effects of water facilities and operations (CM1) on phosphorus levels in water bodies
17 of the affected environment under Alternative 6A would be very similar (i.e., nearly the same) to
18 those discussed for Alternative 1A. Consequently, the environmental consequences to phosphorus
19 levels discussed in detail for Alternative 1A also adequately represent the effects under Alternative
20 6A, which are considered to be not adverse.

21 **CEQA Conclusion:** Key findings discussed in the effects assessment relative to Existing Conditions is
22 provided above are summarized here, and are then compared to the CEQA thresholds of significance
23 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this
24 constituent. For additional details on the effects assessment findings that support this CEQA impact
25 determination, see the effects assessment discussion that immediately precedes this conclusion.

26 Because phosphorus loading to waters upstream of the Delta is not anticipated to change, and
27 because changes in flows do not necessarily result in changes in concentrations or loading of
28 phosphorus to these water bodies, substantial changes in phosphorus concentration upstream of the
29 Delta are not anticipated for Alternative 6A, relative to Existing Conditions.

30 Because phosphorus concentrations in the major source waters to the Delta are similar for much of
31 the year, phosphorus concentrations in the Delta are not anticipated to change substantially on a
32 long term-average basis under Alternative 6A, relative to Existing Conditions. Algal growth rates are
33 limited by availability of light in the Delta, and therefore any minor increases in phosphorus levels
34 that may occur at some locations and times within the Delta would be expected to have little effect
35 on primary productivity in the Delta.

36 The assessment of effects of phosphorus under Alternative 6A in the SWP and CVP Export Service
37 Areas is based on effects on phosphorus at the Banks and Jones pumping plants. As noted above,
38 phosphorus concentrations in the Delta (including Banks and Jones pumping plants) are not
39 anticipated to change substantially on a long term-average basis.

1 Based on the above, there would be no substantial, long-term increase in phosphorus concentrations
2 in the rivers and reservoirs upstream of the Delta, in the Delta Region, or the waters exported to the
3 CVP and SWP service areas under Alternative 6A relative to Existing Conditions. As such, this
4 alternative is not expected to cause additional exceedance of applicable water quality
5 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
6 on any beneficial uses of waters in the affected environment. Because phosphorus concentrations
7 are not expected to increase substantially, no long-term water quality degradation is expected to
8 occur and, thus, no adverse effects to beneficial uses would occur. Phosphorus is not 303(d) listed
9 within the affected environment and thus any minor increases that may occur in some areas would
10 not make any existing phosphorus-related impairment measurably worse because no such
11 impairments currently exist. Because phosphorus is not bioaccumulative, minor increases that may
12 occur in some areas would not bioaccumulate to greater levels in aquatic organisms that would, in
13 turn, pose substantial health risks to fish, wildlife, or humans. This impact is considered to be less
14 than significant. No mitigation is required.

15 **Impact WQ-24: Effects on Phosphorus Concentrations Resulting from Implementation of**
16 **CM2–CM22**

17 **NEPA Effects:** Effects of CM2–CM22 on phosphorus levels in water bodies of the affected
18 environment under Alternative 6A would be very similar (i.e., nearly the same) to those discussed
19 for Alternative 1A. Consequently, the environmental consequences to phosphorus levels from
20 implementing CM2–CM22 discussed in detail for Alternative 1A also adequately represent the
21 effects of these same actions under Alternative 6A, which are considered to be not adverse.

22 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 6A would be similar to
23 those proposed under Alternative 1A. As such, effects on phosphorus resulting from the
24 implementation of CM2–CM22 would be similar to that previously discussed for Alternative 1A. This
25 impact is considered to be less than significant. No mitigation is required.

26 **Impact WQ-25: Effects on Selenium Concentrations Resulting from Facilities Operations and**
27 **Maintenance (CM1)**

28 ***Upstream of the Delta***

29 For the same reasons stated for the No Action Alternative, Alternative 6A would have negligible, if
30 any, effect on selenium concentrations in the rivers and reservoirs upstream of the Delta relative to
31 Existing Conditions and the No Action Alternative. Any negligible increases in selenium
32 concentrations that could occur in the water bodies of the affected environment located upstream of
33 the Delta would not be of frequency, magnitude and geographic extent that would adversely affect
34 any beneficial uses or substantially degrade the quality of these water bodies, with regard to
35 selenium.

36 ***Delta***

37 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
38 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
39 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
40 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
41 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
42 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

1 Alternative 6A would result in small to moderate changes in average selenium concentrations in
 2 water at all modeled Delta assessment locations relative to Existing Conditions and the No Action
 3 Alternative (Appendix 8M, Table M-10A). These changes in selenium concentrations in water are
 4 reflected in small (10% or less) to moderate (between 11% and 50%) percent changes in available
 5 assimilative capacity for selenium (based on 2 µg/L ecological risk benchmark) for all years. Relative
 6 to Existing Conditions, Alternative 6A would result in the largest modeled increase in available
 7 assimilative capacity at Buckley Cove (2%); relative to the No Action Alternative, the largest
 8 increase would be at Staten Island (1%), and the largest decreases relative to Existing Conditions
 9 and the No Action Alternative would be at Contra Costa PP (16% and 15%, respectively) (Figures 8-
 10 59 and 8-60). Although there would be moderate negative changes in assimilative capacity at two
 11 locations (Contra Costa PP and Rock Slough [15% decrease in available assimilative capacity for
 12 Existing Conditions and the No Action Alternative]), the changes are small (10% or less decrease) at
 13 the other locations and the available assimilative capacity at all locations would remain substantial;
 14 therefore, the effect of Alternative 6A is generally minimal for the Delta. Furthermore, the modeled
 15 selenium concentrations in water (Appendix 8M, Table M-19) for Alternative 6A (range 0.24–0.74
 16 µg/L), Existing Conditions (range 0.21–0.76 µg/L), and the No Action Alternative (range 0.21–0.69
 17 µg/L) are generally similar, and all would be below the ecological risk benchmark (2 µg/L).

18 Relative to Existing Conditions and the No Action Alternative, Alternative 6A would generally result
 19 in small changes in estimated selenium concentrations in biota (whole-body fish, bird eggs
 20 [invertebrate diet], bird eggs [fish diet], and fish fillets) (Appendix 8M, Table M-17 and Addendum
 21 M.A to Appendix 8M, Table M.A-2). Relative to Existing Conditions and the No Action Alternative, the
 22 largest increase of selenium concentrations in biota would be at Contra Costa PP for drought years
 23 and in sturgeon at the two western Delta locations in all as well as drought years. Relative to
 24 Existing Conditions, the largest decrease in selenium concentrations in biota would be at Buckley
 25 Cove for drought years; relative to the No Action Alternative, the largest decrease would be at Staten
 26 Island for drought years. Except for sturgeon in the western Delta, concentrations of selenium in
 27 whole-body fish and bird eggs (invertebrate and fish diets) would exceed only the lower
 28 benchmarks (4 and 6 mg/kg dry weight, respectively, indicating a low potential for effects), under
 29 drought conditions, at Buckley Cove for Alternative 6A and for Existing Conditions and the No Action
 30 Alternative (Figures 8-61 through 8-63). However, Exceedance Quotients for these exceedances of
 31 the lower benchmarks are between 1.0 and 1.5, indicating a low risk to biota in the Delta, with
 32 Alternative 6A being similar to Existing Conditions and the No Action Alternative. Selenium
 33 concentrations in fish fillets would not exceed the screening value for protection of human health
 34 (Figure 8-64). For sturgeon in the western Delta, whole-body selenium concentrations would
 35 increase from 12.3 mg/kg under Existing Conditions and the No Action Alternative to 15.1 mg/kg
 36 under Alternative 6A, a 23% increase (Table M.A-2). All of these values exceed both the low and high
 37 toxicity benchmarks. The predicted increases are high enough that they may represent a measurable
 38 increase in body burdens of sturgeon, which would constitute an adverse impact.

39 ***SWP/CVP Export Service Areas***

40 Alternative 6A would result in small to moderate changes in average selenium concentrations
 41 relative to Existing Conditions and the No Action Alternative (Appendix 8M, Table M-10A). These
 42 changes are reflected in small (10% or less) to moderate (between 11% and 50%) percent changes
 43 in available assimilative capacity for selenium for all years. Relative to Existing Conditions and the
 44 No Action Alternative, Alternative 6A would result in increases in available assimilative capacity at
 45 Banks PP (10% and 9%, respectively) and at Jones PP (18% and 19%, respectively) (Figures 8-59
 46 and 8-60), and would have a positive effect at the Export Service Area locations. The modeled

1 selenium concentrations in water (Appendix 8M, Table M-10A) for Alternative 6A (0.32 µg/L) would
2 be lower than the ranges for Existing Conditions (range 0.37–0.58 µg/L) and the No Action
3 Alternative (range 0.37–0.59 µg/L), and all would be below the ecological risk benchmark (2 µg/L).

4 Relative to Existing Conditions and the No Action Alternative, Alternative 6A would result in small
5 changes in estimated selenium concentrations in biota (Appendix 8M, Table M-17). Relative to
6 Existing Conditions, the largest increase of selenium concentrations in biota would be at Banks PP
7 for drought years (except for bird eggs [assuming a fish diet] at Banks PP for all years), and relative
8 to the No Action Alternative, the largest increase would be at Banks PP for drought years. Relative to
9 Existing Conditions and the No Action Alternative, the largest decrease of selenium concentration in
10 biota would be at Jones PP for drought years. However, concentrations in biota would not exceed
11 any benchmarks for Alternative 6A (Figures 8-61 through 8-64).

12 Thus, relative to Existing Conditions and the No Action Alternative, Alternative 6A would result in
13 small to moderate changes in selenium concentrations in water and minimal changes in selenium
14 concentrations in biota at the Export Service Area locations. Selenium concentrations in water and
15 biota would generally decrease under Alternative 6A and would not exceed ecological benchmarks
16 at either location, whereas the lower benchmark for bird eggs (fish diet) would be exceeded under
17 Existing Conditions and the No Action Alternative at Jones PP for drought years. This small positive
18 change in selenium concentrations under Alternative 6A would be expected to slightly decrease the
19 frequency with which applicable benchmarks would be exceeded or slightly improve the quality of
20 water at the Export Service Area locations, with regard to selenium.

21 **NEPA Effects:** Based on the discussion above, the effects on selenium from Alternative 6A are
22 considered to be adverse. This determination is reached because selenium concentrations in whole-
23 body sturgeon modeled at two western Delta locations would increase by an estimated 23%, which
24 may represent a measurable increase in the environment. Because both low and high toxicity
25 benchmarks are already exceeded under the No Action Alternative, these potentially measurable
26 increases represent an adverse impact.

27 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
28 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
29 purpose of making the CEQA impact determination for selenium. For additional details on the effects
30 assessment findings that support this CEQA impact determination, see the effects assessment
31 discussion that immediately precedes this conclusion.

32 There are no substantial point sources of selenium in watersheds upstream of the Delta, and no
33 substantial nonpoint sources of selenium in the watersheds of the Sacramento River and the eastern
34 tributaries. Nonpoint sources in the San Joaquin Valley that contribute selenium to the Delta will be
35 controlled through a TMDL developed by the Central Valley Water Board (2001) for the lower San
36 Joaquin River, established limits for the Grassland Bypass Project, and Basin Plan objectives (Central
37 Valley Water Board 2010c) and State Water Board (2010d, 2010e) that are expected to result in
38 decreasing discharges of selenium from the San Joaquin River to the Delta. Consequently, any
39 modified reservoir operations and subsequent changes in river flows under Alternative 6A, relative
40 to Existing Conditions, are expected to cause negligible changes in selenium concentrations in water.
41 Any negligible changes in selenium concentrations that may occur in the water bodies of the affected
42 environment located upstream of the Delta would not be of frequency, magnitude, and geographic
43 extent that would adversely affect any beneficial uses or substantially degrade the quality of these
44 water bodies as related to selenium.

1 Relative to Existing Conditions, modeling estimates indicate that Alternative 6A would increase
2 selenium concentrations in whole-body sturgeon modeled at two western Delta locations by an
3 estimated 23%, which may represent a measurable increase in the environment. Because both low
4 and high toxicity benchmarks are already exceeded under Existing Conditions, these potentially
5 measurable increases represent a potential impact to aquatic life beneficial uses.

6 Assessment of effects of selenium in the SWP and CVP Export Service Areas is based on effects on
7 selenium concentrations at the Banks and Jones pumping plants. Relative to Existing Conditions,
8 Alternative 6A would slightly decrease the frequency with which applicable benchmarks would be
9 exceeded and slightly improve the quality of water in selenium concentrations at the Banks and
10 Jones pumping plants locations.

11 Based on the above, although waterborne selenium concentrations would not exceed applicable
12 water quality objectives/criteria, significant impacts on some beneficial uses of waters in the Delta
13 could occur because both low and high toxicity benchmarks are already exceeded under Existing
14 Conditions, and uptake of selenium from water to biota may measurably increase. In comparison to
15 Existing Conditions, water quality conditions under this alternative would increase levels of
16 selenium (a bioaccumulative pollutant) by frequency, magnitude, and geographic extent such that
17 the affected environment may have measurably higher body burdens of selenium in aquatic
18 organisms, thereby substantially increasing the health risks to wildlife (including fish); however,
19 impacts to humans consuming those organisms are not expected to occur. Water quality conditions
20 under this alternative with respect to selenium would cause long-term degradation of water quality
21 in the western Delta. Except in the vicinity of the western Delta for sturgeon, water quality
22 conditions under this alternative would not increase levels of selenium by frequency, magnitude,
23 and geographic extent such that the affected environment would be expected to have measurably
24 higher body burdens of selenium in aquatic organisms. The greater level of selenium
25 bioaccumulation in the western Delta would further degrade water quality by measurable levels, on
26 a long-term basis, for selenium and, thus, cause the 303(d)-listed impairment of beneficial use to be
27 made discernibly worse. This impact is considered significant.

28 The need for, and the feasibility and effectiveness of, post-operation mitigation for the predicted
29 level of selenium bioaccumulation is uncertain. The first step shall be to determine the reliability of
30 the model in predicting biota selenium concentrations in the affected environment where effects are
31 predicted but selenium data are lacking. For that reason, the model shall be validated with site-
32 specific sampling before extensive mitigation measures relative to CM1 operations are developed
33 and evaluated for feasibility, as the measures and their evaluation for feasibility are likely to be
34 complex. Specifically, it remains to be determined whether the available existing data for transfer of
35 selenium from water to particulates and through different trophic levels of the food chain are
36 representative of conditions that may occur from implementation of Alternative 6A. Therefore, the
37 proposed mitigation measure requires that sampling be conducted to characterize each step of data
38 inputs needed for the model, and then the refined model be validated for local conditions. This
39 impact is considered significant and unavoidable.

40 **Impact WQ-26: Effects on Selenium Concentrations Resulting from Implementation of CM2-** 41 **CM22**

42 **NEPA Effects:** In general, with the possible exception of changes in Delta hydrodynamics resulting
43 from habitat restoration, CM2-CM11 would not substantially increase selenium concentrations in
44 the water bodies of the affected environment. Modeling scenarios included assumptions regarding

1 how certain habitat restoration activities (CM2 and CM4) would affect Delta hydrodynamics, and
2 thus such effects of these restoration measures were included in the assessment of CM1 facilities
3 operations and maintenance (see Impact WQ-25).

4 However, implementation of these conservation measures may increase water residence time
5 within the restoration areas. Increased restoration area water residence times could potentially
6 increase the bioaccumulation of selenium in biota, thereby potentially increasing fish tissue and bird
7 egg concentrations of selenium, but models are not available to quantitatively estimate the level of
8 changes in residence time and the associated selenium bioavailability. If increases in fish tissue or
9 bird egg selenium were to occur, the increases would likely be of concern only where fish tissues or
10 bird eggs are already elevated in selenium to near or above thresholds of concern. That is, where
11 biota concentrations are currently low and not approaching thresholds of concern, changes in
12 residence time alone would not be expected to cause them to then approach or exceed thresholds of
13 concern. In consideration of this factor, although the Delta as a whole is a 303(d)-listed water body
14 for selenium, and although monitoring data of fish tissue or bird eggs in the Delta are sparse, the
15 most likely areas in which biota tissues would be at levels high enough that additional
16 bioaccumulation due to increased residence time from restoration areas would be a concern are the
17 western Delta and Suisun Bay, and the South Delta in areas that receive San Joaquin River water.

18 The western Delta and Suisun Bay receive elevated selenium loads from North San Francisco Bay
19 (including San Pablo Bay, Carquinez Strait, and Suisun Bay) and from the San Joaquin River. Point
20 sources of selenium in North San Francisco Bay (i.e., refineries) that contribute selenium to Suisun
21 Bay are expected to be reduced through a TMDL under development by the San Francisco Bay Water
22 Board (San Francisco Bay Water Board 2012) that is expected to result in decreasing discharges of
23 selenium. Nonpoint sources of selenium in the San Joaquin Valley that contribute selenium to the
24 San Joaquin River, and thus the Delta and Suisun Bay, will be controlled through a TMDL developed
25 by the Central Valley Water Board (2001) for the lower San Joaquin River, established limits for the
26 Grassland Bypass Project, and Basin Plan objectives (Central Valley Water Board 2010c, d) that are
27 expected to result in decreasing discharges of selenium from the San Joaquin River to the Delta. If
28 selenium levels are not sufficiently reduced via these efforts, it is expected that the State Water
29 Board and the San Francisco Bay and Central Valley Water Boards would initiate additional actions
30 to further control sources of selenium.

31 The South Delta receives elevated selenium loads from the San Joaquin River. In contrast to Suisun
32 Bay and possibly the western Delta in the future, the South Delta lacks the overbite clam (*Corbula*
33 [*Potamocorbula*] *amurensis*), which is considered a key driver of selenium bioaccumulation in
34 Suisun Bay, due to its high bioaccumulation of selenium and its role in the benthic food web that
35 includes long-lived sturgeon. The South Delta does have *Corbicula fluminea*, another bivalve that
36 bioaccumulates selenium, but it is not as invasive as the overbite clam and thus likely makes up a
37 smaller fraction of sturgeon diet. Also, as mentioned above, nonpoint sources of selenium in the San
38 Joaquin Valley that contribute selenium to the Delta will be controlled through a TMDL developed by
39 the Central Valley Water Board (2001) for the lower San Joaquin River, established limits for the
40 Grassland Bypass Project, and Basin Plan objectives (Central Valley Water Board 2010c, d) that are
41 expected to result in decreasing discharges of selenium from the San Joaquin River to the Delta.
42 Further, if selenium levels in the San Joaquin River are not sufficiently reduced via these efforts, it is
43 expected that the State Water Board and Central Valley Water Board would initiate additional
44 TMDLs to further control nonpoint sources of selenium.

1 Wetland restoration areas will not be designed such that water flows in and does not flow out.
2 Exchange of water between the restoration areas and existing Delta channels is an important design
3 factor, since one goal of the restoration areas is to export food produced in these areas to the rest of
4 the Delta (see BDCP Chapter 3, *Conservation Strategy*, Section 3.3, Biological Goals and Objectives).
5 Thus, these areas can be thought of as “flow-through” systems. Consequently, although water
6 residence times associated with BDCP restoration could increase, they are not expected to increase
7 without bound. and selenium concentrations in the water column would not continue to build up
8 and be recycled in sediments and organisms as may be the case within a closed system.

9 However, because increases in bioavailable selenium in the habitat restoration areas are uncertain,
10 proposed avoidance and minimization measures would require evaluating risks of selenium
11 exposure at a project level for each restoration area, minimizing to the extent practicable potential
12 risk of additional bioaccumulation, and monitoring selenium levels in fish and/or wildlife to
13 establish whether, or to what extent, additional bioaccumulation is occurring. See Appendix 3B,
14 *Environmental Commitments* for a description of the environmental commitment BDCP proponents
15 are making with respect to Selenium Management; and Appendix 3.C. of the BDCP for additional
16 detail on this avoidance and minimization measure (AMM27). Data generated as part of the
17 avoidance and minimization measures will assist the State and Regional Water Boards in
18 determining whether beneficial uses are being impacted by selenium, and thus will provide the data
19 necessary to support regulatory actions (including additional TMDL development), should such
20 actions be warranted.

21 Given the factors discussed in the assessment above, any increases in bioaccumulation rates from
22 water-borne selenium that could occur in some areas as a result of increased water residence time
23 would not be of sufficient magnitude and geographic extent that any portion of the Delta would be
24 expected to have measurably higher body burdens of selenium in aquatic organisms and, therefore,
25 would not substantially increase risk for adverse effects to beneficial uses. Furthermore, although
26 the Delta is a 303(d)-listed water body for selenium, given the discussion in the assessment above, it
27 is unlikely that restoration areas would result in measurable increases in selenium in fish tissues or
28 bird eggs such that the beneficial use impairment would be made discernibly worse.

29 Because it is unlikely that substantial increases in selenium in fish tissues or bird eggs would occur
30 such that effects on aquatic life beneficial uses would be anticipated, and because of the avoidance
31 and minimization measures that are designed to further minimize and evaluate the risk of such
32 increases, the effects of WQ-26 are considered not adverse.

33 **CEQA Conclusion:** There would be no substantial, long-term increase in selenium concentrations in
34 water in the rivers and reservoirs upstream of the Delta, water in the Delta, or the waters exported
35 to the CVP and SWP service areas due to implementation of CM2–CM22 relative to Existing
36 Conditions. Waterborne selenium concentrations under this alternative would not exceed applicable
37 water quality objectives/criteria.

38 Given the factors discussed in the assessment above, any increases in bioaccumulation rates from
39 water-borne selenium that could occur in some areas as a result of increased water residence times
40 would not be of sufficient magnitude and geographic extent that any portion of the Delta would be
41 expected to have measurably higher body burdens of selenium in aquatic organisms, and therefore
42 would not substantially increase risk for adverse effects to beneficial uses. CM2-22 would not cause
43 long-term degradation of water quality resulting in sufficient use of available assimilative capacity
44 such that occasionally exceeding water quality objectives/criteria would be likely. Also, CM2-22

1 would not result in substantially increased risk for adverse effects to any beneficial uses.
2 Furthermore, although the Delta is a 303(d)-listed water body for selenium, given the discussion in
3 the assessment above, it is unlikely that restoration areas would result in measurable increases in
4 selenium in fish tissues or bird eggs such that the beneficial use impairment would be made
5 discernibly worse.

6 Since it is unlikely that substantial increases in selenium in fish tissues or bird eggs would occur
7 such that effects on aquatic life beneficial uses would be anticipated, and because of the avoidance
8 and minimization measures that are designed to further minimize and evaluate the risk of such
9 increases (see Appendix 3.C. of the BDCP for more detail on AMM27) as well as the Selenium
10 Management environmental commitment (see Appendix 3B, *Environmental Commitments*), this
11 impact is considered less than significant. No mitigation is required.

12 **Impact WQ-27: Effects on Trace Metal Concentrations Resulting from Facilities Operations** 13 **and Maintenance (CM1)**

14 ***Upstream of the Delta***

15 For the same reasons stated for the No Action Alternative, Alternative 6A would result in negligible,
16 and likely immeasurable, increases in trace metal concentrations in the rivers and reservoirs
17 upstream of the Delta, relative to Existing Conditions and the No Action Alternative. Effects due to
18 the operation and maintenance of the conveyance facilities are expected to be immeasurable, on an
19 annual and long-term average basis. As such, Alternative 6A would not be expected to substantially
20 increase the frequency with which applicable Basin Plan objectives or CTR criteria would be
21 exceeded in water bodies of the affected environment located upstream of the Delta or substantially
22 degrade the quality of these water bodies, with regard to trace metals.

23 ***Delta***

24 For the same reasons stated for the No Action Alternative, Alternative 6A would not result in
25 substantial increases in trace metal concentrations in the Delta relative to Existing Conditions and
26 the No Action Alternative. However, substantial changes in source water fraction would occur in the
27 south Delta (Appendix 8D, Source Water Fingerprinting). Throughout much of the south Delta, San
28 Joaquin River water would replace Sacramento River water, with the future trace metals profile
29 largely reflecting that of the San Joaquin River. As discussed for the No Action Alternative, trace
30 metal concentration profiles between the San Joaquin and Sacramento Rivers are very similar and
31 currently meet Basin Plan objectives and CTR criteria. While the change in trace metal
32 concentrations in the south Delta would likely be measurable, Alternative 6A would not be expected
33 to substantially increase the frequency with which applicable Basin Plan objectives or CTR criteria
34 would be exceeded in the Delta or substantially degrade the quality of Delta waters with regard to
35 trace metals.

36 ***SWP/CVP Export Service Areas***

37 For the same reasons stated for the No Action Alternative, Alternative 6A would not result in
38 substantial increases in trace metal concentrations in SWP/CVP export service area waters under
39 Alternative 6A, relative to Existing Conditions and the No Action Alternative. Unlike current
40 conditions, however, water delivered to the SWP and CVP export service area would be entirely
41 sourced to the Sacramento River, and thus the future trace metals profile would reflect that of the
42 Sacramento River. While the change in trace metal concentrations in SWP and CVP export service

1 area would likely be measurable, Alternative 6A would not be expected to substantially increase the
2 frequency with which applicable Basin Plan objectives or CTR criteria would be exceeded in the
3 water bodies of the affected environment in the SWP/CVP service area or substantially degrade the
4 quality of these water bodies, with regard to trace metals.

5 **NEPA Effects:** In summary, Alternative 6A, relative to the No Action Alternative, would not cause a
6 substantial increase in long-term average trace metals concentrations within the affected
7 environment, nor would it cause an increased frequency of water quality objective/criteria
8 exceedances within the affected environment. The effect on trace metals is determined not to be
9 adverse.

10 **CEQA Conclusion:** Effects of CM1 on trace metals under Alternative 6A would be similar to those
11 discussed for Alternative 1A, and are summarized here, then compared to the CEQA thresholds of
12 significance (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for
13 this constituent. For additional details on the effects assessment findings that support this CEQA
14 impact determination, see the effects assessment discussion under Alternative 1A.

15 While greater water demands under the Alternative 6A would alter the magnitude and timing of
16 reservoir releases north, south and east of the Delta, these activities would have no substantial effect
17 on the various watershed sources of trace metals. Moreover, long-term average flow and trace
18 metals at Sacramento River at Hood and San Joaquin River at Vernalis are poorly correlated;
19 therefore, changes in river flows would not be expected to cause a substantial long-term change in
20 trace metal concentrations upstream of the Delta.

21 Average and 95th percentile trace metal concentrations are very similar across the primary source
22 waters to the Delta. Given this similarity, very large changes in source water fraction would be
23 necessary to effect a relatively small change in trace metal concentration at a particular Delta
24 location. Moreover, average and 95th percentile trace metal concentrations for these primary source
25 waters are all below their respective water quality criteria, including those that are hardness-based
26 without a WER adjustment. No mixing of these three source waters could result in a metal
27 concentration greater than the highest source water concentration, and given that trace metals do
28 not already exceed water quality criteria, more frequent exceedances of criteria in the Delta would
29 not be expected to occur under the Alternative 6A.

30 The assessment of the Alternative 6A effects on trace metals in the SWP/CVP Export Service Areas is
31 based on assessment of changes in trace metal concentrations at Banks and Jones pumping plants.
32 As just discussed regarding similarities in Delta source water trace metal concentrations, the
33 Alternative 6A is not expected to result in substantial changes in trace metal concentrations in Delta
34 waters, including Banks and Jones pumping plants, therefore effects on trace metal concentrations
35 in the SWP/CVP Export Service Area are expected to be negligible.

36 Based on the above, there would be no substantial long-term increase in trace metal concentrations
37 in the rivers and reservoirs upstream of the Delta, in the Delta Region, or the SWP/CVP export
38 service area waters under Alternative 6A relative to Existing Conditions. As such, this alternative is
39 not expected to cause additional exceedance of applicable water quality objectives by frequency,
40 magnitude, and geographic extent that would cause adverse effects on any beneficial uses of waters
41 in the affected environment. Because trace metal concentrations are not expected to increase
42 substantially, no long-term water quality degradation for trace metals is expected to occur and, thus,
43 no adverse effects to beneficial uses would occur. Furthermore, any negligible changes in long-term
44 trace metal concentrations that may occur in water bodies of the affected environment would not be

1 expected to make any existing beneficial use impairments measurably worse. The trace metals
2 discussed in this assessment are not considered bioaccumulative, and thus would not directly cause
3 bioaccumulative problems in aquatic life or humans. This impact is considered to be less than
4 significant. No mitigation is required.

5 **Impact WQ-28: Effects on Trace Metal Concentrations Resulting from Implementation of** 6 **CM2–CM22**

7 **NEPA Effects:** Conservation Measures 2–22 proposed under Alternative 6A would be the same as
8 those proposed under Alternative 1A. As such, effects on trace metals resulting from the
9 implementation of CM2–CM22 would be similar to that previously discussed for Alternative 1A. As
10 they pertain to trace metals, implementation of CM2–CM22 would not be expected to adversely
11 affect beneficial uses of the affected environment or substantially degrade water quality with
12 respect to trace metals.

13 In summary, implementation of CM2–CM22 under Alternative 6A, relative to the No Action
14 Alternative, would have negligible, if any, effect on trace metals concentrations. The effect on trace
15 metals from implementing CM2–CM22 is determined not to be adverse.

16 **CEQA Conclusion:** Implementation of CM2–CM22 under Alternative 6A would not cause substantial
17 long-term increase in trace metal concentrations in the rivers and reservoirs upstream of the Delta,
18 in the Delta Region, or the SWP/CVP export service area. As such, this alternative is not expected to
19 cause additional exceedance of applicable water quality objectives by frequency, magnitude, and
20 geographic extent that would cause adverse effects on any beneficial uses of waters in the affected
21 environment. Because trace metal concentrations are not expected to increase substantially, no
22 long-term water quality degradation for trace metals is expected to occur and, thus, no adverse
23 effects to beneficial uses would occur. Furthermore, any negligible changes in long-term trace metal
24 concentrations that may occur throughout the affected environment would not be expected to make
25 any existing beneficial use impairments measurably worse. The trace metals discussed in this
26 assessment are not considered bioaccumulative, and thus would not directly cause bioaccumulative
27 problems in aquatic life or humans. This impact is considered to be less than significant. No
28 mitigation is required.

29 **Impact WQ-29: Effects on TSS and Turbidity Resulting from Facilities Operations and** 30 **Maintenance (CM1)**

31 **NEPA Effects:** Effects of CM1 on TSS and turbidity under Alternative 6A are the same as those
32 discussed for Alternative 1A. The effects on TSS and turbidity from implementing CM1 is determined
33 to not be adverse.

34 **CEQA Conclusion:** Effects of CM1 on TSS and turbidity under Alternative 6A would be similar to
35 those discussed for Alternative 1A, and are summarized here, then compared to the CEQA
36 thresholds of significance (defined in Section 8.3.2) for the purpose of making the CEQA impact
37 determination for this constituent. For additional details on the effects assessment findings that
38 support this CEQA impact determination, see the effects assessment discussion under Alternative
39 1A.

40 Changes river flow rate and reservoir storage that would occur under Alternative 6A, relative to
41 Existing Conditions, would not be expected to result in a substantial adverse change in TSS
42 concentrations and turbidity levels in the reservoirs and rivers upstream of the Delta, given that

1 suspended sediment concentrations are more affected by season than flow. Site-specific and
 2 temporal exceptions may occur due to localized temporary construction activities, dredging
 3 activities, development, or other land use changes would be site-specific and temporal, which would
 4 be regulated to limit both their short-term and long-term effects on TSS and turbidity levels to less
 5 than substantial levels.

6 Within the Delta, geomorphic changes associated with sediment transport and deposition are
 7 usually gradual, occurring over years, and high storm event inflows would not be substantially
 8 affected. Thus, it is expected that the TSS concentrations and turbidity levels in the affected channels
 9 would not be substantially different from the levels under Existing Conditions. Consequently, this
 10 alternative is expected to have minimal effect on TSS concentrations and turbidity levels in the Delta
 11 region, relative to Existing Conditions.

12 There is not expected to be substantial, if even measurable, changes in TSS concentrations and
 13 turbidity levels in the SWP/CVP Export Service Areas waters under Alternative 6A, relative to
 14 Existing Conditions, because as stated above, this alternative is not expected to result in substantial
 15 changes in TSS concentrations and turbidity levels at the south Delta export pumps, relative to
 16 Existing Conditions.

17 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
 18 objectives where such objectives are not exceeded under Existing Conditions. Because TSS
 19 concentrations and turbidity levels are not expected to be substantially different, long-term water
 20 quality degradation is not expected, and, thus, beneficial uses are not expected to be adversely
 21 affected. Finally, TSS and turbidity are neither bioaccumulative nor Clean Water Act section 303(d)
 22 listed constituents. This impact is considered to be less than significant. No mitigation is required.

23 **Impact WQ-30: Effects on TSS and Turbidity Resulting from Implementation of CM2–CM22**

24 **NEPA Effects:** Effects of CM2–CM22 on TSS and turbidity under Alternative 6A are the same as those
 25 discussed for Alternative 1A. The effects on TSS and turbidity from implementing CM2–CM22 is
 26 determined to not be adverse.

27 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 6A would be similar to
 28 those proposed under Alternative 1A. As such, effects on TSS and turbidity resulting from the
 29 implementation of CM2–CM22 would be similar to that previously discussed for Alternative 1A. This
 30 impact is considered to be less than significant. No mitigation is required.

31 **Impact WQ-31: Water Quality Effects Resulting from Construction-Related Activities (CM1–** 32 **CM22)**

33 The conveyance features for CM1 under Alternative 6A would be very similar to those discussed for
 34 Alternative 1A. The primary difference between Alternative 6A and Alternative 1A is that under
 35 Alternative 6A, there would be additional features constructed to create the isolated conveyance
 36 system. As such, construction techniques and locations of major features of the conveyance system
 37 within the Delta would be similar. The remainder of the facilities constructed under Alternative 6A,
 38 including CM2–CM22, would be very similar to, or the same as, those to be constructed for
 39 Alternative 1A.

40 **NEPA Effects:** The types and magnitude of potential construction-related water quality effects
 41 associated with implementation of CM1–CM22 under Alternative 6A would be very similar to the
 42 effects discussed for Alternative 1A, and the effects anticipated with implementation of CM2–CM22

1 would be essentially identical. Nevertheless, the construction of CM1, and any individual
 2 components necessitated by CM2, and CM4–CM10, with the implementation of the BMPs specified in
 3 Appendix 3B, *Environmental Commitments*, and other agency permitted construction requirements
 4 would result in the potential water quality effects being largely avoided and minimized. The specific
 5 environmental commitments that would be implemented under Alternative 6A would be similar to
 6 those described for Alternative 1A (refer to Chapter 3, *Description of Alternatives*, and Appendix 3B,
 7 *Environmental Commitments*, for additional information regarding the environmental commitments
 8 and environmental permits). Consequently, relative to Existing Conditions, Alternative 6A would not
 9 be expected to cause exceedance of applicable water quality objectives/criteria or substantial water
 10 quality degradation with respect to constituents of concern, and thus would not adversely affect any
 11 beneficial uses upstream of the Delta, in the Delta, or in the SWP and CVP service area.

12 In summary, with implementation of environmental commitments in Appendix 3B, the potential
 13 construction-related water quality effects are considered to be not adverse.

14 **CEQA Conclusion:** Because environmental commitments would be implemented under Alternative
 15 6A for construction-related activities along with agency-issued permits that also contain
 16 construction requirements to protect water quality, the construction-related effects, relative to
 17 Existing Conditions, would not be expected to cause or contribute to substantial alteration of
 18 existing drainage patterns which would result in substantial erosion or siltation on- or off-site,
 19 substantial increased frequency of exceedances of water quality objectives/criteria, or substantially
 20 degrade water quality with respect to the constituents of concern on a long-term average basis, and
 21 thus would not adversely affect any beneficial uses in water bodies upstream of the Delta, within the
 22 Delta, or in the SWP and CVP service area. Moreover, because the construction-related activities
 23 would be temporary and intermittent in nature, the construction would involve negligible
 24 discharges, if any, of bioaccumulative or 303(d) listed constituents to water bodies of the affected
 25 environment. As such, construction activities would not contribute measurably to bioaccumulation
 26 of contaminants in organisms or humans or cause 303(d) impairments to be discernibly worse.
 27 Based on these findings, this impact is determined to be less than significant. No mitigation is
 28 required.

29 **8.4.3.12 Alternative 6B—Isolated Conveyance with East Alignment and** 30 **Intakes 1–5 (15,000 cfs; Operational Scenario D)**

31 Alternative 6B would comprise physical/structural components similar to those under Alternative
 32 1B with the principal exception that Alternative 6B would be an “isolated” conveyance, no longer
 33 involving operation of the existing SWP and CVP south Delta export facilities for Clifton Court
 34 Forebay and Jones Pumping Plant. Alternative 6B would utilize five screened intakes (i.e., Intakes 1
 35 through 5) to convey up to 15,000 cfs of water from the north Delta to the south Delta through a
 36 canal along the east side of the Delta. An intermediate pumping plant north of the town of Holt
 37 would be constructed as well as a new 600 acre Byron Tract Forebay located adjacent to Clifton
 38 Court Forebay. Water supply and conveyance operations would follow the guidelines described as
 39 Scenario D, which includes fall X2. CM2–CM22 would be implemented under this alternative, and
 40 these conservation measures would be the same as those under Alternative 1A. See Chapter 3,
 41 *Description of Alternatives*, Section 3.5.12, for additional details on Alternative 6B.

1 **Water Quality Effects Resulting from Facilities Operations and Maintenance (CM1)**

2 Alternative 6B has the same diversion and conveyance operations as Alternative 6A. The primary
 3 difference between the two alternatives is that conveyance under Alternative 6B would be in a lined
 4 or unlined canal, instead of pipeline. Because there would be no difference in conveyance capacity or
 5 operations, there would be no differences between these two alternatives in upstream of Delta river
 6 flows or reservoir operations, Delta inflow, source fractions to various Delta locations, and
 7 hydrodynamics in the Delta. Conveyance of water in an open channel instead of a pipeline may
 8 result in differing physical properties (e.g., DO, pH, temperature) of the water upon reaching the
 9 south Delta export pumps than if the water was conveyed in a pipeline. However, the physical
 10 properties of water arriving at the south Delta export pumps would continue to change and would
 11 equilibrate to similar levels as Alternative 6A as it is conveyed throughout the SWP/CVP Export
 12 Service Areas. Because no substantial differences in water quality effects are anticipated anywhere
 13 in the affected environment under Alternative 6B compared to those described in detail for
 14 Alternative 6A, the water quality effects described for Alternative 6A also appropriately characterize
 15 effects under Alternative 6B.

16 **Water Quality Effects Resulting from Implementation of CM2–CM22**

17 Alternative 6B has the same conservation measures as Alternative 6A. Because no substantial
 18 differences in water quality effects are anticipated anywhere in the affected environment under
 19 Alternative 6B compared to those described in detail for Alternative 6A, the water quality effects
 20 described for Alternative 6A also appropriately characterize effects under Alternative 6B.

21 **Impact WQ-31: Water Quality Effects Resulting from Construction-Related Activities (CM1–** 22 **CM22)**

23 *NEPA Effects:* The primary difference between Alternative 6B and Alternative 1A is that under
 24 Alternative 6B, a canal would be constructed for conservation measure CM1 along the eastern side
 25 of the Delta to convey the Sacramento River water south, rather than the tunnel/pipeline features.
 26 As such, construction techniques and locations of major features of the conveyance system within
 27 the Delta would be different (see Chapter 3, *Description of Alternatives*, Section 3.5.12). The
 28 remainder of the facilities constructed under Alternative 6B, including CM2–CM22, would be very
 29 similar to, or the same as, those to be constructed for Alternative 1A.

30 The types of potential construction-related water quality effects associated with implementation of
 31 CM1 under Alternative 6B would be very similar to the effects discussed for Alternative 1A, and the
 32 effects anticipated with implementation of CM2–CM22 would be essentially identical. However,
 33 given the substantial differences in the conveyance features under CM1 with construction of a canal,
 34 there could be differences in the location, magnitude, duration, and frequency of construction
 35 activities and related water quality effects. In particular, relative to the Existing Conditions and No
 36 Action Alternative conditions, construction of the major intakes and canal features for CM1 under
 37 Alternative 6B would involve extensive general construction activities, material
 38 handling/storage/placement activities, surface soil grading/excavation/disposal and associated
 39 exposure of disturbed sites to erosion and runoff, and construction site dewatering operations.
 40 Nevertheless, the construction of CM1, and any individual components necessitated by CM2, and
 41 CM4–CM10, with the implementation of the BMPs specified in Appendix 3B, *Environmental*
 42 *Commitments*, and other agency permitted construction requirements would result in the potential
 43 water quality effects being largely avoided and minimized. The specific environmental commitments

1 that would be implemented under Alternative 6B would be similar to those described for
 2 Alternative 1A with the exception that Category “B” BMPs for RTM dewatering basin construction
 3 and operations, if necessary at all, would be much reduced. Consequently, relative to Existing
 4 Conditions, Alternative 6B would not be expected to cause exceedance of applicable water quality
 5 objectives/criteria or substantial water quality degradation with respect to constituents of concern,
 6 and thus would not adversely affect any beneficial uses upstream of the Delta, in the Delta, or in the
 7 SWP and CVP service area.

8 In summary, with implementation of environmental commitments in Appendix 3B, the potential
 9 construction-related water quality effects are considered to be not adverse.

10 **CEQA Conclusion:** Construction-related contaminant discharges would be temporary and
 11 intermittent in nature and would involve negligible, if any, discharges of bioaccumulative or 303(d)
 12 listed constituents to water bodies of the affected environment. As such, construction activities
 13 would not contribute measurably to bioaccumulation of contaminants in organisms or humans or
 14 cause 303(d) impairments to be discernibly worse. Because environmental commitments would be
 15 implemented under Alternative 6B for construction-related activities along with agency-issued
 16 permits that also contain construction related mitigation requirements to protect water quality, the
 17 construction-related effects, relative to Existing Conditions, would not be expected to cause or
 18 contribute to substantial alteration of existing drainage patterns which would result in substantial
 19 erosion or siltation on- or off-site, substantial increased frequency of exceedances of water quality
 20 objectives/criteria, or substantially degrade water quality with respect to the constituents of
 21 concern on a long-term average basis, and thus would not adversely affect any beneficial uses in
 22 water bodies upstream of the Delta, within the Delta, or in the SWP and CVP service area. Based on
 23 these findings, this impact is determined to be less than significant. No mitigation is required.

24 **8.4.3.13 Alternative 6C—Isolated Conveyance with West Alignment and** 25 **Intakes W1–W5 (15,000 cfs; Operational Scenario D)**

26 Alternative 6C would comprise physical/structural components similar to those under Alternative
 27 1C with the principal exception that Alternative 6B would be an “isolated” conveyance, no longer
 28 involving operation of the existing SWP and CVP south Delta export facilities for Clifton Court
 29 Forebay and Jones Pumping Plant. Alternative 6C would utilize five screened intakes (i.e., Intakes 1
 30 through 5) to convey up to 15,000 cfs of water from the north Delta to the south Delta through a
 31 series of canals and tunnels along the west side of the Delta. An intermediate pumping plant would
 32 be utilized and a new 600 acre forebay at Byron Tract would be constructed adjacent Clifton Court
 33 Forebay. There would be no intermediate forebay. Water supply and conveyance operations would
 34 follow the guidelines described as Scenario D, which includes fall X2. CM2–CM22 would be
 35 implemented under this alternative, and these conservation measures would be the same as those
 36 under Alternative 1A. See Chapter 3, *Description of Alternatives*, Section 3.5.13, for additional details
 37 on Alternative 6C.

38 **Water Quality Effects Resulting from Facilities Operations and Maintenance (CM1)**

39 Alternative 6C has the same diversion and conveyance operations as Alternative 6A. The primary
 40 differences between the two alternatives are that conveyance under Alternative 6C would be in a
 41 lined or unlined canal, instead of pipeline, and the alignment of the canal would be along the
 42 western side of the Delta, rather than the eastern side. Because there would be no difference in
 43 conveyance capacity or operations, there would be no differences between these two alternatives in

1 upstream of Delta river flows or reservoir operations, Delta inflow, source fractions to various Delta
 2 locations, and hydrodynamics in the Delta. Conveyance of water in an open channel instead of a
 3 pipeline may result in differing physical properties (e.g., DO, pH, temperature) of the water upon
 4 reaching the south Delta export pumps than if the water was conveyed in a pipeline. However, the
 5 physical properties of water arriving at the south Delta export pumps would continue to change and
 6 would equilibrate to similar levels as Alternative 6A as it is conveyed throughout the SWP/CVP
 7 Export Service Areas. Because no substantial differences in water quality effects are anticipated
 8 anywhere in the affected environment under Alternative 6C compared to those described in detail
 9 for Alternative 6A, the water quality effects described for Alternative 6A also appropriately
 10 characterize effects under Alternative 6C.

11 **Water Quality Effects Resulting from Implementation of CM2–CM22**

12 Alternative 6C has the same conservation measures as Alternative 6A. Because no substantial
 13 differences in water quality effects are anticipated anywhere in the affected environment under
 14 Alternative 6C compared to those described in detail for Alternative 6A, the water quality effects
 15 described for Alternative 6A also appropriately characterize effects under Alternative 6C.

16 **Impact WQ-31: Water Quality Effects Resulting from Construction-Related Activities (CM1–** 17 **CM22)**

18 *NEPA Effects:* The primary difference between Alternative 6C and Alternative 1A is that under
 19 Alternative 6C, a canal would be constructed for CM1 along the western side of the Delta to convey
 20 the Sacramento River water south, in addition to the tunnel/pipeline features. As such, construction
 21 techniques and locations of major features of the conveyance system within the Delta would be
 22 different (see Chapter 3, *Description of Alternatives*, Section 3.5.13). The remainder of the facilities
 23 constructed under Alternative 6C, including CM2–CM22, would be very similar to, or the same as,
 24 those to be constructed for Alternative 1A.

25 The types of potential construction-related water quality effects associated with implementation of
 26 CM1 under Alternative 6C would be very similar to the effects discussed for Alternative 1A, and the
 27 effects anticipated with implementation of CM2–CM22 would be essentially identical. Given the
 28 substantial differences in the conveyance features under CM1 with construction of a canal in
 29 addition to the tunnel/pipeline features, there could be differences in the location, magnitude,
 30 duration, and frequency of construction activities and related water quality effects. In particular,
 31 relative to the Existing Conditions and No Action Alternative conditions, construction of the major
 32 intakes and canal features for CM1 under Alternative 6C would involve extensive general
 33 construction activities, material handling/storage/placement activities, surface soil
 34 grading/excavation/disposal and associated exposure of disturbed sites to erosion and runoff, and
 35 construction site dewatering operations. Nevertheless, the construction of CM1, and any individual
 36 components necessitated by CM2, and CM4–CM10, with the implementation of the BMPs specified in
 37 Appendix 3B, *Environmental Commitments*, and other agency permitted construction requirements
 38 would result in the potential water quality effects being largely avoided and minimized. The specific
 39 environmental commitments that would be implemented under Alternative 6C would be similar to
 40 those described for Alternative 1A. However, this alternative would involve environmental
 41 commitments associated with both tunnel/pipeline and canal construction activities. Consequently,
 42 relative to Existing Conditions, Alternative 6C would not be expected to cause exceedance of
 43 applicable water quality objectives/criteria or substantial water quality degradation with respect to

1 constituents of concern, and thus would not adversely affect any beneficial uses upstream of the
2 Delta, in the Delta, or in the SWP and CVP service area.

3 In summary, with implementation of environmental commitments in Appendix 3B, the potential
4 construction-related water quality effects are considered to be not adverse.

5 **CEQA Conclusion:** Construction-related contaminant discharges would be temporary and
6 intermittent in nature and would involve negligible, if any, discharges of bioaccumulative or 303(d)
7 listed constituents to water bodies of the affected environment. As such, construction activities
8 would not contribute measurably to bioaccumulation of contaminants in organisms or humans or
9 cause 303(d) impairments to be discernibly worse. Because environmental commitments would be
10 implemented under Alternative 6C for construction-related activities along with agency-issued
11 permits that also contain construction related mitigation requirements to protect water quality, the
12 construction-related effects, relative to Existing Conditions, would not be expected to cause or
13 contribute to substantial alteration of existing drainage patterns which would result in substantial
14 erosion or siltation on- or off-site, substantial increased frequency of exceedances of water quality
15 objectives/criteria, or substantially degrade water quality with respect to the constituents of
16 concern on a long-term average basis, and thus would not adversely affect any beneficial uses in
17 water bodies upstream of the Delta, within the Delta, or in the SWP and CVP service area. Based on
18 these findings, this impact is determined to be less than significant. No mitigation is required.

19 **8.4.3.14 Alternative 7—Dual Conveyance with Pipeline/Tunnel, Intakes 2, 20 3, and 5, and Enhanced Aquatic Conservation (9,000 cfs; 21 Operational Scenario E)**

22 Alternative 7 would comprise physical/structural components similar to those under Alternative 1A
23 with the principal exception that Alternative 7 would construct only three intakes and intake
24 pumping plants (i.e., Intakes 2, 3, and 5). Alternative 7 would convey up to 9,000 cfs of water from
25 the north Delta to the south Delta through pipelines/tunnels from three screened intakes on the east
26 bank of the Sacramento River between Clarksburg and Walnut Grove. A 750 acre intermediate
27 forebay and pumping plant would be constructed near Hood. A new 600 acre Byron Tract Forebay,
28 adjacent to and south of Clifton Court Forebay, would be constructed which would provide water to
29 the south Delta pumping plants. Water supply and conveyance operations would follow the
30 guidelines described as Scenario E, which includes fall X2. The modifications under this enhanced
31 aquatic alternative are intended to further improve fish and wildlife habitat, especially along the San
32 Joaquin River. Conservation Measures 2–22 (CM2–22) would be implemented under this
33 alternative, and would be the same as those under Alternative 1A, except that 40 linear miles rather
34 than 20 linear miles of channel margin habitat would be enhanced, and 20,000 acres rather than
35 10,000 acres of seasonally inundated floodplain would be restored. See Chapter 3, *Description of*
36 *Alternatives*, Section 3.5.14, for additional details on Alternative 7.

37 **Effects of the Alternative on Delta Hydrodynamics**

38 Under the No Action Alternative and Alternatives 1–9, the following two primary factors can
39 substantially affect water quality within the Delta:

- 40 • Within the south, west, and interior Delta, a decrease in the percentage of Sacramento River-
41 sourced water and a concurrent increase in San Joaquin River-sourced water can increase the
42 concentrations of numerous constituents (e.g., boron, bromide, chloride, electrical conductivity,

1 nitrate, organic carbon, some pesticides, selenium). This source water replacement is caused by
 2 decreased exports of San Joaquin River water (due to increased Sacramento River water
 3 exports), or effects of climate change on timing of flows in the rivers. Changes in channel flows
 4 also can affect water residence time and many related physical, chemical, and biological
 5 variables.

- 6 • Particularly in the west Delta, sea water intrusion as a result of sea level rise or decreased Delta
 7 outflow can increase the concentration of salts (bromide, chloride) and levels of electrical
 8 conductivity. Conversely, increased Delta outflow (e.g., as a result of Fall X2 operations in wet
 9 and above normal water years) will decrease levels of these constituents, particularly in the
 10 west Delta.

11 Under Alternative 7, over the long term, average annual delta exports are anticipated to decrease by
 12 1,389 TAF relative to Existing Conditions, and by 682 TAF relative to the No Action Alternative.
 13 Since, over the long-term, approximately 62% of the exported water will be from the new north
 14 Delta intakes, average monthly diversions at the south Delta intakes would be decreased because of
 15 the shift in diversions to the north Delta intakes (see Chapter 5, *Water Supply*, for more
 16 information). The result of this is greatly increased San Joaquin River water influence throughout
 17 the south, west, and interior Delta, and a corresponding decrease in Sacramento River water
 18 influence. This can be seen, for example, in Appendix 8D, ALT 7–Old River at Rock Slough for ALL
 19 years (1976–1991), which shows increased San Joaquin River (SJR) percentage and decreased
 20 Sacramento River (SAC) percentage under the alternative, relative to Existing Conditions and the No
 21 Action Alternative.

22 Under Alternative 7, long-term average annual Delta outflow is anticipated to increase 1,383 TAF
 23 relative to Existing Conditions, due to both changes in operations (including north Delta intake
 24 capacity of 9,000 cfs and numerous other operational components of Scenario E) and climate
 25 change/sea level rise (see Chapter 5, *Water Supply*, for more information). The result of this is
 26 decreased sea water intrusion in the west Delta. The decrease of sea water intrusion in the west
 27 Delta under Alternative 7 is greater relative to the Existing Conditions because it does not include
 28 operations to meet Fall X2, whereas the No Action alternative and Alternative 7 do. Long-term
 29 average annual Delta outflow is anticipated to increase under Alternative 7 by 683 TAF relative to
 30 the No Action Alternative, due only to changes in operations. The decreases in sea water intrusion
 31 (represented by an decrease in San Francisco Bay (BAY) percentage) can be seen, for example, in
 32 Appendix 8D, ALT 7–Sacramento River at Mallard Island for ALL years (1976–1991).

33 **Impact WQ-1: Effects on Ammonia Concentrations Resulting from Facilities Operations and** 34 **Maintenance (CM1)**

35 ***Upstream of the Delta***

36 For the same reasons stated for the No Action Alternative, Alternative 7 would have negligible, if
 37 any, effect on ammonia concentrations in the rivers and reservoirs upstream of the Delta relative to
 38 Existing Conditions and the No Action Alternative. Any negligible increases in ammonia-N
 39 concentrations that could occur in the water bodies of the affected environment located upstream of
 40 the Delta would not be of frequency, magnitude and geographic extent that would adversely affect
 41 any beneficial uses or substantially degrade the quality of these water bodies, with regard to
 42 ammonia.

1 **Delta**

2 Assessment of effects of ammonia under Alternative 7 is the same as discussed under Alternative
3 1A, except that because flows in the Sacramento River at Freeport are different between the two
4 alternatives, estimated monthly average and long term annual average predicted ammonia-N
5 concentrations in the Sacramento River downstream of Freeport are different.

6 As Table 8-70 shows, estimated ammonia-N concentrations in the Sacramento River downstream of
7 Freeport (upon full mixing of the SRWTP discharge with river water) under Alternative 7 and the No
8 Action Alternative are expected to be similar. Minor increases in ammonia-N concentrations would
9 occur during January through March, July through September, November, and December, and
10 remaining months would be unchanged or have a minor decrease. A minor increase in the annual
11 average concentration would occur under Alternative 7, compared to the No Action Alternative.
12 Moreover, the estimated concentrations downstream of Freeport under Alternative 7 would be
13 similar to existing source water concentrations for the San Francisco Bay and San Joaquin River.
14 Consequently, changes in source water fraction anticipated under Alternative 7, relative to the No
15 Action Alternative, are not expected to substantially increase ammonia concentrations at any Delta
16 locations.

17 **Table 8-70. Estimated Ammonia-N (mg-L as N) Concentrations in the Sacramento River Downstream of**
18 **the Sacramento Regional Wastewater Treatment Plant for the No Action Alternative and Alternative 7**

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual Average
No Action Alternative	0.074	0.084	0.069	0.060	0.057	0.060	0.058	0.064	0.067	0.060	0.067	0.064	0.065
Alternative 7	0.073	0.086	0.070	0.061	0.058	0.061	0.058	0.064	0.065	0.061	0.069	0.066	0.066

19

20 Any negligible increases in ammonia-N concentrations that could occur at certain locations in the
21 Delta would not be of frequency, magnitude and geographic extent that would adversely affect any
22 beneficial uses or substantially degrade the water quality at these locations, with regards to
23 ammonia.

24 **SWP/CVP Export Service Areas**

25 The assessment of effects on ammonia in the SWP/CVP Export Service Area is based on assessment
26 of ammonia-N concentrations at Banks and Jones pumping plants. Similar to the discussion for
27 Alternative 1A, under Alternative 7 for areas of the Delta that are influenced by Sacramento River
28 water, including Banks and Jones pumping plants, ammonia-N concentrations are expected to
29 decrease, relative to Existing Conditions (in association with less diversion of water influenced by
30 the SRWTP). This decrease in ammonia-N concentrations for water exported via the south Delta
31 pumps is not expected to result in adverse effects on beneficial uses or substantially degrade water
32 quality of exported water, with regards to ammonia.

33 Furthermore, as discussed above for the Plan Area, for all areas of the Delta, including Banks and
34 Jones pumping plants, ammonia-N concentrations are not expected to be substantially different
35 under Alternative 7, relative to No Action Alternative. Any negligible increases in ammonia-N
36 concentrations that could occur at Banks and Jones pumping plants would not be of frequency,

1 magnitude and geographic extent that would adversely affect any beneficial uses or substantially
2 degrade the water quality at these locations, with regards to ammonia.

3 **NEPA Effects:** In summary, based on the discussion above, effects on ammonia from implementation
4 of CM1 are considered to be not adverse.

5 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
6 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
7 purpose of making the CEQA impact determination for this constituent. For additional details on the
8 effects assessment findings that support this CEQA impact determination, see the effects assessment
9 discussion that immediately precedes this conclusion.

10 Ammonia-N concentrations are generally low in the reservoirs and rivers of the watersheds, owing
11 to the lack of substantial point and nonpoint sources of ammonia-N upstream of the SRWTP in the
12 Sacramento River watershed, in the watersheds of the eastern tributaries (Cosumnes, Mokelumne,
13 and Calaveras Rivers), or upstream of the Delta in the San Joaquin River watershed. Consequently,
14 any modified reservoir operations and subsequent changes in river flows under Alternative 7,
15 relative to Existing Conditions, are expected to have negligible, if any, effects on reservoir and river
16 ammonia-N concentrations upstream of Freeport in the Sacramento River watershed and upstream
17 of the Delta in the San Joaquin River watershed.

18 Ammonia-N concentrations in the Sacramento River downstream of the SRWTP would be
19 substantially lower under Alternative 7, relative to Existing Conditions, due to upgrades to the
20 SRWTP that are assumed to be in place, and thus, ammonia concentrations for all areas of the Delta
21 that are influenced by Sacramento River water are expected to decrease. At locations which are not
22 influenced notably by Sacramento River water, concentrations are expected to remain relatively
23 unchanged, due to the similarity in SJR and BAY concentrations and the lack of expected changes in
24 either of these concentrations.

25 The assessment of effects on ammonia in the SWP/CVP Export Service Areas is based on assessment
26 of ammonia-N concentrations at Banks and Jones pumping plants. As discussed above for the Plan
27 Area, for areas of the Delta that are influenced by Sacramento River water, including Banks and
28 Jones pumping plants, ammonia-N concentrations are expected to decrease under Alternative 7,
29 relative to Existing Conditions.

30 There would be no substantial, long-term increase in ammonia-N concentrations in the rivers and
31 reservoirs upstream of the Delta, in the Plan Area, or the waters exported to the CVP and SWP
32 service areas under Alternative 7 relative to Existing Conditions. As such, this alternative is not
33 expected to cause additional exceedance of applicable water quality objectives/criteria by
34 frequency, magnitude, and geographic extent that would cause adverse effects on any beneficial uses
35 of waters in the affected environment. Because ammonia concentrations are not expected to
36 increase substantially, no long-term water quality degradation is expected to occur and, thus, no
37 adverse effects on beneficial uses would occur. Ammonia is not 303(d) listed within the affected
38 environment and thus any minor increases that could occur in some areas would not make any
39 existing ammonia-related impairment measurably worse because no such impairments currently
40 exist. Because ammonia-N is not bioaccumulative, minor increases that could occur in some areas
41 would not bioaccumulate to greater levels in aquatic organisms that would, in turn, pose substantial
42 health risks to fish, wildlife, or humans. This impact is considered to be less than significant. No
43 mitigation is required.

1 **Impact WQ-2: Effects on Ammonia Concentrations Resulting from Implementation of CM2-**
 2 **CM22**

3 **NEPA Effects:** Effects of CM2–CM22 on ammonia under Alternative 7 are the same as those
 4 discussed for Alternative 1A and are considered to be not adverse.

5 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 7 would be similar to
 6 those proposed under Alternative 1A. As such, effects on ammonia resulting from the
 7 implementation of CM2–CM22 would be similar to that previously discussed for Alternative 1A. This
 8 impact is considered to be less than significant. No mitigation is required.

9 **Impact WQ-3: Effects on Boron Concentrations Resulting from Facilities Operations and**
 10 **Maintenance (CM1)**

11 ***Upstream of the Delta***

12 Effects of CM1 on boron under Alternative 7 in areas upstream of the Delta would be very similar to
 13 the effects discussed for Alternative 1A. There would be no expected change to the sources of boron
 14 in the Sacramento and east-side tributary watersheds, and resultant changes in flows from altered
 15 system-wide operations would have negligible, if any, effects on the concentration of boron in the
 16 rivers and reservoirs of these watersheds. The modeled long-term annual average lower San Joaquin
 17 River flow at Vernalis would decrease slightly compared to Existing Conditions (in association with
 18 project operations, climate change, and increased water demands) and would be similar compared
 19 to the No Action Alternative considering only changes due to Alternative 7 operations. The reduced
 20 flow would result in possible increases in long-term average boron concentrations of up to about
 21 3% relative to the Existing Conditions (Appendix 8F, Table 24). The increased boron concentrations
 22 would not increase the frequency of exceedances of any applicable objectives or criteria and would
 23 not be expected to cause further degradation at measurable levels in the lower San Joaquin River,
 24 and thus would not cause the existing impairment there to be discernibly worse. Consequently,
 25 Alternative 7 would not be expected to cause exceedance of boron objectives/criteria or
 26 substantially degrade water quality with respect to boron, and thus would not adversely affect any
 27 beneficial uses of the Sacramento River, the east-side tributaries, associated reservoirs upstream of
 28 the Delta, or the San Joaquin River.

29 ***Delta***

30 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 31 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 32 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 33 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 34 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
 35 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

36 Effects of CM1 on boron under Alternative 7 in the Delta would be similar to the effects discussed for
 37 Alternative 1A. Relative to the Existing Conditions and No Action Alternative, Alternative 7 would
 38 result in increased long-term average boron concentrations for the 16-year period modeled at
 39 interior and western Delta locations (by as much as 10% at the SF Mokelumne River at Staten Island,
 40 33% at Franks Tract, and 56% at Old River at Rock Slough) (Appendix 8F, Table Bo-18). The
 41 comparison to Existing Conditions reflects changes due to both Alternative 7 operations (including
 42 north Delta intake capacity of 9,000 cfs and numerous other operational components of Scenario E)

1 and climate change/sea level rise. The comparison to the No Action Alternative reflects changes due
2 only to operations.

3 Implementation of tidal habitat restoration under CM4 also may contribute to increased boron
4 concentrations at western Delta assessment locations (more discussion of this phenomenon is
5 included in Section 8.3.1.3), and thus would not be anticipated to substantially affect agricultural
6 diversions which occur primarily at interior Delta locations. The long-term annual average and
7 monthly average boron concentrations, for either the 16-year period or drought period modeled,
8 would never exceed the 2,000 µg/L human health advisory objective (i.e., for children) or 500 µg/L
9 agricultural objective at any of the eleven Delta assessment locations, which represents no change
10 from the Existing Conditions and the No Action Alternative (Appendix 8F, Table Bo-3A). The
11 increased concentrations at interior Delta locations would result in moderate reductions in the long-
12 term average assimilative capacity of up to 33% at Franks Tract and up to 56% at Old River at Rock
13 Slough locations (Appendix 8F, Table Bo-19). However, because the absolute boron concentrations
14 would still be well below the lowest 500 µg/L objective for the protection of the agricultural
15 beneficial use under Alternative 7, the levels of boron degradation would not be of sufficient
16 magnitude to substantially increase the risk of exceeding objectives or cause adverse effects to
17 municipal and agricultural water supply beneficial uses, or any other beneficial uses, in the Delta
18 (Appendix 8F, Figure Bo-5).

19 ***SWP/CVP Export Service Areas***

20 Effects of CM1 on boron under Alternative 7 in the Delta would be similar to the effects discussed for
21 Alternative 1A. Under Alternative 7, long-term average boron concentrations would decrease by as
22 much as 41% at the Banks Pumping Plant and by as much as 48% at Jones Pumping Plant relative to
23 Existing Conditions and No Action Alternative (Appendix 8F, Table Bo-18) as a result of export of a
24 greater proportion of low-boron Sacramento River water. Commensurate with the decrease in
25 exported boron concentrations, boron concentrations in the lower San Joaquin River may be
26 reduced and would likely alleviate or lessen any expected increase in boron concentrations at
27 Vernalis associated with flow reductions (see discussion of Upstream of the Delta), as well as
28 locations in the Delta receiving a large fraction of San Joaquin River water. Reduced export boron
29 concentrations also may contribute to reducing the existing 303(d) impairment in the lower San
30 Joaquin River and associated TMDL actions for reducing boron loading.

31 Maintenance of SWP and CVP facilities under Alternative 7 would not be expected to create new
32 sources of boron or contribute towards a substantial change in existing sources of boron in the
33 affected environment. Maintenance activities would not be expected to cause any substantial
34 increases in boron concentrations or degradation with respect to boron such that objectives would
35 be exceeded more frequently, or any beneficial uses would be adversely affected anywhere in the
36 affected environment.

37 ***NEPA Effects:*** In summary, relative to the No Action Alternative conditions, Alternative 7 would
38 result in relatively small long-term average increases in boron levels in the San Joaquin River and
39 moderate increases in the interior and western Delta locations Delta. However, the predicted
40 changes in the Delta would not be expected to result in exceedances of applicable objectives or
41 further water quality degradation such that objectives would likely be exceeded or there would be
42 substantially increased risk of adverse effects on water quality.

43 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
44 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the

1 purpose of making the CEQA impact determination for this constituent. For additional details on the
2 effects assessment findings that support this CEQA impact determination, see the effects assessment
3 discussion that immediately precedes this conclusion.

4 Boron is not a constituent of concern in the Sacramento River watershed upstream of the Delta, thus
5 river flow rate and reservoir storage reductions that would occur under the Alternative 7, relative to
6 Existing Conditions, would not be expected to result in a substantial adverse change in boron levels.
7 Additionally, relative to Existing Conditions, Alternative 7 would not result in reductions in river
8 flow rates (i.e., less dilution) or increased boron loading such that there would be any substantial
9 increases in boron concentration upstream of the Delta in the San Joaquin River watershed.

10 Moderate increased boron levels (i.e., up to 56% increased concentration) and degradation
11 predicted for interior and western Delta locations in response to a shift in the Delta source water
12 percentages and tidal habitat restoration under this alternative would not be expected to cause
13 exceedances of objectives. Alternative 7 maintenance also would not result in any substantial
14 increases in boron concentrations in the affected environment. Boron concentrations would be
15 reduced in water exported from the Delta to the CVP/SWP Export Service Areas, thus reflecting a
16 potential improvement to boron loading in the lower San Joaquin River.

17 Boron is not a bioaccumulative constituent, thus any increased concentrations under Alternative 7
18 would not result in adverse boron bioaccumulation effects to aquatic life or humans. Relative to
19 Existing Conditions, Alternative 7 would not result in substantially increased boron concentrations
20 such that frequency of exceedances of municipal and agricultural water supply objectives would
21 increase. The levels of boron degradation that may occur under Alternative 7, while widespread in
22 particular at interior Delta locations, would not be of sufficient magnitude to cause substantially
23 increased risk for adverse effects to municipal or agricultural beneficial uses within the affected
24 environment. Long-term average boron concentrations would decrease in Delta water exports to the
25 SWP and CVP service area, which may contribute to reducing the existing 303(d) impairment of
26 agricultural beneficial uses in the lower San Joaquin River. Consequently, Alternative 7 would not be
27 expected to cause any substantial increases in boron concentrations or degradation with respect to
28 boron such that objectives would be exceeded more frequently, or any beneficial uses would be
29 adversely affected anywhere in the affected environment. Based on these findings, this impact is
30 determined to be less than significant. No mitigation is required.

31 **Impact WQ-4: Effects on Boron Concentrations Resulting from Implementation of CM2–CM22**

32 **NEPA Effects:** Effects of CM2–CM22 on boron under Alternative 7 are the same as those discussed
33 for Alternative 1A and are determined to be not adverse.

34 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 7 would be similar to
35 those proposed under Alternative 1A. As such, effects on boron resulting from the implementation
36 of CM2–CM22 would be similar to that previously discussed for Alternative 1A. This impact is
37 considered to be less than significant. No mitigation is required.

1 **Impact WQ-5: Effects on Bromide Concentrations Resulting from Facilities Operations and**
 2 **Maintenance (CM1)**

3 ***Upstream of the Delta***

4 Under Alternative 7 there would be no expected change to the sources of bromide in the Sacramento
 5 and eastside tributary watersheds. Bromide loading in these watersheds would remain unchanged
 6 and resultant changes in flows from altered system-wide operations under Alternative 7 would have
 7 negligible, if any, effects on the concentration of bromide in the rivers and reservoirs of these
 8 watersheds. Consequently, Alternative 7 would not be expected to adversely affect the MUN
 9 beneficial use, or any other beneficial uses, of the Sacramento River, the eastside tributaries, or their
 10 associated reservoirs upstream of the Delta.

11 Under Alternative 7, modeling indicates that long-term annual average flows on the San Joaquin
 12 River would decrease by 6%, relative to Existing Conditions, and would remain virtually the same
 13 relative to the No Action Alternative (Appendix 5A). Similar to the No Action Alternative, these
 14 decreases in flow would result in possible increases in long-term average bromide concentrations of
 15 about 3%, relative to Existing Conditions and less than <1% relative to No Action Alternative
 16 (Appendix 8E, Bromide Table 22). The small increases in lower San Joaquin River bromide levels
 17 that could occur under Alternative 7, relative to existing and the No Action Alternative conditions
 18 would not be expected to adversely affect the MUN beneficial use, or any other beneficial uses, of the
 19 lower San Joaquin River.

20 ***Delta***

21 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 22 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 23 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 24 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 25 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
 26 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

27 Using the mass-balance modeling approach for bromide (see Section 8.3.1.3), relative to Existing
 28 Conditions, Alternative 7 would result in increases in long-term average bromide concentrations at
 29 Staten Island and Barker Slough (for the modeled drought period only), while long-term average
 30 concentrations would decrease at the other assessment locations (Appendix 8E, *Bromide*, Table 16).
 31 At Barker Slough, predicted long-term average bromide concentrations would decrease from 51
 32 µg/L to 50 µg/L (2% relative decrease) for the modeled 16-year hydrologic period, but would
 33 increase from 54 µg/L to 72 µg/L (34% relative increase) for the modeled drought period. At Barker
 34 Slough, the predicted 50 µg/L exceedance frequency would decrease from 49% under Existing
 35 Conditions to 29% under Alternative 7, but would increase slightly from 55% to 57% during the
 36 drought period. At Barker Slough, the predicted 100 µg/L exceedance frequency would increase
 37 from 0% under Existing Conditions to 8% under Alternative 7, and would increase from 0% to 22%
 38 during the drought period. At Staten Island, predicted long-term average bromide concentrations
 39 would increase from 50 µg/L to 63 µg/L (27% relative increase) for the modeled 16-year hydrologic
 40 period and would increase from 51 µg/L to 64 µg/L (25% relative increase) for the modeled
 41 drought period. At Staten Island, increases in average bromide concentrations would correspond to
 42 an increased frequency of 50 µg/l threshold exceedance, from 47% under Existing Conditions to
 43 80% under Alternative 7 (52% to 88% for the modeled drought period), and an increase from 1% to
 44 2% (0% to 0% for the modeled drought period) for the 100 µg/L threshold. Changes in exceedance

1 frequency of the 50 µg/L and 100 µg/L concentration thresholds at other assessment locations
2 would be less considerable, with exception to Franks Tract. Although long-term average bromide
3 concentrations were modeled to decrease at Franks Tract, exceedances of the 100 µg/L threshold
4 would increase slightly, from 82% under Existing Conditions to 99% under Alternative 7 (78% to
5 97% for the modeled drought period). This comparison to Existing Conditions reflects changes in
6 bromide due to both Alternative 7 operations (including north Delta intake capacity of 9,000 cfs and
7 numerous other operational components of Scenario E) and climate change/sea level rise.

8 Due to the relatively small differences between modeled Existing Conditions and No Action
9 baselines, changes in long-term average bromide concentrations and changes in exceedance
10 frequencies relative to the No Action Alternative are generally of similar magnitude to those
11 previously described for the existing condition comparison (Appendix 8E, *Bromide*, Table 16).
12 Modeled long-term average bromide concentration at Barker Slough is predicted to increase by 1%
13 (34% for the modeled drought period) relative to the No Action Alternative. Modeled long-term
14 average bromide concentration increases at Staten Island are predicted to increase by 31% (29% for
15 the modeled drought period) relative to the No Action Alternative. However, unlike the Existing
16 Conditions comparison, long-term average bromide concentrations at Buckley Cove would increase
17 relative to the No Action Alternative, although the increases would be relatively small (≤9%). Unlike
18 the comparison to Existing Conditions, this comparison to the No Action Alternative reflects changes
19 in bromide due only to Alternative 7 operations.

20 At Barker Slough, modeled long-term average bromide concentrations for the two baseline
21 conditions are very similar (Appendix 8E, *Bromide*, Table 16). Such similarity demonstrates that the
22 modeled Alternative 7 change in bromide is almost entirely due to Alternative 7 operations, and not
23 climate change/sea level rise. Therefore, operations are the primary driver of effects on bromide at
24 Barker Slough, regardless whether Alternative 7 is compared to Existing Conditions, or compared to
25 the No Action Alternative.

26 Results of the modeling approach which used relationships between EC and chloride and between
27 chloride and bromide (see Section 8.3.1.3) differed somewhat from what is presented above for the
28 mass-balance approach (see Appendix 8E, *Bromide*, Table 17). For most locations, the frequency of
29 exceedance of the 50 µg/L and 100 µg/L were similar. The greatest difference between the methods
30 was predicted for Barker Slough. The increases in frequency of exceedance of the 100 µg/L
31 threshold, relative to Existing Conditions and the No Action Alternative, were not as great using this
32 alternative EC to chloride and chloride to bromide relationship modeling approach as compared to
33 that presented above from the mass-balance modeling approach. Results indicate 2% exceedance
34 over the modeled period under Alternative 7, as compared to 1% under Existing Conditions and 2%
35 under the No Action Alternative. For the drought period, exceedance frequency increased from 0%
36 under Existing Conditions and the No Action Alternative, to 7% under Alternative 7. Because the
37 mass-balance approach predicts a greater level of impact at Barker Slough, determination of impacts
38 was based on the mass-balance results.

39 While the increase in long-term average bromide concentrations at Barker Slough are relatively
40 small when modeled over a representative 16-year hydrologic period, increases during the modeled
41 drought period, principally the relative increase in 100 µg/L exceedance frequency, would represent
42 a substantial change in source water quality during a season of drought. As discussed for Alternative
43 1A, drinking water treatment plants obtaining water via the North Bay Aqueduct utilize a variety of
44 conventional and enhanced treatment technologies in order to achieve DBP drinking water criteria.
45 While the implications of such a modeled drought period change in bromide concentrations at

1 Barker Slough is difficult to predict, the substantial modeled increases could lead to adverse changes
2 in the formation of disinfection byproducts such that considerable treatment plant upgrades may be
3 necessary in order to achieve equivalent levels of health protection during seasons of drought.
4 Increases at Staten Island are also considerable, although there are no existing or foreseeable
5 municipal intakes in the immediate vicinity. Because many of the other modeled locations already
6 frequently exceed the 100 µg/L threshold under Existing Conditions and the No Action Alternative,
7 these locations likely already require treatment plant technologies to achieve equivalent levels of
8 health protection, and thus no additional treatment technologies would be triggered by the small
9 increases in the frequency of exceeding the 100 µg/L threshold. Hence, no further impact on the
10 drinking water beneficial use would be expected at these locations.

11 The seasonal intakes at Mallard Slough and City of Antioch are infrequently used due to water
12 quality constraints related to sea water intrusion. On a long-term average basis, bromide at these
13 locations is in excess of 3,000 µg/L, but during seasonal periods of high Delta outflow can be <300
14 µg/L. Based on modeling using the mass-balance approach, use of the seasonal intakes at Mallard
15 Slough and City of Antioch under Alternative 7 would experience a period average increase in
16 bromide during the months when these intakes would most likely be utilized. For those wet and
17 above normal water year types where mass balance modeling would predict water quality typically
18 suitable for diversion, predicted long-term average bromide would increase from 103 µg/L to 152
19 µg/L (48% increase) at City of Antioch and would increase from 150 µg/L to 204 µg/L (36%
20 increase) at Mallard Slough relative to Existing Conditions (Appendix 8E, *Bromide*, Table 23).
21 Increases would be similar for the No Action Alternative comparison. Modeling results using the EC
22 to chloride and chloride to bromide relationships show increases during these months, but the
23 relative magnitude of the increases is much lower (Appendix 8E, *Bromide*, Table 24). Regardless of
24 the differences in the data between the two modeling approaches, the decisions surrounding the use
25 of these seasonal intakes is largely driven by acceptable water quality, and thus have historically
26 been opportunistic. Opportunity to use these intakes would remain, and the predicted increases in
27 bromide concentrations at the City of Antioch and Mallard Slough intake would not be expected to
28 adversely affect MUN beneficial uses, or any other beneficial use, at these locations.

29 Based on modeling using the mass-balance approach, relative to existing and No Action Alternative
30 conditions, Alternative 7 would lead to predicted improvements in long-term average bromide
31 concentrations at Franks Tract, Rock Slough, and Contra Costa PP No. 1, in addition to Banks and
32 Jones (discussed below). At these locations, long-term average bromide concentrations would be
33 predicted to decrease by as much as 16–32%, depending on baseline comparison. Modeling results
34 using the EC to chloride and chloride to bromide relationships generally do not show similar
35 decreases for Rock Slough and Contra Costa PP No. 1, but rather, predict small increases. Based on
36 the small magnitude of increases predicted, these increases would not adversely affect beneficial
37 uses at those locations.

38 ***SWP/CVP Export Service Areas***

39 Under Alternative 7, improvement in long-term average bromide concentrations would occur at the
40 Banks and Jones pumping plants. Long-term average bromide concentrations for the modeled 16-
41 year hydrologic period at these locations would decrease by as much as 71% relative to Existing
42 Conditions and 67% relative to the No Action Alternative (Appendix 8E, *Bromide* Table 16). As a
43 result, exceedances of the 50 µg/L and 100 µg/L assessment thresholds would be substantially
44 reduced, resulting in considerable overall improvement in Export Service Areas water quality
45 respective to bromide. Commensurate with the decrease in exported bromide, an improvement in

1 lower San Joaquin River bromide would also be observed since bromide in the lower San Joaquin
2 River is principally related to irrigation water deliveries from the Delta. While the magnitude of this
3 expected lower San Joaquin River improvement in bromide is difficult to predict, the relative
4 decrease in overall loading of bromide to the Export Service Areas would likely alleviate or lessen
5 any expected increase in bromide concentrations at Vernalis (see discussion of Upstream of the
6 Delta) as well as locations in the Delta receiving a large fraction of San Joaquin River water, such as
7 much of the south Delta.

8 The discussion above is based on results of the mass-balance modeling approach. Results of the
9 modeling approach which used relationships between EC and chloride and between chloride and
10 bromide (see Section 8.3.1.3) were consistent with the discussion above, and assessment of bromide
11 using these data results in the same conclusions as are presented above for the mass-balance
12 approach (see Appendix 8E, *Bromide*, Table 17).

13 Similar to the discussion pertaining to the No Action Alternative, maintenance of SWP and CVP
14 facilities under Alternative 7 would not be expected to create new sources of bromide or contribute
15 towards a substantial change in existing sources of bromide in the affected environment.
16 Maintenance activities would not be expected to cause any substantial change in bromide such that
17 MUN beneficial uses, or any other beneficial use, would be adversely affected anywhere in the
18 affected environment.

19 **NEPA Effects:** In summary, Alternative 7 operations and maintenance, relative to the No Action
20 Alternative, would result in small increases (i.e., <1%) in long-term average bromide concentrations
21 at Vernalis related to relatively small declines in long-term average flow on the San Joaquin River.
22 However, Alternative 7 operation and maintenance activities would cause substantial degradation
23 to water quality with respect to bromide at Barker Slough, source of the North Bay Aqueduct.
24 Resultant substantial change in long-term average bromide at Barker Slough could necessitate
25 changes in water treatment plant operations or require treatment plant upgrades in order to
26 maintain DBP compliance, and thus would constitute an adverse effect on water quality. Mitigation
27 Measure WQ-5 is available to reduce these effects (implementation of this measure along with a
28 separate, non-environmental commitment as set forth in EIR/EIS Appendix 3B, *Environmental*
29 *Commitments*, relating to the potential increased treatment costs associated with bromide-related
30 changes would reduce these effects).

31 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
32 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
33 purpose of making the CEQA impact determination for this constituent. For additional details on the
34 effects assessment findings that support this CEQA impact determination, see the effects assessment
35 discussion that immediately precedes this conclusion.

36 Under Alternative 7 there would be no expected change to the sources of bromide in the Sacramento
37 and eastside tributary watersheds. Bromide loading in these watersheds would remain unchanged
38 and resultant changes in flows from altered system-wide operations under Alternative 7 would have
39 negligible, if any, effects on the concentration of bromide in the rivers and reservoirs of these
40 watersheds. However, south of the Delta, the San Joaquin River is a substantial source of bromide,
41 primarily due to the use of irrigation water imported from the southern Delta. Concentrations of
42 bromide at Vernalis are inversely correlated to net river flow. Under Alternative 7, long-term
43 average flows at Vernalis would decrease only slightly, resulting in less than substantial predicted
44 increases in long-term average bromide of about 3% relative to Existing Conditions.

1 Relative to Existing Conditions, Alternative 7 would result in substantial increases in long-term
2 average bromide concentration at Staten Island and Barker Slough (for the modeled drought period
3 only). There are no existing or foreseeable municipal drinking water intakes in the vicinity of Staten
4 Island, but Barker Slough is the source of the North Bay Aqueduct. While the increase in long-term
5 average bromide concentrations at Barker Slough are predicted to be relatively small when modeled
6 over a representative 16-year hydrologic period, increases during the modeled drought period
7 would represent a substantial change in source water quality during a season of drought. These
8 predicted drought season related increases in bromide at Barker Slough could lead to adverse
9 changes in the formation of disinfection byproducts at drinking water treatment plants such that
10 considerable water treatment plant upgrades would be necessary in order to achieve equivalent
11 levels of drinking water health protection.

12 The assessment of effects on bromide in the SWP/CVP Export Service Areas is based on assessment
13 of changes in bromide concentrations at Banks and Jones pumping plants. Under Alternative 7,
14 substantial improvement would occur at the Banks and Jones pumping plants, where predicted
15 long-term average bromide concentrations are predicted to decrease by as much as 71% relative to
16 Existing Conditions. An overall improvement in bromide-related water quality would be predicted
17 in the SWP/CVP Export Service Areas.

18 Based on the above, Alternative 7 operation and maintenance would not result in any substantial
19 change in long-term average bromide concentration upstream of the Delta. Furthermore, under
20 Alternative 7, water exported from the Delta to the SWP/CVP service area would be substantially
21 improved relative to bromide. Bromide is not bioaccumulative, therefore change in long-term
22 average bromide concentrations would not directly cause bioaccumulative problems in aquatic life
23 or humans. Additionally, bromide is not a constituent related to any 303(d) listings. Alternative 7
24 operation and maintenance activities would not cause substantial long-term degradation to water
25 quality respective to bromide with the exception of water quality at Barker Slough (drought period
26 only) and at Staten Island in the eastern Delta. There are no existing or foreseeable municipal
27 intakes in the vicinity of Staten Island, but Barker Slough is the source of the North Bay Aqueduct. At
28 Barker Slough, modeled long-term annual average concentrations of bromide would increase by
29 34% during the modeled drought period. For the modeled 1 drought period the frequency of
30 predicted bromide concentrations exceeding 100 µg/L would increase from 0% under Existing
31 Conditions to 22% under Alternative 7. Substantial changes in long-term average bromide during
32 seasons of drought could necessitate changes in treatment plant operation or require treatment
33 plant upgrades in order to maintain DBP compliance. The model predicted change at Barker Slough
34 during the drought period is substantial and, therefore, would represent a substantially increased
35 risk for adverse effects on existing MUN beneficial uses should treatment upgrades not be
36 undertaken. The impact is considered significant.

37 Implementation of Mitigation Measure WQ-5 along with a separate, non-environmental
38 commitment relating to the potential increased treatment costs associated with bromide-related
39 changes would reduce these effects. While mitigation measures to reduce these water quality effects
40 in affected water bodies to less than significant levels are not available, implementation of
41 Mitigation Measure WQ-5 is recommended to attempt to reduce the effect that increased bromide
42 concentrations may have on Delta beneficial uses. However, because the effectiveness of this
43 mitigation measure to result in feasible measures for reducing water quality effects is uncertain, this
44 impact is considered to remain significant and unavoidable. Please see Mitigation Measure WQ-5
45 under Impact WQ-5 in the discussion of Alternative 1A.

1 In addition to and to supplement Mitigation Measure WQ-5, the BDCP proponents have incorporated
 2 into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*, a separate, non-
 3 environmental commitment to address the potential increased water treatment costs that could
 4 result from bromide-related concentration effects on municipal water purveyor operations.
 5 Potential options for making use of this financial commitment include funding or providing other
 6 assistance towards implementation of the North Bay Aqueduct AIP, acquiring alternative water
 7 supplies, or other actions to indirectly reduce the effects of elevated bromide and DOC in existing
 8 water supply diversion facilities. Please refer to Appendix 3B, *Environmental Commitments*, for the
 9 full list of potential actions that could be taken pursuant to this commitment in order to reduce the
 10 water quality treatment costs associated with water quality effects relating to chloride, electrical
 11 conductivity, and bromide.

12 **Mitigation Measure WQ-5: Avoid, Minimize, or Offset, as Feasible, Adverse Water Quality**
 13 **Conditions**

14 Please see Mitigation Measure WQ-5 under Impact WQ-5 in the discussion of Alternative 1A.

15 **Impact WQ-6: Effects on Bromide Concentrations Resulting from Implementation of CM2–**
 16 **CM22**

17 **NEPA Effects:** Conservation Measures 2–22 under Alternative 7 would be similar to those under
 18 Alternative 1A, but 40 linear miles rather than 20 linear miles of channel margin habitat would be
 19 enhanced, and 20,000 acres rather than 10,000 acres of seasonally inundated floodplain would be
 20 restored. As discussed for Alternative 1A, implementation of the CM2–CM22 would not present new
 21 or substantially changed sources of bromide to the study area. Some conservation measures may
 22 replace or substitute for existing irrigated agriculture in the Delta. This replacement or substitution
 23 is not expected to substantially increase or present new sources of bromide. CM2–CM22 would not
 24 be expected to cause any substantial change in bromide such that MUN beneficial uses, or any other
 25 beneficial use, would be adversely affected anywhere in the affected environment.

26 In summary, implementation of CM2–CM22 under Alternative 7, relative to the No Action
 27 Alternative, would have negligible, if any, effects on bromide concentrations. The effects on bromide
 28 from implementing CM2–CM22 are determined to not be adverse.

29 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 7 would be similar to
 30 those proposed under Alternative 1A. As discussed for Alternative 1A, implementation of CM2–
 31 CM22 would not present new or substantially changed sources of bromide to the study area. As
 32 such, effects on bromide resulting from the implementation of CM2–CM22 would be similar to that
 33 previously discussed for Alternative 1A. This impact is considered to be less than significant. No
 34 mitigation is required.

35 **Impact WQ-7: Effects on Chloride Concentrations Resulting from Facilities Operations and**
 36 **Maintenance (CM1)**

37 ***Upstream of the Delta***

38 Under Alternative 7 there would be no expected change to the sources of chloride in the Sacramento
 39 and eastside tributary watersheds. Chloride loading in these watersheds would remain unchanged
 40 and resultant changes in flows from altered system-wide operations would have negligible, if any,
 41 effects on the concentration of chloride in the rivers and reservoirs of these watersheds. The

1 modeled long-term annual average flows on the lower San Joaquin River at Vernalis would decrease
2 slightly compared to Existing Conditions and be similar compared to the No Action Alternative (as a
3 result of climate change). The reduced flow would result in possible increases in long-term average
4 chloride concentrations of about 2%, relative to the Existing Conditions and no change relative to No
5 Action Alternative (Appendix 8G, Table Cl-62). Consequently, Alternative 7 would not be expected to
6 cause exceedance of chloride objectives/criteria or substantially degrade water quality with respect
7 to chloride, and thus would not adversely affect any beneficial uses of the Sacramento River, the
8 eastside tributaries, associated reservoirs upstream of the Delta, or the San Joaquin River.

9 ***Delta***

10 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
11 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
12 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
13 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
14 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
15 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

16 Relative to the Existing Conditions and No Action Alternative, Alternative 7 would result in similar
17 or reduced long-term average chloride concentrations for the 16-year period modeled at most of the
18 assessment locations, and, depending on modeling approach (see Section 8.3.1.3) increased
19 concentrations at the Contra Costa Canal at Pumping Plant #1 (i.e., up to 29% compared to No
20 Action Alternative), Rock Slough (i.e., up to 22% compared to No Action Alternative), and the San
21 Joaquin River at Staten Island (i.e., up to 28% compared to Existing Conditions and No Action
22 Alternative) (Appendix 8G, *Chloride*, Table Cl-43 and Table Cl-44). Moreover, the direction and
23 magnitude of predicted changes for Alternative 7 are similar between the alternatives, thus, the
24 effects relative to Existing Conditions and the No Action Alternative are discussed together.
25 Additionally, implementation of tidal habitat restoration under CM4 would increase the tidal
26 exchange volume in the Delta, and thus may contribute to increased chloride concentrations in the
27 Bay source water as a result of increased salinity intrusion. More discussion of this phenomenon is
28 included in Section 8.3.1.3. Consequently, while uncertain, the magnitude of chloride increases may
29 be greater than indicated herein and would affect the western Delta assessment locations the most
30 which are influenced to the greatest extent by the Bay source water. The comparison to Existing
31 Conditions reflects changes in chloride due to both Alternative 7 operations (including north Delta
32 intake capacity of 9,000 cfs and numerous other operational components of Scenario E) and climate
33 change/sea level rise. The comparison to the No Action Alternative reflects changes in chloride due
34 only to operations. The following outlines the modeled chloride changes relative to the applicable
35 objectives and beneficial uses of Delta waters.

36 ***Municipal Beneficial Uses***

37 Estimates of chloride concentrations generated using EC-chloride relationships and DSM2 EC output
38 (see Section 8.3.1.3) were used to evaluate the 150 mg/L Bay-Delta WQCP objective for municipal
39 and industrial beneficial uses on a basis of the percent of years the chloride objective is exceeded for
40 the modeled 16-year period. The objective is exceeded if chloride concentrations exceed 150 mg/L
41 for a specified number of days in a given water year at both the Antioch and Contra Costa Pumping
42 Plant #1 locations. For Alternative 7, the modeled frequency of objective exceedance would increase
43 from 6% of years under Existing Conditions and 6% under the No Action Alternative to 25% of years
44 under Alternative 7 (Appendix 8G, Table Cl-64).

1 Similarly, estimates of chloride concentrations generated using EC-chloride relationships and DSM2
2 EC output (see Section 8.3.1.3) were also used to evaluate the 250 mg/L Bay-Delta WQCP objective
3 for chloride at Contra Costa Pumping Plant #1 where daily average objectives apply. The basis for
4 the evaluation was the predicted number of days the objective was exceeded for the modeled 16-
5 year period. For Alternative 7, the modeled frequency of objective exceedance would decrease, from
6 6% of modeled days under Existing Conditions and 5% under the No Action Alternative to 1% of
7 modeled days under Alternative 7 (Appendix 8G, Table Cl-63).

8 Given the limitations inherent to estimating future chloride concentrations (see Section 8.3.1.3),
9 estimation of chloride concentrations through both a mass balance approach and an EC-chloride
10 relationship approach was used to evaluate the 250 mg/L Bay-Delta WQCP objectives in terms of
11 both frequency of exceedance and use of assimilative capacity. When utilizing the mass balance
12 approach to model monthly average chloride concentrations for the 16-year period, the predicted
13 frequency of exceeding the 250 mg/L objective would decrease up to 12% (i.e., 24% for Existing
14 Conditions to 12%) at the Contra Costa Canal at Pumping Plant #1 (Appendix 8G, Table Cl-45 and
15 Figure Cl-13). The frequency of exceedances would decrease at the San Joaquin River at Antioch (i.e.,
16 from 66% under Existing Conditions to 60%) with no substantial change predicted for Mallard
17 Island (i.e., maximum increase of 1%) (Appendix 8G, Table Cl-45) and no substantial long-term
18 degradation (Appendix 8G, Table Cl-47). However, relative to the No Action conditions, available
19 assimilative capacity for chloride at the Contra Costa Canal at Pumping Plant #1 would be
20 substantially reduced in August through October (i.e., reduction ranging from 35% to 74% for the 16
21 year period modeled, and 100% in August and September [i.e., eliminated]) (Appendix 8G, Table Cl-
22 47), thus reflecting substantial degradation when concentrations would be near, or exceed, the
23 objective.

24 In comparison, when utilizing the chloride-EC relationship to model monthly average chloride
25 concentrations for the 16-year period, trends in frequency of exceedance generally agreed, but use
26 of assimilative capacity were predicted to be larger at some locations (Appendix 8G, Table Cl-46 and
27 Table Cl-48). Specifically, while the model predicted exceedance frequency would decrease at the
28 Contra Costa Canal at Pumping Plant #1 and Rock Slough locations, use of assimilative capacity
29 would increase substantially for the months of February through June as well as September (i.e.,
30 maximum of 82% in March for the modeled drought period). Due to such seasonal long-term
31 average water quality degradation at these locations, the potential exists for substantial adverse
32 effects on the municipal and industrial beneficial uses through reduced opportunity for diversion of
33 water with acceptable chloride levels. Moreover, due to the increased frequency of exceeding the
34 150 mg/L Bay-Delta WQCP objective, the potential exists for adverse effects on the municipal and
35 industrial beneficial uses at Contra Costa Pumping Plant #1 and Antioch.

36 *303(d) Listed Water Bodies*

37 With respect to the 303(d) listing for chloride in Tom Paine Slough, the monthly average chloride
38 concentrations for the 16-year period modeled at Old River at Tracy Road would generally be
39 similar compared to Existing Conditions, and thus, would not be further degraded on a long-term
40 basis (Appendix 8G, Figure Cl-14). With respect to Suisun Marsh, the monthly average chloride
41 concentrations for the 16-year period modeled would generally increase compared to Existing
42 Conditions in some months during October through May at the Sacramento River at Collinsville
43 (Appendix 8G, Figure Cl-15), Mallard Island (Appendix 8G, Figure Cl-13), and increase substantially
44 at Montezuma Slough at Beldon's Landing (i.e., over a doubling of concentration in December
45 through February) (Appendix 8G, Figure Cl-16), thereby contributing to additional, measureable

1 long-term degradation that potentially would adversely affect the necessary actions to reduce
2 chloride loading for any TMDL that is developed.

3 ***SWP/CVP Export Service Areas***

4 Under Alternative 7, long-term average chloride concentrations based on the mass balance analysis
5 of modeling results for the 16-year period modeled at the Banks and Jones pumping plants would
6 decrease by as much as 70% relative to Existing Conditions and 66% compared to No Action
7 Alternative (Appendix 8G, *Chloride*, Table Cl-43). The modeled frequency of exceedances of
8 applicable water quality objectives/criteria would decrease relative to Existing Conditions and No
9 Action Alternative, for both the 16-year period and the drought period modeled (Appendix 8G,
10 *Chloride*, Table Cl-45). Consequently, water exported into the SWP/CVP service area would
11 generally be of similar or better quality with regards to chloride relative to Existing Conditions and
12 the No Action Alternative conditions.

13 Results of the modeling approach which used relationships between EC and chloride (see Section
14 8.3.1.3) were consistent with the discussion above, and assessment of chloride using these data
15 results in the same conclusions as are presented above for the mass-balance approach (Appendix
16 8G, Table Cl-44 and Table Cl-46).

17 Commensurate with the reduced chloride concentrations in water exported to the service area,
18 reduced chloride loading in the lower San Joaquin River would be anticipated which would likely
19 alleviate or lessen any expected increase in chloride at Vernalis related to decreased annual average
20 San Joaquin River flows (see discussion of Upstream of the Delta).

21 Maintenance of SWP and CVP facilities would not be expected to create new sources of chloride or
22 contribute towards a substantial change in existing sources of chloride in the affected environment.
23 Maintenance activities would not be expected to cause any substantial change in chloride such that
24 any long-term water quality degradation would occur, thus, beneficial uses would not be adversely
25 affected anywhere in the affected environment.

26 ***NEPA Effects:*** In summary, relative to the No Action Alternative conditions, Alternative 7 would
27 result in substantial increased water quality degradation relative to the 150 mg/L Bay-Delta WCCP
28 objective at Contra Costa Pumping Plant #1 and Antioch, substantial seasonal use of assimilative
29 capacity at Contra Costa Pumping Plant #1 and Rock Slough, and measureable water quality
30 degradation relative to the 303(d) impairment in Suisun Marsh. The predicted chloride increases
31 constitute an adverse effect on water quality (see Mitigation Measure WQ-7 below; implementation
32 of this measure along with a separate, non-environmental commitment relating to the potential
33 increased chloride treatment costs would reduce these effects). Additionally, the predicted changes
34 relative to the No Action Alternative conditions indicate that in addition to the effects of climate
35 change/sea level rise, implementation of CM1 and CM4 under Alternative 7 would contribute
36 substantially to the adverse water quality effects.

37 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
38 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
39 purpose of making the CEQA impact determination for this constituent. For additional details on the
40 effects assessment findings that support this CEQA impact determination, see the effects assessment
41 discussion that immediately precedes this conclusion.

42 Chloride is not a constituent of concern in the Sacramento River watershed upstream of the Delta,
43 thus river flow rate and reservoir storage reductions that would occur under the Alternative 7,

1 relative to Existing Conditions, would not be expected to result in a substantial adverse change in
2 chloride levels. Additionally, relative to Existing Conditions, the Alternative 7 would not result in
3 reductions in river flow rates (i.e., less dilution) or increased chloride loading such that there would
4 be any substantial increase in chloride concentrations upstream of the Delta in the San Joaquin River
5 watershed.

6 Relative to Existing Conditions, Alternative 7 operations would result in reduced chloride
7 concentrations in the Delta such that exceedances of the 250 mg/L Bay-Delta WQCP objective at the
8 San Joaquin River at Antioch and Mallard Slough would be reduced. Nevertheless, due to the
9 predicted increased frequency of exceeding the 150 mg/L Bay-Delta WQCP objective at Contra Costa
10 Pumping Plant #1 and Antioch as well as substantial seasonal use of assimilative capacity at Contra
11 Costa Pumping Plant #1 and Rock Slough, the potential exists for adverse effects on the municipal
12 and industrial beneficial uses at Contra Costa Pumping Plant #1 and Antioch (see Mitigation
13 Measure WQ-7 below; implementation of this measure along with a separate, non-environmental
14 commitment relating to the potential increased chloride treatment costs would reduce these
15 effects). Moreover, the modeled increased chloride concentrations and degradation in the western
16 Delta could further contribute, at measurable levels (i.e., over a doubling of concentration), to the
17 existing 303(d) listed impairment due to chloride in Suisun Marsh for the protection of fish and
18 wildlife. Also, relative to the Existing Conditions, long-term degradation at interior Delta locations
19 could still occur and may increase the risk of exceeding aquatic life criteria.

20 Chloride concentrations would be reduced in water exported from the Delta to the CVP/SWP Export
21 Service Areas, thus reflecting a potential improvement to chloride loading in the lower San Joaquin
22 River.

23 Chloride is not a bioaccumulative constituent, thus any increased concentrations under Alternative
24 7 would not result in substantial chloride bioaccumulation impacts on aquatic life or humans.
25 Alternative 7 maintenance would not result in any substantial changes in chloride concentration
26 upstream of the Delta or in the SWP/CVP Export Service Areas. However, based on these findings,
27 this impact is determined to be significant due to increased chloride concentrations and frequency
28 of objective exceedance in the western Delta, as well as potential adverse effects on aquatic life
29 beneficial uses in the interior Delta and fish and wildlife beneficial uses in Suisun Marsh.

30 While mitigation measures to reduce these water quality effects in affected water bodies to less than
31 significant levels are not available, implementation of Mitigation Measure WQ-7 is recommended to
32 attempt to reduce the effect that increased chloride concentrations may have on Delta beneficial
33 uses. However, because the effectiveness of this mitigation measure to result in feasible measures
34 for reducing water quality effects is uncertain, this impact is considered to remain significant and
35 unavoidable. Please see Mitigation Measure WQ-7 under Impact WQ-7 in the discussion of
36 Alternative 1A.

37 In addition to and to supplement Mitigation Measure WQ-7, the BDCP proponents have incorporated
38 into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*, a separate, non-
39 environmental commitment to address the potential increased water treatment costs that could
40 result from chloride concentration effects on municipal, industrial and agricultural water purveyor
41 operations. Potential options for making use of this financial commitment include funding or
42 providing other assistance towards acquiring alternative water supplies or towards modifying
43 existing operations when chloride concentrations at a particular location reduce opportunities to
44 operate existing water supply diversion facilities. Please refer to Appendix 3B, *Environmental*

1 *Commitments*, for the full list of potential actions that could be taken pursuant to this commitment in
 2 order to reduce the water quality treatment costs associated with water quality effects relating to
 3 chloride, electrical conductivity, and bromide.

4 **Mitigation Measure WQ-7: Conduct Additional Evaluation and Modeling of Increased**
 5 **Chloride Levels and Develop and Implement Phased Mitigation Actions**

6 Please see Mitigation Measure WQ-7 under Impact WQ-7 in the discussion of Alternative 1A.

7 **Impact WQ-8: Effects on Chloride Concentrations Resulting from Implementation of CM2–**
 8 **CM22**

9 **NEPA Effects:** Under Alternative 7, the types and geographic extent of effects on chloride
 10 concentrations in the Delta as a result of implementation of the other conservation measures (i.e.,
 11 CM2–CM22) would be similar to, and undistinguishable from, those effects previously described for
 12 Alternative 1A. The conservation measures would present no new direct sources of chloride to the
 13 affected environment. Moreover, some habitat restoration conservation measures (CM4-10) would
 14 occur on lands within the Delta currently used for irrigated agriculture, thus replacing agricultural
 15 land uses with restored tidal wetlands, floodplain, and related channel margin and off-channel
 16 habitats. The potential reduction in irrigated lands within the Delta may result in reduced
 17 discharges of agricultural field drainage with elevated chloride concentrations, which would be
 18 considered an improvement compared to Existing Conditions and No Action Alternative conditions.

19 In summary, based on the discussion above, the effects on chloride from implementing CM2-CM22
 20 are considered to be not adverse.

21 **CEQA Conclusion:** Implementation of the CM2–CM22 for Alternative 7 would not present new or
 22 substantially changed sources of chloride to the affected environment upstream of the Delta, within
 23 Delta, or in the SWP/CVP service area. Replacement of irrigated agricultural land uses in the Delta
 24 with habitat restoration conservation measures may result in some reduction in discharge of
 25 agricultural field drainage with elevated chloride concentrations, thus resulting in improved water
 26 quality conditions. Based on these findings, this impact is considered to be less than significant. No
 27 mitigation is required.

28 **Impact WQ-9: Effects on Dissolved Oxygen Resulting from Facilities Operations and**
 29 **Maintenance (CM1)**

30 **NEPA Effects:** Effects of CM1 on dissolved oxygen under Alternative 7 are the same as those
 31 discussed for Alternative 1A and are considered to not be adverse.

32 **CEQA Conclusion:** Effects of CM1 on DO under Alternative 7 would be similar to those discussed for
 33 Alternative 1A, and are summarized here, then compared to the CEQA thresholds of significance
 34 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this
 35 constituent. For additional details on the effects assessment findings that support this CEQA impact
 36 determination, see the effects assessment discussion under Alternative 1A.

37 River flow rate and reservoir storage reductions that would occur under Alternative 7, relative to
 38 Existing Conditions, would not be expected to result in a substantial adverse change in DO levels in
 39 the reservoirs and rivers upstream of the Delta, given that mean monthly flows would remain within
 40 the ranges historically seen under Existing Conditions and the affected river are large and turbulent.
 41 Any reduced DO saturation level that may be caused by increased water temperature would not be

1 expected to cause DO levels to be outside of the range seen historically. Finally, amounts of oxygen
2 demanding substances and salinity would not be expected to change sufficiently to affect DO levels.

3 It is expected there would be no substantial change in Delta DO levels in response to a shift in the
4 Delta source water percentages under this alternative or substantial degradation of these water
5 bodies, with regard to DO. DO levels would be affected by nutrient loading, which the state has
6 begun to aggressively regulate the discharges of, and this loading would not be expected to lower DO
7 levels relative to Existing Conditions based on historical DO levels. Further, the anticipated changes
8 in salinity would have relatively minor effects on DO levels, and tidal exchange, which contribute to
9 the reaeration of Delta waters would not be expected to change substantially.

10 There is not expected to be substantial, if even measurable, changes in DO levels in the SWP/CVP
11 Export Service Areas waters under Alternative 7, relative to Existing Conditions, because the
12 biochemical oxygen demand of the exported water would not be expected to substantially differ
13 from that under Existing Conditions (due to ever increasing water quality regulations), canal
14 turbulence and exposure of the water to the atmosphere and the algal communities that exist within
15 the canals would establish an equilibrium for DO levels within the canals. The same would occur in
16 downstream reservoirs.

17 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
18 objectives by frequency, magnitude, and geographic extent that would result in significant impacts
19 on any beneficial uses within affected water bodies. Because no substantial changes in DO levels are
20 expected, long-term water quality degradation would not be expected to occur, and, thus, beneficial
21 uses would not be adversely affected. Various Delta waterways are 303(d)-listed for low DO, but
22 because no substantial decreases in DO levels would be expected, greater degradation and DO-
23 related impairment of these areas would not be expected. This impact would be less than significant.
24 No mitigation is required.

25 **Impact WQ-10: Effects on Dissolved Oxygen Resulting from Implementation of CM2–CM22**

26 **NEPA Effects:** Effects of CM2–CM22 on DO under Alternative 7 are the same as those discussed for
27 Alternative 1A and are considered to not be adverse.

28 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 7 would be similar to
29 those proposed under Alternative 1A. As such, effects on DO resulting from the implementation of
30 CM2–CM22 would be similar to that previously discussed for Alternative 1A. This impact is
31 considered to be less than significant. No mitigation is required.

32 **Impact WQ-11: Effects on Electrical Conductivity Concentrations Resulting from Facilities** 33 **Operations and Maintenance (CM1)**

34 ***Upstream of the Delta***

35 For the same reasons stated for the No Action Alternative, EC levels (highs, lows, typical conditions)
36 in the Sacramento River and its tributaries, the eastside tributaries, their associated reservoirs, and
37 the San Joaquin River upstream of the Delta under Alternative 7 are not expected to be outside the
38 ranges occurring under Existing Conditions or would occur under the No Action Alternative. Any
39 minor changes in EC levels that could occur under Alternative 7 in water bodies upstream of the
40 Delta would not be of sufficient magnitude, frequency and geographic extent that would cause
41 adverse effects on beneficial uses or substantially degrade water quality with regard to EC.

1 **Delta**

2 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
3 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
4 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
5 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
6 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
7 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

8 Relative to Existing Conditions, Alternative 7 would result in an increase in the number of days the
9 Bay-Delta WQCP EC objectives would be exceeded in the Sacramento River at Emmaton, and the San
10 Joaquin River at San Andreas Landing, Prisoners Point, and Brandt Bridge (Appendix 8H, Table EC-
11 7). The percent of days the Emmaton EC objective would be exceeded for the entire period modeled
12 (1976–1991) would increase from 6% under Existing Conditions to 16% under Alternative 7, and
13 the percent of days out of compliance would increase from 11% under Existing Conditions to 26%
14 under Alternative 7. The percent of days the San Andreas Landing EC objective would be exceeded
15 would increase from 1% under Existing Conditions to 3% under Alternative 7, and the percent of
16 days out of compliance with the EC objective would increase from 1% under Existing Conditions to
17 6% under Alternative 7. The percent of days the Prisoners Point EC objective would be exceeded for
18 the entire period modeled would increase from 6% under Existing Conditions to 35% under
19 Alternative 7, and the percent of days out of compliance with the EC objective would increase from
20 10% under Existing Conditions to 35% under Alternative 7. In the San Joaquin River at Brandt
21 Bridge, the percent of days exceeding the EC objective would increase from 3% under Existing
22 Conditions to 4% under Alternative 7; the percent of days out of compliance would increase from
23 8% under Existing Conditions to 9% under Alternative 7. Average EC levels at the western and
24 southern Delta compliance locations and San Joaquin River at San Andreas Landing (an interior
25 Delta location) would decrease from 0–46% for the entire period modeled and 2–45% during the
26 drought period modeled (1987–1991) (Appendix 8H, Table EC-18). In the S. Fork Mokelumne River
27 at Terminous, average EC would increase 6% for the entire period modeled and 5% during the
28 drought period modeled. Average EC in the S. Fork Mokelumne River at Terminous would increase
29 during all months (Appendix 8H, Table EC-18). Average EC in the San Joaquin River at Prisoners
30 Point would increase by 1% during the drought period (Appendix 8H, Table EC-18). Given that the
31 western and southern Delta are Clean Water Act section 303(d) listed as impaired due to elevated
32 EC, the increase in the incidence of exceedance of EC objectives under Alternative 7, relative to
33 Existing Conditions, has the potential to contribute to additional impairment and potentially
34 adversely affect beneficial uses. The comparison to Existing Conditions reflects changes in EC due to
35 both Alternative 7 operations (including north Delta intake capacity of 9,000 cfs and numerous
36 other operational components of Scenario E) and climate change/sea level rise.

37 Relative to the No Action Alternative, the percent of days exceeding EC objectives and percent of
38 days out of compliance would increase at: Sacramento River at Emmaton, San Joaquin River at
39 Jersey Point, San Andreas Landing, Vernalis, Brandt Bridge, and Prisoners Point; and Old River near
40 Middle River and at Tracy Bridge (Appendix 8H, Table EC-7). The increase in percent of days
41 exceeding the EC objective would be 34% at Prisoners Point and 10% or less at the remaining
42 locations. The increase in percent of days out of compliance would be 34% at Prisoners Point and
43 15% or less at the remaining locations. For the entire period modeled, average EC levels would
44 increase at: S. Fork Mokelumne River (6%), Old River at Tracy Bridge (1%), and San Joaquin River at
45 Prisoners Point (10%) (Appendix 8H, Table EC-18). During the drought period modeled, average EC
46 would increase at: S. Fork Mokelumne River (6%), San Joaquin River at Brandt Bridge (1%) and

1 Prisoners Point (8%), and Old River at Tracy Bridge 1%) (Appendix 8H, Table EC-18). Given that the
 2 western and southern Delta are Clean Water Act section 303(d) listed as impaired due to elevated
 3 EC, the increase in the incidence of exceedance of EC objectives under Alternative 7, relative to the
 4 No Action Alternative, has the potential to contribute to additional impairment and potentially
 5 adversely affect beneficial uses. The comparison to the No Action Alternative reflects changes in EC
 6 due only to Alternative 7 operations (including north Delta intake capacity of 9,000 cfs and
 7 numerous other operational components of Scenario E).

8 For Suisun Marsh, October–May is the period when Bay-Delta WQCP EC objectives for protection of
 9 fish and wildlife apply. Long-term average EC would increase under Alternative 7, relative to
 10 Existing Conditions, during the months of April and May by 0.2 mS/cm in the Sacramento River at
 11 Collinsville (Appendix 8H, Table EC-21). Long-term average EC would decrease relative to Existing
 12 Conditions in Montezuma Slough at National Steel during October–May (Appendix 8H, Table EC-22).
 13 The most substantial increase would occur near Beldon Landing, with long-term average EC levels
 14 increasing by 0.8–3.3 mS/cm, depending on the month, nearly doubling during some months the
 15 long-term average EC relative to Existing Conditions (Appendix 8H, Table EC-23). Sunrise Duck Club
 16 and Volanti Slough also would have long-term average EC increases of 0.1–1.6 mS/cm (Appendix 8H,
 17 Tables EC-24 and EC-25). The degree to which the long-term average EC increases would cause
 18 exceedance of Bay-Delta WQCP objectives is unknown, because objectives are expressed as a
 19 monthly average of daily high tide EC, which does not have to be met if it can be demonstrated
 20 “equivalent or better protection will be provided at the location” (State Water Resources Control
 21 Board 2006:14). The described long-term average EC increase may, or may not, contribute to
 22 adverse effects on beneficial uses, depending on how and when wetlands are flooded, soil leaching
 23 cycles, and how agricultural use of water is managed, and future actions taken with respect to the
 24 marsh. However, the EC increases at certain locations would be substantial and it is uncertain the
 25 degree to which current management plans for the Suisun Marsh would be able to address these
 26 substantially higher EC levels and protect beneficial uses. Thus, these increased EC levels in Suisun
 27 Marsh are considered to have a potentially adverse effect on marsh beneficial uses. Long-term
 28 average EC increases in Suisun Marsh under Alternative 7 relative to the No Action Alternative
 29 would be similar to the increases relative to Existing Conditions. Suisun Marsh is section 303(d)
 30 listed as impaired due to elevated EC, and the potential increases in long-term average EC
 31 concentrations could contribute to additional impairment, because the increases would be double
 32 that relative to Existing Conditions and the No Action Alternative.

33 ***SWP/CVP Export Service Areas***

34 At the Banks and Jones pumping plants, Alternative 7 would result in no exceedances of the Bay-
 35 Delta WQCP’s 1,000 μ mhos/cm EC objective for the entire period modeled (Appendix 8H, Table EC-
 36 10). Thus, there would be no adverse effect on the beneficial uses in the SWP/CVP Export Service
 37 Areas using water pumped at this location under the Alternative 7.

38 At the Banks pumping plant, relative to Existing Conditions, average EC levels under Alternative 7
 39 would decrease substantially: 47% for the entire period modeled and 51% during the drought
 40 period modeled. Relative to the No Action Alternative, average EC levels would decrease by 43% for
 41 the entire period modeled and 46% during the drought period modeled. (Appendix 8H, Table EC-18)

42 At the Jones pumping plant, relative to Existing Conditions, average EC levels under Alternative 7
 43 would also decrease substantially: 52% for the entire period modeled and 59% during the drought

1 period modeled. Relative to the No Action Alternative, average EC levels would decrease by 50% for
2 the entire period modeled and 57% during the drought period modeled. (Appendix 8H, Table EC-18)

3 Based on the decreases in long-term average EC levels that would occur at the Banks and Jones
4 pumping plants, Alternative 7 would not cause degradation of water quality with respect to EC in
5 the SWP/CVP Export Service Areas; rather, Alternative 7 would improve long-term average EC
6 conditions in the SWP/CVP Export Service Areas.

7 Commensurate with the EC decrease in exported waters, an improvement in lower San Joaquin
8 River average EC levels would be expected since EC in the lower San Joaquin River is, in part, related
9 to irrigation water deliveries from the Delta. While the magnitude of this expected lower San
10 Joaquin River improvement in EC is difficult to predict, the relative decrease in overall loading of EC-
11 elevating constituents to the Export Service Areas would likely alleviate or lessen any expected
12 increase in EC at Vernalis related to decreased annual average San Joaquin River flows (see EC
13 impact discussion under the No Action Alternative).

14 The export area of the Delta is listed on the state's CWA Section 303(d) list as impaired due to
15 elevated EC. Alternative 7 would result in lower average EC levels relative to Existing Conditions and
16 the No Action Alternative and, thus, would not contribute to additional beneficial use impairment
17 related to elevated EC in the SWP/CVP Export Service Areas waters.

18 **NEPA Effects:** In summary, the increased frequency of exceedance of EC objectives and increased
19 long-term and drought period average EC levels that would occur at interior and southern Delta
20 compliance locations, and increased frequency of exceedance of EC objectives in the western Delta
21 under Alternative 7, relative to the No Action Alternative, would contribute to adverse effects on the
22 agricultural beneficial uses. In addition, the increased frequency of exceedance of the San Joaquin
23 River at Prisoners Point EC objective and long-term and drought period average EC could contribute
24 to adverse effects on fish and wildlife beneficial uses. Given that the western and southern Delta are
25 Clean Water Act section 303(d) listed as impaired due to elevated EC, the increase in the incidence
26 of exceedance of EC objectives and long-term average and drought period average EC in these
27 portions of the Delta has the potential to contribute to additional beneficial use impairment. The
28 increases in long-term average EC levels that would occur in Suisun Marsh would further degrade
29 existing EC levels and could contribute additional to adverse effects on the fish and wildlife
30 beneficial uses. Suisun Marsh is section 303(d) listed as impaired due to elevated EC, and the
31 potential increases in long-term average EC levels could contribute to additional beneficial use
32 impairment. These increases in EC constitute an adverse effect on water quality. Mitigation Measure
33 WQ-11 would be available to reduce these effects (implementation of this measure along with a
34 separate, non-environmental commitment as set forth in EIR/EIS Appendix 3B, *Environmental*
35 *Commitments*, relating to the potential EC-related changes would reduce these effects).

36 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
37 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
38 purpose of making the CEQA impact determination for this constituent. For additional details on the
39 effects assessment findings that support this CEQA impact determination, see the effects assessment
40 discussion that immediately precedes this conclusion.

41 River flow rate and reservoir storage reductions that would occur under Alternative 7, relative to
42 Existing Conditions, would not be expected to result in a substantial adverse change in EC levels in
43 the reservoirs and rivers upstream of the Delta, given that: changes in the quality of watershed
44 runoff and reservoir inflows would not be expected to occur in the future; the state's aggressive

1 regulation of point-source discharge effects on Delta salinity-elevating parameters and the expected
2 further regulation as salt management plans are developed; the salt-related TMDLs adopted and
3 being developed for the San Joaquin River; and the expected improvement in lower San Joaquin
4 River average EC levels commensurate with the lower EC of the irrigation water deliveries from the
5 Delta.

6 Relative to Existing Conditions, Alternative 7 would not result in any substantial increases in long-
7 term average EC levels in the SWP/CVP Export Service Areas. There would be no exceedance of the
8 EC objective at the Jones and Banks pumping plants. Average EC levels for the entire period modeled
9 would decrease at both plants and, thus, this alternative would not contribute to additional
10 beneficial use impairment related to elevated EC in the SWP/CVP Export Service Areas waters.
11 Rather, this alternative would improve long-term EC levels in the SWP/CVP Export Service Areas,
12 relative to Existing Conditions.

13 In the Plan Area, Alternative 7 would result in an increase in the frequency with which Bay-Delta
14 WQCP EC objectives are exceeded in the Sacramento River at Emmaton (agricultural objective; 10%
15 increase), San Joaquin River at San Andreas Landing (agricultural objective; 2% increase) and
16 Brandt Bridge (agricultural objective; 1% increase) in the southern Delta, and San Joaquin River at
17 Prisoners Point (fish and wildlife objective; 29% increase) in the interior Delta for the entire period
18 modeled (1976–1991). The increased frequency of exceedance of the fish and wildlife objective at
19 Prisoners Point could contribute to adverse effects on aquatic life, and the increased frequency of
20 the EC exceedance at Emmaton could contribute to adverse effects on agricultural uses. Because EC
21 is not bioaccumulative, the increases in long-term average EC levels would not directly cause
22 bioaccumulative problems in aquatic life or humans. The western and southern Delta are Clean
23 Water Act section 303(d) listed for elevated EC and the increased frequency of exceedance of EC
24 objectives that would occur in these portions of the Delta could make beneficial use impairment
25 measurably worse. This impact is considered to be significant.

26 Further, relative to Existing Conditions, Alternative 7 would result in substantial increases in long-
27 term average EC during the months of October through May in Suisun Marsh, such that EC levels
28 would be double that relative to Existing Conditions. The increases in long-term average EC levels
29 that would occur in Suisun Marsh could further degrade existing EC levels and thus contribute
30 additionally to adverse effects on the fish and wildlife beneficial uses. Because EC is not
31 bioaccumulative, the increases in long-term average EC levels would not directly cause
32 bioaccumulative problems in wildlife. Suisun Marsh is Clean Water Act section 303(d) listed for
33 elevated EC and the increases in long-term average EC that would occur in the marsh could make
34 beneficial use impairment measurably worse. This impact is considered to be significant.

35 Implementation of Mitigation Measure WQ-11 along with a separate, non-environmental
36 commitment relating to the potential increased costs associated with EC-related changes would
37 reduce these effects. While mitigation measures to reduce these water quality effects in affected
38 water bodies to less than significant levels are not available, implementation of Mitigation Measure
39 WQ-11 is recommended to attempt to reduce the effect that increased EC concentrations may have
40 on Delta beneficial uses. However, because the effectiveness of this mitigation measure to result in
41 feasible measures for reducing water quality effects is uncertain, this impact is considered to remain
42 significant and unavoidable. Please see Mitigation Measure WQ-11 under Impact WQ-11 in the
43 discussion of Alternative 1A.

1 In addition to and to supplement Mitigation Measure WQ-11, the BDCP proponents have
 2 incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*, a
 3 separate, non-environmental commitment to address the potential increased water treatment costs
 4 that could result from EC concentration effects on municipal, industrial and agricultural water
 5 purveyor operations. Potential options for making use of this financial commitment include funding
 6 or providing other assistance towards acquiring alternative water supplies or towards modifying
 7 existing operations when EC concentrations at a particular location reduce opportunities to operate
 8 existing water supply diversion facilities. Please refer to Appendix 3B, *Environmental Commitments*,
 9 for the full list of potential actions that could be taken pursuant to this commitment in order to
 10 reduce the water quality treatment costs associated with water quality effects relating to chloride,
 11 electrical conductivity, and bromide.

12 **Mitigation Measure WQ-11: Avoid, Minimize, or Offset, as Feasible, Reduced Water**
 13 **Quality Conditions**

14 Please see Mitigation Measure WQ-11 under Impact WQ-11 in the discussion of Alternative 1A.

15 **Impact WQ-12: Effects on Electrical Conductivity Resulting from Implementation of CM2–**
 16 **CM22**

17 **NEPA Effects:** Effects of CM2–CM22 on EC under Alternative 7 are the same as those discussed for
 18 Alternative 1A and are considered not to be adverse.

19 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 7 would be similar to
 20 those proposed under Alternative 1A. As such, effects on EC resulting from the implementation of
 21 CM2–CM22 would be similar to that previously discussed for Alternative 1A. This impact is
 22 considered to be less than significant. No mitigation is required.

23 **Impact WQ-13: Effects on Mercury Concentrations Resulting from Facilities Operations and**
 24 **Maintenance (CM1)**

25 ***Upstream of the Delta***

26 Under Alternative 7, the magnitude and timing of reservoir releases and river flows upstream of the
 27 Delta in the Sacramento River watershed and east-side tributaries would be altered, relative to
 28 Existing Conditions and the No Action Alternative.

29 The Sacramento River at Freeport and San Joaquin River at Vernalis (as summarized for water
 30 quality average concentrations in Tables 8-48 and 8-49) were examined for flow/concentration
 31 relationships for mercury and methylmercury. No significant, predictive regression relationships
 32 were discovered for mercury or methylmercury, except for total mercury with flow at Freeport
 33 (monthly or annual)(Figures 8I-10 through 8I-13, Appendix 8I). Such a positive relationship
 34 between total mercury and flow is to be expected based on the association of mercury with
 35 suspended sediment and the mobilization of sediments during storm flows. However, the changes in
 36 flow in the Sacramento River under Alternative 7 relative to Existing Conditions and the No Action
 37 Alternative are not of the magnitude of storm flows, in which substantial sediment-associated
 38 mercury is mobilized. Therefore mercury loading should not be substantially different due to
 39 changes in flow. In addition, even though it may be flow-affected, total mercury concentrations
 40 remain well below criteria at upstream locations. Any negligible changes in mercury concentrations
 41 that may occur in the water bodies of the affected environment located upstream of the Delta would

1 not be of frequency, magnitude, and geographic extent that would adversely affect any beneficial
2 uses or substantially degrade the quality of these water bodies as related to mercury. Both
3 waterborne methylmercury concentrations and largemouth bass fillet mercury concentrations are
4 expected to remain above guidance levels at upstream of Delta locations, but will not change
5 substantially relative to Existing Conditions or the No Action Alternative due to changes in flows
6 under Alternative 7.

7 The upstream of Delta areas in the north will benefit from the implementation of the Cache Creek,
8 Sulfur Creek, Harley Gulch, and Clear Lake Mercury TMDLs and the American River methylmercury
9 TMDL. These projects will target specific sources of mercury and methylation upstream of the Delta
10 and could result in net improvement to Delta mercury loading in the future. The implementation of
11 these projects could help to ensure that upstream of Delta environments will not be substantially
12 degraded for water quality with respect to mercury or methylmercury.

13 ***Delta***

14 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
15 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
16 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
17 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
18 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
19 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

20 The water quality impacts of waterborne concentrations of mercury and methylmercury and fish
21 tissue mercury concentrations were evaluated for 9 Delta locations. The analysis of percentage
22 change in assimilative capacity of waterborne total mercury of Alternative 7 relative to the 25 ng/L
23 ecological risk benchmark as compared to Existing Conditions showed a 6.7% reduction at Old River
24 at Rock Slough and Contra Costa Pumping Plant, and a 6.6% reduction at those same locations
25 relative to the No Action Alternative. These changes are not expected to result in adverse effects to
26 beneficial use (Figures 8-53 and 8-54). Similarly, changes in methylmercury concentration are
27 expected to be relatively small. The greatest annual average methylmercury concentration for
28 drought conditions was 0.164 ng/L for the San Joaquin River at Buckley Cove which was slightly
29 higher than Existing Conditions (0.161 ng/L), and slightly lower than the No Action Alternative
30 (0.167 ng/L) (Appendix 8I, Table I-6). All modeled input concentrations exceeded the
31 methylmercury TMDL guidance objective of 0.06 ng/L, therefore percentage change in assimilative
32 capacity was not evaluated for methylmercury.

33 Fish tissue estimates show substantial percentage increases in concentration and exceedance
34 quotients for mercury at some Delta locations. The greatest changes in exceedance quotients
35 relative to Existing Conditions and the No Action Alternative are 30 - 39% at the Contra Costa
36 Pumping Plant and 32–45% for Old River at Rock Slough (Figure 8-55, Appendix 8I, Table I-14b).

37 ***SWP/CVP Export Service Areas***

38 The analysis of mercury and methylmercury in the SWP/CVP Export Service Areas was based on
39 concentrations estimated at the Banks and Jones pumping plants. Both waterborne total and
40 methylmercury concentrations for Alternative 7 are projected to be lower than Existing Conditions
41 and the No Action Alternative (Appendix 8I, Figures 8I-8 and 8I-9). Therefore, mercury shows an
42 increased assimilative capacity at these locations (Figures 8-53 and 8-54).

1 The largest improvements in bass tissue mercury concentrations and exceedance quotients for
2 Alternative 7, relative to Existing Conditions and the No Action Alternative at any location within the
3 Delta are expected for the export pump locations (specifically, at Jones Pumping plant, 30%
4 improvement relative to Existing Conditions, 32% relative to the No Action Alternative) (Figure 8-
5 55, Appendix 8I, Table I-14b).

6 **NEPA Effects:** Based on the above discussion, the effects of mercury and methylmercury in
7 comparison of Alternative 7 to the No Action Alternative (as waterborne and bioaccumulated forms)
8 are considered to be adverse for the case of fish tissue bioaccumulation at some locations.

9 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
10 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
11 purpose of making the CEQA impact determination for this constituent. For additional details on the
12 effects assessment findings that support this CEQA impact determination, see the effects assessment
13 discussion that immediately precedes this conclusion.

14 Under Alternative 7, greater water demands and climate change would alter the magnitude and
15 timing of reservoir releases and river flows upstream of the Delta in the Sacramento River
16 watershed and east-side tributaries, relative to Existing Conditions. Concentrations of mercury and
17 methylmercury upstream of the Delta will not be substantially different relative to Existing
18 Conditions due to the lack of important relationships between mercury/methylmercury
19 concentrations and flow for the major rivers.

20 Methylmercury concentrations exceed criteria at all locations in the Delta and no assimilative
21 capacity exists. However, monthly average waterborne concentrations of total and methylmercury,
22 over the period of record, are very similar to Existing Conditions. Similarly, estimates of fish tissue
23 mercury concentrations show almost no differences would occur among sites for Alternative 7 as
24 compared to Existing Conditions for Delta sites.

25 Assessment of effects of mercury in the SWP and CVP Export Service Areas were based on effects on
26 mercury concentrations and fish tissue mercury concentrations at the Banks and Jones pumping
27 plants. The Banks and Jones pumping plants are expected to show increased assimilative capacity
28 for waterborne mercury and decreased fish tissue concentrations of mercury for Alternative 7 as
29 compared to Existing Conditions.

30 As such, this alternative is not expected to cause additional exceedance of applicable water quality
31 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
32 on any beneficial uses of waters in the affected environment. However, increases in fish tissue
33 mercury concentrations are substantial, and changes in fish tissue mercury concentrations would
34 make existing mercury-related impairment in the Delta measurably worse. In comparison to
35 Existing Conditions, Alternative 7 would increase levels of mercury by frequency, magnitude, and
36 geographic extent such that the affected environment would be expected to have measurably higher
37 body burdens of mercury in aquatic organisms, thereby substantially increasing the health risks to
38 wildlife (including fish) or humans consuming those organisms. This impact is considered to be
39 significant. Feasible or effective actions to reduce the effects on mercury resulting from CM1 are
40 unknown. General mercury management measures through CM12, or actions taken by other entities
41 or programs such as TMDL implementation, may minimize or reduce sources and inputs of mercury
42 to the Delta and methylmercury formation. However, it is uncertain whether this impact would be
43 reduced to a level that would be less than significant as a result of CM12 or other future actions.
44 Therefore, the impact would be significant and unavoidable.

1 **Impact WQ-14: Effects on Mercury Concentrations Resulting from Implementation of CM2–**
 2 **CM22**

3 **NEPA Effects:** Some habitat restoration activities under Alternative 7 would occur on lands in the
 4 Delta formerly used for irrigated agriculture. Tidal and other restoration proposed under
 5 Alternative 7 have the potential to increase water residence times and increase accumulation of
 6 organic sediments that are known to enhance methylmercury bioaccumulation in biota in the
 7 restored habitat. Therefore, increases in mercury methylation in the habitat restoration areas is
 8 possible but uncertain depending on the specific restoration design implemented at a particular
 9 Delta location. Models to estimate the potential for methylmercury formation in restored areas are
 10 not currently available. However, DSM2 modeling for Alternative 7 operations does incorporate
 11 assumptions for certain habitat restoration activities proposed under CM2 and CM4 (see Section
 12 8.3.1.3) that result in changes to Delta hydrodynamics compared to the No Action Alternative. These
 13 modeled restoration assumptions provide some insight into potential hydrodynamic changes that
 14 could be expected related to implementing CM2 and CM4 and are considered in the evaluation of the
 15 potential for increased mercury and methylmercury concentrations under Alternative 7.

16 BDCP Conservation Measure 12 (CM12) addresses the potential for methylmercury bioaccumulation
 17 associated with restoration activities and acknowledges the uncertainties associated with mitigating
 18 or minimizing this potential effect. CM12 proposes project-specific mercury management plans for
 19 restoration actions that will incorporate relevant approaches recommended in Phase 1
 20 Methylmercury TMDL control studies. Specific approaches recommended under CM12 that are
 21 intended to minimize or mitigate for potential increases in methylmercury bioaccumulation at
 22 future restoration sites include:

- 23 • Characterizing mercury, methylmercury, organic carbon, iron, and sulfate concentrations to
 24 better inform restoration design,
- 25 • Sequestering methylmercury at restoration sites using low intensity chemical dosing
 26 techniques,
- 27 • Minimizing microbial methylation associated with anoxic conditions by reducing the amount of
 28 organic material at a restoration site,
- 29 • Designing restoration sites to enhance photo degeneration that converts methylmercury into a
 30 biologically unavailable, inorganic form of mercury,
- 31 • Remediating restoration site soils with iron to reduce methylation in sulfide rich soils, and
 32 • Considering capping mercury laden sediments, where possible to reduce methylation potential
 33 at a site.

34 Because of the uncertainties associated with site-specific estimates of methylmercury
 35 concentrations and the uncertainties in source modeling and tissue modeling, the effectiveness of
 36 methylmercury management proposed under CM12 to reduce methylmercury concentrations would
 37 need to be evaluated separately for each restoration effort, as part of design and implementation.
 38 Because of this uncertainty and the known potential for methylmercury creation in the Delta this
 39 potential effect of implementing CM2–CM22 is considered adverse.

40 **CEQA Conclusion:** There would be no substantial, long-term increase in mercury or methylmercury
 41 concentrations or loads in the rivers and reservoirs upstream of the Delta or the waters exported to
 42 the CVP and SWP service areas due to implementation of CM2–CM22 relative to Existing Conditions.

1 However, uptake of mercury from water and/or methylation of inorganic mercury may increase to
 2 an unquantified degree as part of the creation of new, marshy, shallow, or organic-rich restoration
 3 areas. Methylmercury is 303(d)-listed within the affected environment, and therefore any potential
 4 measurable increase in methylmercury concentrations would make existing mercury-related
 5 impairment measurably worse. Because mercury is bioaccumulative, increases in water-borne
 6 mercury or methylmercury that could occur in some areas could bioaccumulate to somewhat
 7 greater levels in aquatic organisms and would, in turn, pose health risks to fish, wildlife, or humans.
 8 Design of restoration sites under Alternative 7 would be guided by CM12 which requires
 9 development of site specific mercury management plans as restoration actions are implemented.
 10 The effectiveness of minimization and mitigation actions implemented according to the mercury
 11 management plans is not known at this time although the potential to reduce methylmercury
 12 concentrations exists based on current research. Although the BDCP will implement CM12 with the
 13 goal to reduce this potential effect the uncertainties related to site specific restoration conditions
 14 and the potential for increases in methylmercury concentrations in the Delta result in this potential
 15 impact being considered significant. No mitigation measures would be available until specific
 16 restoration actions are proposed. Therefore this programmatic impact is considered significant and
 17 unavoidable.

18 **Impact WQ-15: Effects on Nitrate Concentrations Resulting from Facilities Operations and**
 19 **Maintenance (CM1)**

20 ***Upstream of the Delta***

21 For the same reasons stated for the No Action Alternative, Alternative 7 would have negligible, if
 22 any, impact on nitrate concentrations in the rivers and reservoirs upstream of the Delta in the
 23 Sacramento River watershed relative to Existing Conditions and the No Action Alternative.

24 Under Alternative 7, modeling indicates that long-term annual average flows on the San Joaquin
 25 River would decrease by an estimated 6%, relative to Existing Conditions, and would remain
 26 virtually the same relative to the No Action Alternative (Appendix 5A). Given these relatively small
 27 decreases in flows and the weak correlation between nitrate and flows in the San Joaquin River (see
 28 Nitrate Appendix 8J, Figure 2), it is expected that nitrate concentrations in the San Joaquin River
 29 would be minimally affected, if at all, by changes in flow rates under Alternative 7.

30 Any negligible changes in nitrate-N concentrations that may occur in the water bodies of the affected
 31 environment located upstream of the Delta would not be of frequency, magnitude and geographic
 32 extent that would adversely affect any beneficial uses or substantially degrade the quality of these
 33 water bodies, with regards to nitrate.

34 ***Delta***

35 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 36 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 37 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 38 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 39 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
 40 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

41 Results of the mixing calculations indicate that under Alternative 7, relative to Existing Conditions
 42 and the No Action Alternative, nitrate concentrations throughout the Delta are anticipated to remain

low (<1.4 mg/L-N) relative to adopted objectives (Nitrate Appendix 8J, Table 25 and 26). Long-term average nitrate concentrations are anticipated to increase at most locations in the Delta. The increase would be greatest at Franks Tract, Old River at Rock Slough, and Contra Costa Pumping Plant #1 (all >85% increase). Long-term average concentrations were estimated to increase to 0.67, 1.04 and 1.10 mg/L-N for Franks Tract, Old River at Rock Slough, and Contra Costa Pumping Plant #1, respectively, due primarily to increased San Joaquin River water percentage at these locations (see Fingerprinting Appendix 8D). Although changes at specific Delta locations and for specific months may be substantial on a relative basis, the absolute concentration of nitrate in Delta waters would remain low (<1.4 mg/L-N) in relation to the drinking water MCL of 10 mg/L-N, as well as all other thresholds identified in Table 8-50. No additional exceedances of the MCL are anticipated at any location (Nitrate Appendix 8J, Table 25). On a monthly average basis and on a long term annual average basis, for all modeled years and for the drought period (1987–1991) only, use of assimilative capacity available under Existing Conditions and the No Action Alternative, relative to the drinking water MCL of 10 mg/L-N, was up to approximately 13% at Old River at Rock Slough and Contra Costa Pumping Plant #1, and averaged approximately 6% on a long-term average basis (Nitrate Appendix 8J, Table 27). Similarly, the use of available assimilative capacity at Franks Tract was up to approximately 6%, and averaged 3% over the long term. The concentrations estimated for these locations would not increase the likelihood of exceeding the 10 mg/L-N MCL, nor would they increase the risk for adverse effects to beneficial uses. At all other locations, use of assimilative capacity was negligible (<5%) (Nitrate Appendix 8J, Table 27).

Nitrate concentrations will likely be higher than the modeling results indicate in certain locations. This includes in the Sacramento River between Freeport and Mallard Island and other areas in the Delta downstream of Freeport that are influenced by Sacramento River water. These increases are associated with ammonia and nitrate that are discharged from the SRWTP, which are not included in the modeling.

- Under Existing Conditions, most of the ammonia discharged from the SRWTP is converted to nitrate downstream of the facility's discharge at Freeport, and thus, nitrate concentrations under Existing Conditions in these areas are expected to be higher than the modeling predicts, the increase becoming greater with increasing distance downstream. However, the increase in nitrate concentrations downstream of the SRWTP is expected to be small—the existing increase appears to be from approximately 0.1 mg/L-N to approximately 0.4–0.5 mg/L-N over this reach, due to approximately a 1:1 conversion of ammonia-N to nitrate-N (Central Valley Water Board 2010a:32).
- Under Alternative 7, the planned upgrades to the SRWTP, which include nitrification/partial denitrification, would substantially decrease ammonia concentrations in the discharge, but would increase nitrate concentrations in the discharge up to 10 mg/L-N, which is substantially higher than under Existing Conditions.
- Overall, under Alternative 7, the nitrogen load from the SRWTP discharge is expected to decrease (by up to 50%), relative to Existing Conditions, due to nitrification/partial denitrification upgrades at the SRWTP facility. Thus, while concentrations of nitrate downstream of the facility are expected to be higher than modeling results indicate for both Existing Conditions and Alternative 7, the increase is expected to be greater under Existing Conditions than for Alternative 7 due to the upgrades that are assumed under Alternative 7.

1 The other areas in which nitrate concentrations will be higher than the modeling results indicate are
2 immediately downstream of other wastewater treatment plants that practice nitrification, but not
3 denitrification (e.g., City of Rio Vista Beach WWTF, Town of Discovery Bay WWTF, City of Stockton
4 RWCF). For all such facilities in the Delta, the Regional Water Boards have issued NPDES permits
5 that allow discharge of wastewater containing nitrate into the Delta, and under these permits, the
6 State has determined that no beneficial uses are adversely affected by the discharge, and that the
7 discharger's use of available assimilative capacity of the water body is acceptable. When dilution is
8 necessary in order for the discharge to be in compliance with the Basin Plans (which incorporate the
9 10 mg/L-N MCL by reference), not all of the assimilative capacity of the receiving water is granted to
10 the discharger. Thus, limited decreases in flows are not anticipated to result in systemic
11 exceedances of the MCLs by these POTWs. Furthermore, NPDES permits are renewed on a 5-year
12 basis, and thus, if under changes in flows, dilution was no longer sufficient to maintain nitrate below
13 the MCL in the receiving water, the NPDES permit renewal process would address such cases.

14 Therefore, any increases in nitrate-N concentrations that may occur at certain locations within the
15 Delta would not be of frequency, magnitude and geographic extent that would adversely affect any
16 beneficial uses or substantially degrade the water quality at these locations, with regards to nitrate.

17 ***SWP/CVP Export Service Areas***

18 Assessment of effects of nitrate in the SWP and CVP Export Service Areas is based on effects on
19 nitrate-N at the Banks and Jones pumping plants.

20 Results of the mixing calculations indicate that under Alternative 7, relative to Existing Conditions
21 and the No Action Alternative, nitrate concentrations at Banks and Jones pumping plants are
22 anticipated to decrease on a long-term average annual basis (Nitrate Appendix 8J, Table 25 and 26).
23 During the late summer, particularly in the drought period assessed, concentrations are expected to
24 increase substantially on a relative basis (i.e., >50%), but the absolute value of these changes (i.e., in
25 mg/L-N) is small. Additionally, given the many factors that contribute to potential algal blooms in
26 the SWP and CVP canals within the Export Service Area, and the lack of studies that have shown a
27 direct relationship between nutrient concentrations in the canals and reservoirs and problematic
28 algal blooms in these water bodies, there is no basis to conclude that these small (i.e., generally <0.3
29 mg/L-N), seasonal increases in nitrate concentrations would increase the potential for problem algal
30 blooms in the SWP and CVP Export Service Area. No additional exceedances of the MCL are
31 anticipated (Nitrate Appendix 8J, Table 25). On a monthly average basis and on a long term annual
32 average basis, for all modeled years and for the drought period (1987–1991) only, use of
33 assimilative capacity available under Existing Conditions and the No Action Alternative, relative to
34 the 10 mg/L-N MCL, was negligible for both Banks and Jones pumping plants (Nitrate Appendix 8J,
35 Table 27).

36 Any increases in nitrate-N concentrations that may occur in water exported via Banks and Jones
37 pumping plants are not expected to result in adverse effects to beneficial uses or substantially
38 degrade the quality of exported water, with regards to nitrate.

39 ***NEPA Effects:*** In summary, based on the discussion above, the effects on nitrate from implementing
40 CM1 are considered to be not adverse.

41 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
42 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
43 purpose of making the CEQA impact determination for this constituent. For additional details on the

1 effects assessment findings that support this CEQA impact determination, see the effects assessment
2 discussion that immediately precedes this conclusion.

3 Nitrate-N concentrations are generally low in the reservoirs and rivers of the watersheds, owing to
4 substantial dilution available for point sources and the lack of substantial nonpoint sources of
5 nitrate-N upstream of the SRWTP in the Sacramento River watershed, and in the watersheds of the
6 eastern tributaries (Cosumnes, Mokelumne, and Calaveras Rivers). Although higher in the San
7 Joaquin River watershed, nitrate-N concentrations are not well-correlated with flow rates.
8 Consequently, any modified reservoir operations and subsequent changes in river flows under
9 Alternative 7, relative to Existing Conditions, are expected to have negligible, if any, effects on
10 reservoir and river nitrate-N concentrations upstream of Freeport in the Sacramento River
11 watershed and upstream of the Delta in the San Joaquin River watershed.

12 In the Delta, results of the mixing calculations indicate that under Alternative 7, relative to Existing
13 Conditions, long-term average nitrate concentrations are anticipated to increase at most locations.
14 The increase would be greatest at Franks Tract, Old River at Rock Slough, and Contra Costa Pumping
15 Plant #1 (all >85% increase), due primarily to increased San Joaquin River water percentage at
16 these locations. However, nitrate concentrations throughout the Delta are anticipated to remain low
17 (<1.4 mg/L-N) relative to adopted objectives, and no additional exceedances of the MCL are
18 anticipated at any location. Use of assimilative capacity at locations throughout the Delta (up to
19 13%) did not result in concentrations that would increase the likelihood of exceeding the 10 mg/L-N
20 MCL, nor would they increase the risk for adverse effects to beneficial uses.

21 Assessment of effects of nitrate in the SWP and CVP Export Service Areas is based on effects on
22 nitrate-N concentrations at the Banks and Jones pumping plants. Results of the mixing calculations
23 indicate that under Alternative 7, relative to Existing Conditions, long-term average nitrate
24 concentrations at Banks and Jones pumping plants are anticipated to decrease. No additional
25 exceedances of the MCL are anticipated. Monthly average use of assimilative capacity available
26 under Existing Conditions, relative to the MCL, for both Banks and Jones pumping plants in drought
27 conditions was at times >50%, but the absolute value of these changes (i.e., in mg/L-N) was small.
28 Additionally, given the many factors that contribute to potential algal blooms in the SWP and CVP
29 canals within the Export Service Area, and the lack of studies that have shown a direct relationship
30 between nutrient concentrations in the canals and reservoirs and problematic algal blooms in these
31 water bodies, there is no basis to conclude that these small (i.e., generally <0.3 mg/L-N), seasonal
32 increases in nitrate concentrations would increase the potential for problem algal blooms in the
33 SWP and CVP Export Service Area.

34 Based on the above, this alternative is not expected to cause additional exceedance of applicable
35 water quality objectives/criteria by frequency, magnitude, and geographic extent that would cause
36 adverse effects on any beneficial uses of waters in the affected environment. No long-term water
37 quality degradation is expected to occur such that exceedance of criteria is more likely or such that
38 there is an increased risk of adverse impacts to beneficial uses. Nitrate is not 303(d) listed within
39 the affected environment and thus any increases that may occur in some areas and months would
40 not make any existing nitrate-related impairment measurably worse because no such impairments
41 currently exist. Because nitrate is not bioaccumulative, increases that may occur in some areas and
42 months would not bioaccumulate to greater levels in aquatic organisms that would, in turn, pose
43 substantial health risks to fish, wildlife, or humans. This impact is considered to be less than
44 significant. No mitigation is required.

1 **Impact WQ-16: Effects on Nitrate Concentrations Resulting from Implementation of CM2-**
 2 **CM22**

3 **NEPA Effects:** Effects of CM2–CM22 on nitrate under Alternative 7 are the same as those discussed
 4 for Alternative 1A and are considered not to be adverse.

5 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 7 would be similar to
 6 those proposed under Alternative 1A. As such, effects on nitrate resulting from the implementation
 7 of CM2–CM22 would be similar to that previously discussed for Alternative 1A. This impact is
 8 considered to be less than significant. No mitigation is required.

9 **Impact WQ-17: Effects on Dissolved Organic Carbon Concentrations Resulting from Facilities**
 10 **Operations and Maintenance (CM1)**

11 ***Upstream of the Delta***

12 Under Alternative 7, there would be no substantial change to the sources of DOC within the
 13 watersheds upstream of the Delta. Moreover, long-term average flow and DOC levels in the
 14 Sacramento River at Hood and San Joaquin River at Vernalis are poorly correlated. Thus changes in
 15 system operations and resulting reservoir storage levels and river flows would not be expected to
 16 cause a substantial long-term change in DOC concentrations in the water bodies upstream of the
 17 Delta. Any negligible changes in DOC levels in water bodies upstream of the Delta under Alternative
 18 7, relative to Existing Conditions and the No Action Alternative, would not be of sufficient frequency,
 19 magnitude and geographic extent that would adversely affect any beneficial uses or substantially
 20 degrade the quality of these water bodies, with regards to DOC.

21 ***Delta***

22 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 23 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 24 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 25 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 26 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
 27 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

28 Under Alternative 7, the geographic extent of effects pertaining to long-term average DOC
 29 concentrations in the Delta would be similar to that previously described for Alternative 1A,
 30 although the magnitude of predicted long-term increase and relative frequency of concentration
 31 threshold exceedances would be substantially greater. Modeled effects would be greatest at Franks
 32 Tract, Rock Slough, and Contra Costa PP No. 1., where for the 16-year hydrologic period and the
 33 modeled drought period, long-term average concentration increases ranging from 0.7–1.1 mg/L
 34 would be predicted ($\leq 30\%$ net increase), resulting in long-term average DOC concentrations greater
 35 than 4 mg/L at Rock Slough and Contra Costa PP No. 1 (Appendix 8K, DOC Table 8). Increases in
 36 long-term average concentrations would correspond to more frequent concentration threshold
 37 exceedances, with the greatest change occurring at Rock Slough and Contra Costa PP No. 1 locations.
 38 For Rock Slough, long-term average DOC concentrations exceeding 3 mg/L would increase from
 39 52% under Existing Conditions to 85% under the Alternative 7 (an increase from 47% to 82% for
 40 the drought period), and concentrations exceeding 4 mg/L would increase from 30% to 47% (32%
 41 to 57% for the drought period). For Contra Costa PP No. 1, long-term average DOC concentrations
 42 exceeding 3 mg/L would increase from 52% under Existing Conditions to 85% under Alternative 7

1 (45% to 88% for the drought period), and concentrations exceeding 4 mg/L would increase from
 2 32% to 52% (35% to 58% for the drought period). Relative change in frequency of threshold
 3 exceedance for other assessment locations would be similar or less. This comparison to Existing
 4 Conditions reflects changes in DOC due to both Alternative 7 operations (including north Delta
 5 intake capacity of 9,000 cfs and numerous other operational components of Scenario E) and climate
 6 change/sea level rise.

7 In comparison, Alternative 7 relative to the No Action Alternative would generally result in a similar
 8 magnitude of change to that discussed for the comparison to Existing Conditions. Maximum
 9 increases of 0.7–1.0 mg/L DOC (i.e., ≤26%) would be predicted at Franks Tract, Rock Slough, and
 10 Contra Costa PP No. 1 relative to No Action Alternative) (Appendix 8K, DOC Table 8). Threshold
 11 concentration exceedance frequency trends would also be similar to that discussed for the existing
 12 condition comparison, with exception to the predicted 4 mg/L exceedance frequency at Buckley
 13 Cove. In comparison to the No Action Alternative, the frequency which long-term average DOC
 14 concentrations exceeded 4 mg/L at Buckley Cove would increase from 27% to 33% (42% to 57% for
 15 the modeled drought period). Unlike the comparison to Existing Conditions, this comparison to the
 16 No Action Alternative reflects changes in DOC due only to Alternative 7 operations.

17 The increases in long-term average DOC concentrations estimated to occur at Franks Tract, Rock
 18 Slough, and Contra Costa PP No. 1 are considered substantial and could potentially trigger
 19 significant changes in drinking water treatment plant design or operations. In particular, assessment
 20 locations at Rock Slough and Contra Costa PP No. 1 represent municipal intakes servicing existing
 21 drinking water treatment plants. Under Alternative 7, drinking water treatment plants obtaining
 22 water from these interior Delta locations would likely need to upgrade existing treatment systems in
 23 order to achieve EPA Stage 1 Disinfectants and Disinfection Byproduct Rule action thresholds. While
 24 treatment technologies sufficient to achieve the necessary DOC removals exist, implementation of
 25 such technologies would likely require substantial investment in new or modified infrastructure.

26 Relative to existing and No Action Alternative conditions, Alternative 7 would lead to predicted
 27 improvements in long-term average DOC concentrations at Barker Slough, as well as Banks and
 28 Jones pumping plants (discussed below). Predicted long-term average DOC concentrations at Barker
 29 Slough would decrease <0.1–0.2 mg/L, depending on baseline conditions comparison and modeling
 30 period.

31 ***SWP/CVP Export Service Areas***

32 Under Alternative 7, modeled long-term average DOC concentrations would decrease at Banks and
 33 Jones pumping plants for both the modeled 16-year hydrologic period and the modeled drought
 34 period. Modeled decreases would generally be similar between Existing Conditions and the No
 35 Action Alternative. Relative to Existing Conditions, long-term average DOC concentrations at Banks
 36 would be predicted to decrease by 1.1 mg/L (1.3 mg/L during drought period) (Appendix 8K, DOC
 37 Table 8). At Jones, long-term average DOC concentrations would be predicted to decrease by 1.0
 38 mg/L (1.2 mg/L during drought period). Such substantial improvement in long-term average DOC
 39 concentrations would include fewer exceedances of concentration thresholds. Average DOC
 40 concentrations exceeding the 2 mg/L concentration threshold would decrease from 100% under
 41 Existing Conditions and the No Action Alternative to 67% at Banks and 61% at Jones under
 42 Alternative 7 (60% and 57%, respectively during the drought period), while concentrations
 43 exceeding 4 mg/L would nearly be eliminated (i.e., ≤15% exceedance frequency). Such modeled

1 improvement would correspond to substantial improvement in Export Service Areas water quality,
2 respective to DOC.

3 Similar to the discussion pertaining to the No Action Alternative, maintenance of SWP and CVP
4 facilities under Alternative 7 would not be expected to create new sources of DOC or contribute
5 towards a substantial change in existing sources of DOC in the affected area. Maintenance activities
6 would not be expected to cause any substantial change in long-term average DOC concentrations
7 such that MUN beneficial uses, or any other beneficial use, would be adversely affected.

8 **NEPA Effects:** In summary, Alternative 7, relative to the No Action Alternative, would not cause a
9 substantial long-term change in DOC concentrations in the water bodies upstream of the Delta.
10 Long-term average DOC concentrations at Banks and Jones pumping plants are predicted to
11 decrease by as much as 1.4 mg/L, while long-term average DOC concentrations for some Delta
12 interior locations, including Franks Tract, Rock Slough and Contra Costa PP #1, are predicted to
13 increase by as much as 1.0 mg/L. Resultant substantial changes in long-term average DOC at these
14 Delta interior locations could necessitate changes in water treatment plant operations or require
15 treatment plant upgrades in order to maintain DBP compliance, and thus would constitute an
16 adverse effect on water quality and MUN beneficial uses. Mitigation Measure WQ-17 is available to
17 reduce these effects.

18 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
19 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
20 purpose of making the CEQA impact determination for this constituent. For additional details on the
21 effects assessment findings that support this CEQA impact determination, see the effects assessment
22 discussion that immediately precedes this conclusion.

23 While greater water demands under the Alternative 7 would alter the magnitude and timing of
24 reservoir releases north, south and east of the Delta, these activities would have no substantial effect
25 on the various watershed sources of DOC. Moreover, long-term average flow and DOC at Sacramento
26 River at Hood and San Joaquin River at Vernalis are poorly correlated; therefore, changes in river
27 flows would not be expected to cause a substantial long-term change in DOC concentrations
28 upstream of the Delta.

29 Relative to Existing Conditions, Alternative 7 would result in substantial increases (i.e., 0.7–1.1
30 mg/L) in long-term average DOC concentrations at some Delta interior locations, and would be
31 greatest at Franks Tract, Rock Slough, and Contra Costa PP No. 1. At these locations the predicted
32 changes in DOC would substantially increase the frequency with which long-term average
33 concentrations exceeds 2, 3, or 4 mg/L. Drinking water treatment plants obtaining water from these
34 interior Delta locations would likely need to upgrade existing treatment systems in order to achieve
35 EPA Stage 1 Disinfectants and Disinfection Byproduct Rule action thresholds. Such predicted
36 magnitude change in long-term average DOC concentrations would represent a substantially
37 increased risk for adverse effects on existing MUN beneficial.

38 The assessment of Alternative 7 effects on DOC in the SWP/CVP Export Service Areas is based on
39 assessment of changes in DOC concentrations at Banks and Jones pumping plants. Relative to the
40 existing condition, long-term average DOC concentrations would decrease by as much as 1.3 mg/L at
41 Banks and Jones pumping plants. The frequency with which long-term average DOC concentrations
42 would exceed 2, 3, or 4 mg/L would be substantially reduced, where predicted exceedances of >4
43 mg/L would be nearly eliminated (i.e., ≤15% exceedance frequency). As a result, substantial

1 improvement in DOC-related water quality would be predicted in the SWP/CVP Export Service
2 Areas.

3 Based on the above, Alternative 7 operation and maintenance would not result in any substantial
4 change in long-term average DOC concentration upstream of the Delta. Furthermore, under
5 Alternative 7, water exported from the Delta to the SWP/CVP service area would be substantially
6 improved relative to DOC. DOC is not bioaccumulative, therefore change in long-term average DOC
7 concentrations would not directly cause bioaccumulative problems in aquatic life or humans.
8 Additionally, DOC is not a constituent related to any 303(d) listings. Nevertheless, new and modified
9 conveyance facilities proposed under Alternative 7 would result in a substantial increase in long-
10 term average DOC concentrations (i.e., 0.7–1.1 mg/L, equivalent to $\leq 30\%$ relative increase) at
11 Franks Tract, Rock Slough, and Contra Costa PP No. 1. In particular, under Alternative 7, model
12 predicted long-term average DOC concentrations would be greater than 4 mg/L at Rock Slough and
13 Contra Costa PP No. 1 with commensurate substantial increases in the frequency with which
14 average DOC concentrations exceed 2, 3, and 4 mg/L levels. Drinking water treatment plants
15 obtaining water from these interior Delta locations would likely need to upgrade existing treatment
16 systems in order to achieve EPA Stage 1 Disinfectants and Disinfection Byproduct Rule action
17 thresholds. Therefore, such a magnitude change in long-term average DOC concentrations would
18 represent a substantially increased risk for adverse effects on existing MUN beneficial uses at Rock
19 Slough and Contra Costa PP No. 1 should such treatment upgrades not be undertaken. The impact is
20 considered significant and mitigation is required. While Mitigation Measure WQ-17 is available to
21 partially reduce this impact of DOC, the feasibility and effectiveness of this mitigation measure is
22 uncertain and implementation would not necessarily reduce the identified impact to a level that
23 would be less than significant, and therefore it is significant and unavoidable.

24 **Mitigation Measure WQ-17: Consult with Delta Water Purveyors to Identify Means to**
25 **Avoid, Minimize, or Offset Increases in Long-Term Average DOC Concentrations**

26 Please see Mitigation Measure WQ-17 under Impact WQ-17 in the discussion of Alternative 6A.

27 **Impact WQ-18: Effects on Dissolved Organic Carbon Concentrations Resulting from**
28 **Implementation of CM2–CM22**

29 **NEPA Effects:** Conservation Measures 2–22 under Alternative 7 would be similar to those under
30 Alternative 1A, but 40 linear miles rather than 20 linear miles of channel margin habitat would be
31 enhanced, and 20,000 acres rather than 10,000 acres of seasonally inundated floodplain would be
32 restored. Effects on DOC resulting from the implementation of CM2–CM22 would be similar to that
33 previously discussed for Alternative 1A, except that the increased linear miles of channel margin
34 habitat enhancement and increased acreage of seasonally inundated floodplain would increase the
35 overall Alternative 7 DOC loading to the Delta. In total, CM4–CM7 and CM10 could contribute
36 substantial amounts of DOC to raw drinking water supplies, largely depending on final design and
37 operational criteria for the related restoration activities. Substantially increased long-term average
38 DOC in raw water supplies could lead to a need for treatment plant upgrades in order to
39 appropriately manage DBP formation in treated drinking water. This potential for future DOC
40 increases would lead to substantially greater associated risk of long-term adverse effects on the
41 MUN beneficial use.

42 In summary, the habitat restoration elements of CM4–CM7 and CM10 under Alternative 7 would
43 present new localized sources of DOC to the study area, and in some circumstances would substitute

1 for existing sources related to replaced agriculture. Depending on localized hydrodynamics and
 2 proximity to municipal drinking water intakes, such restoration activities could contribute
 3 substantial amounts of DOC to municipal raw water. Substantial increases in municipal raw water
 4 DOC could necessitate changes in water treatment plant operations or require treatment plant
 5 upgrades in order to maintain DBP compliance, and thus would constitute an adverse effect on
 6 water quality. Mitigation Measure WQ-18 is available to reduce these effects.

7 **CEQA Conclusion:** Effects of CM4–CM7 and CM10 on DOC under Alternative 7 are similar to, and
 8 possibly greater than, those discussed for Alternative 1A. Similar to the discussion for Alternative
 9 1A, this impact is considered to be significant. It is uncertain whether implementation of Mitigation
 10 Measure WQ-18 would reduce identified impacts to a less-than-significant level. Hence, this impact
 11 remains significant and unavoidable.

12 In addition to and to supplement Mitigation Measure WQ-18, the BDCP proponents have
 13 incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*, a
 14 separate, non-environmental commitment to address the potential increased water treatment costs
 15 that could result from DOC concentration effects on municipal and industrial water purveyor
 16 operations. Potential options for making use of this financial commitment include funding or
 17 providing other assistance towards implementing treatment for DOC and/or DBPs or DOC source
 18 control strategies. Please refer to Appendix 3B, *Environmental Commitments*, for the full list of
 19 potential actions that could be taken pursuant to this commitment in order to reduce the water
 20 quality treatment costs associated with water quality effects relating to DOC.

21 **Mitigation Measure WQ-18: Design Wetland and Riparian Habitat Features to Minimize**
 22 **Effects on Municipal Intakes**

23 Please see Mitigation Measure WQ-18 under Impact WQ-18 in the discussion of Alternative 1A.

24 **Impact WQ-19: Effects on Pathogens Resulting from Facilities Operations and Maintenance**
 25 **(CM1)**

26 **NEPA Effects:** Effects of CM1 on pathogens under Alternative 7 are the same as those discussed for
 27 Alternative 1A and are considered to not be adverse.

28 **CEQA Conclusion:** Effects of CM1 on pathogens under Alternative 7 are the same as those discussed
 29 for Alternative 1A, and are summarized here, then compared to the CEQA thresholds of significance
 30 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this
 31 constituent. For additional details on the effects assessment findings that support this CEQA impact
 32 determination, see the effects assessment discussion under Alternative 1A.

33 River flow rate and reservoir storage reductions that would occur due to implementation of CM1
 34 (water facilities and operations) under Alternative 7, relative to Existing Conditions, would not be
 35 expected to result in a substantial adverse change in pathogen concentrations in the reservoirs and
 36 rivers upstream of the Delta, given the small magnitude of urban runoff contributions relative to the
 37 magnitude of river flows, that pathogen concentrations in the rivers have a minimal relationship to
 38 river flow rate, and the expected reduced pollutant loadings in response to NPDES stormwater-
 39 related regulations.

40 It is expected there would be no substantial change in Delta pathogen concentrations in response to
 41 a shift in the Delta source water percentages under this alternative or substantial degradation of
 42 these water bodies, with regard to pathogens. This conclusion is based on the Pathogens Conceptual

1 Model, which found that pathogen sources in close proximity to a Delta site appear to have the
 2 greatest influence on pathogen levels at the site, rather than the primary source(s) of water to the
 3 site. In-Delta potential pathogen sources, including water-based recreation, tidal habitat, wildlife,
 4 and livestock-related uses, would continue under this alternative.

5 In the SWP/CVP Export Service Areas waters, relative to Existing Conditions, an increased
 6 proportion of water coming from the Sacramento River would not adversely affect beneficial uses in
 7 the SWP/CVP Export Service Areas. The pathogen levels in the Sacramento River are similar to or
 8 lower than the water diverted at the Delta export pumps. Further, it is localized sources of
 9 pathogens that appear to have the greatest influence on concentrations. Thus, an increased
 10 proportion of Sacramento River water diverted to the SWP/CVP Export Service Areas would result
 11 in minimal changes in pathogen levels in the SWP/CVP Export Service Areas waters.

12 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
 13 objectives by frequency, magnitude, and geographic extent that would cause adverse effects on any
 14 beneficial uses of waters in the affected environment. Because pathogen concentrations are not
 15 expected to increase substantially, no long-term water quality degradation for pathogens is
 16 expected to occur and, thus, no adverse effects on beneficial uses would occur. The San Joaquin
 17 River in the Stockton Deep Water Ship Channel is Clean Water Act section 303(d) listed for
 18 pathogens. Because no measurable increase in Deep Water Ship Channel pathogen concentrations
 19 are expected to occur on a long-term basis, further degradation and impairment of this area is not
 20 expected to occur. Finally, pathogens are not bioaccumulative constituents. This impact is
 21 considered to be less than significant. No mitigation is required.

22 **Impact WQ-20: Effects on Pathogens Resulting from Implementation of CM2–CM22**

23 **NEPA Effects:** Effects of CM2–CM22 on pathogens under Alternative 7 are the same as those
 24 discussed for Alternative 1A and are considered to not be adverse.

25 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 7 would be similar to
 26 those proposed under Alternative 1A. As such, effects on pathogens resulting from the
 27 implementation of CM2–CM22 would be similar to that previously discussed for Alternative 1A. This
 28 impact is considered to be less than significant. No mitigation is required.

29 **Impact WQ-21: Effects on Pesticide Concentrations Resulting from Facilities Operations and** 30 **Maintenance (CM1)**

31 ***Upstream of the Delta***

32 For the same reasons stated for the No Action Alternative, under Alternative 7 no specific operations
 33 or maintenance activity of the SWP or CVP would substantially drive a change in pesticide use, and
 34 thus pesticide sources would remain unaffected upstream of the Delta. Nevertheless, changes in the
 35 timing and magnitude of reservoir releases could have an effect on available dilution capacity along
 36 river segments such as the Sacramento, Feather, American, and San Joaquin Rivers.

37 Under Alternative 7, winter (November–March) and summer (April–October) season average flow
 38 rates on the Sacramento River at Freeport, American River at Nimbus, Feather River at Thermalito
 39 and the San Joaquin River at Vernalis would change. Relative to existing condition and the No Action
 40 Alternative, seasonal average flow rates on the Sacramento would decrease no more than 3% during
 41 the summer and 4% during the winter (Appendix 8L, Seasonal average flows Tables 1-4). On the

1 Feather River, average flow rates would decrease no more than 5% during the summer, but would
2 increase as much as 7% in the winter. American River average flow rates would decrease by as
3 much as 15% in the summer but would increase by as much as 6% in the winter. Seasonal average
4 flow rates on the San Joaquin River would decrease by as much as 12% in the summer, but increase
5 by as much as 1% in the winter. For the same reasons stated for the No Action Alternative,
6 decreased seasonal average flow of $\leq 15\%$ is not considered to be of sufficient magnitude to
7 substantially increase pesticide concentrations or alter the long-term risk of pesticide-related
8 toxicity to aquatic life, nor adversely affect other beneficial uses of water bodies upstream of the
9 Delta.

10 **Delta**

11 Sources of diuron, OP and pyrethroid insecticides to the Plan Area include direct input of surface
12 runoff from in-Delta agriculture and Delta urbanized areas as well as inputs from rivers upstream of
13 the Delta. Similar to Upstream of the Delta, CVP/SWP operations would not affect these sources.

14 Under Alternative 7, the distribution and mixing of Delta source waters would change. Percent
15 change in monthly average source water fraction were evaluated for the modeled 16-year (1976–
16 1991) hydrologic period and a representative drought period (1987–1991), with special attention
17 given to changes in San Joaquin River, Sacramento River and Delta Agriculture sources water
18 fractions. Relative to Existing Conditions, under Alternative 7 modeled San Joaquin River fractions
19 would increase greater than 10% at Franks Tract, Rock Slough, Contra Costa PP No. 1, and the San
20 Joaquin River at Antioch (Appendix 8D, Source Water Fingerprinting). At Antioch, San Joaquin River
21 source water fractions when modeled for the 16-year hydrologic period would increase by 11–14%
22 from November through May (no increase $>10\%$ for the modeled drought period). While this change
23 at Antioch is not considered substantial, changes in San Joaquin River source water fraction in the
24 Delta interior would be considerable. At Franks Tract, San Joaquin River source water fractions
25 would increase between 18–28% for October through June (12–25% for November through June of
26 the modeled drought period). Changes at Rock Slough and Contra Costa PP No. 1 would be very
27 similar, where modeled San Joaquin River source water fractions would increase from 27–71% (11–
28 70% for the modeled drought period) for October through June. Relative to Existing Conditions,
29 there would be no modeled increases in Sacramento River fractions greater than 16% (with
30 exception to Banks and Jones which are discussed below) and Delta agricultural fractions greater
31 than 6%. Increases in San Joaquin River source water fraction at Franks Tract, Rock Slough, and
32 Contra Costa PP NO. 1 would primarily balance through decreases in Sacramento River water, and
33 as a result the San Joaquin River would account for greater than 50% of the total source water
34 volume at Franks Tract between March through May ($<50\%$ for all months during the modeled
35 drought period), and would be 50%, and as much as 81% during November through May at Rock
36 Slough and Contra Costa PP No. 1 for both the modeled drought and 16-year hydrologic periods.
37 While the source water and potential pesticide related toxicity co-occurrence predictions do not
38 mean adverse effects would occur, such considerable modeled increases in early summer source
39 water fraction at Franks Tract and winter and summer source water fractions at Rock Slough and
40 Contra Costa PP No. 1 could substantially alter the long-term risk of pesticide-related toxicity to
41 aquatic life, given the apparent greater incidence of pesticides in the San Joaquin River.

42 When compared to the No Action Alternative, changes in source water fractions would be similar in
43 season, geographic extent, and magnitude to those discussed for Existing Conditions with exception
44 to Buckley Cove during the modeled drought period. At Buckley Cove, modeled drought period San
45 Joaquin River fractions would increase 15% in July and 14% in August when compared to No Action

1 Alternative (Appendix 8D, Source Water Fingerprinting). These increases would primarily balance
2 through decreases in Sacramento River water and eastside tributary waters. Nevertheless, the San
3 Joaquin River at Buckley Cove during the modeled drought period would only account for 36% of
4 the total source water volume in July and 26% in August. These changes at Buckley Cove are not
5 considered substantial, however, as discussed for Existing Conditions, under the No Action
6 Alternative the similar magnitude change at Franks Tract, Rock Slough, and Contra Costa PP No. 1
7 would be considered substantial and could substantially alter the long-term risk of pesticide-related
8 toxicity to aquatic life.

9 These predicted adverse effects on pesticides relative to Existing Conditions and the No Action
10 Alternative fundamentally assume that the present pattern of pesticide incidence in surface water
11 will occur at similar levels into the future. In reality, however, the makeup and character of the
12 pesticide use market in the late long-term (i.e., the year 2060) will not be exactly as it is today.
13 Current use of chlorpyrifos and diazinon is on the decline with their replacement by pyrethroids on
14 the rise, yet in this assessment it is the apparent greater incidence of diazinon and chlorpyrifos on
15 the San Joaquin River that serves as the basis for concluding that substantially increased San Joaquin
16 River source water fraction would correspond to an increased risk of pesticide-related toxicity to
17 aquatic life. By 2060, however, alternative pesticides, such as neonicotinoids and biologicals, will
18 likely be a more substantial contributing part of the existing mix of pesticides, and perhaps more
19 prominent. The trend in the development of future-use pesticides is towards reduced risk pesticides,
20 including more biopesticides, with greater targeted specificity, fewer residues, and lower overall
21 non-target toxicity. By 2060 existing chlorpyrifos and diazinon TMDLs for the Sacramento and San
22 Joaquin Rivers will have been in effect for more than 50 years. Moreover, it is reasonable to expect
23 that CWA section 303(d) listings and future additional listings will have developed TMDLs by 2060.
24 To the extent these existing and future TMDL's address current and future-use pesticides, a greater
25 degree of pesticide related source control can be anticipated. Nevertheless, forecasting whether
26 these various efforts will ultimately be successful at resolving current pesticide related impairments
27 requires considerable speculation. While the fundamental assumptions that have guided this
28 assessment of pesticides may be somewhat altered by 2060, these assumptions are informed by
29 actual studies and monitoring data collected from the recent past and, therefore, judging project
30 alternative effects in the future remain most accurate through use of these informed assumptions
31 rather than based on assumptions founded upon future speculative conditions.

32 ***SWP/CVP Export Service Areas***

33 Assessment of effects in SWP/CVP Export Service Areas is based on effects seen in the Plan Area at
34 the Banks and Jones pumping plants. Under Alternative 7, Sacramento River source water fractions
35 would increase substantially at both Banks and Jones pumping plants relative to Existing Conditions
36 and the No Action Alternative (Appendix 8D, Source Water Fingerprinting). At Banks pumping plant,
37 Sacramento source water fractions would generally increase from 27–79% for October through June
38 (13–32% for December through March of the modeled drought period) and at Jones pumping plant
39 Sacramento source water fractions would generally increase from 43–96% for October through June
40 (37–89% for October through June of the modeled drought period). These increases in Sacramento
41 source water fraction would primarily balance through equivalent decreases in San Joaquin River
42 water. Based on the general observation that San Joaquin River, in comparison to the Sacramento
43 River, is a greater contributor of OP insecticides in terms of greater frequency of incidence and
44 presence at concentrations exceeding water quality benchmarks, modeled increases in Sacramento
45 River fraction at Banks and Jones would generally represent an improvement in export water
46 quality respective to pesticides.

1 **NEPA Effects:** In summary, the changes in long-term average flows on the Sacramento, Feather,
2 American, and San Joaquin Rivers, under Alternative 7 relative to the No Action Alternative, are of
3 insufficient magnitude to substantially increase the long-term risk of pesticide-related water quality
4 degradation and related toxicity to aquatic life in these water bodies upstream of the Delta.
5 However, modeled increases in San Joaquin River fraction at Franks Tract, Rock Slough, and Contra
6 Costa PP No. 1 are of sufficient magnitude to substantially alter the long-term risk of pesticide-
7 related water quality degradation and related toxicity to aquatic life in the Delta. The effects on
8 pesticides from operations and maintenance (CM1) are determined to be adverse and unavoidable.

9 **CEQA Conclusion:** Key findings discussed in the effects assessment relative to Existing Conditions is
10 provided above are summarized here, and are then compared to the CEQA thresholds of significance
11 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this
12 constituent. For additional details on the effects assessment findings that support this CEQA impact
13 determination, see the effects assessment discussion that immediately precedes this conclusion.

14 Sources of pesticides upstream of the Delta include direct input of pesticide containing surface
15 runoff from agriculture and urbanized areas. Flows in rivers receiving these discharges dilute these
16 pesticide inputs. Relative to Existing Conditions, however, modeled changes in long-term average
17 flows on the Sacramento, Feather, American, and San Joaquin Rivers are of insufficient magnitude to
18 substantially increase the long-term risk of pesticide-related water quality degradation and related
19 toxicity to aquatic life in these water bodies upstream of the Delta.

20 In the Delta, sources of pesticides include direct input of surface runoff from Delta agriculture and
21 Delta urbanized areas as well as inputs from rivers upstream of the Delta. While facilities operations
22 and maintenance activities would not affect these sources, changes in Delta source water fraction
23 could change the relative risk associated with pesticide related toxicity to aquatic life. Under
24 Alternative 7, modeled long-term average San Joaquin River source water fractions at Franks Tract,
25 Rock Slough and Contra Costa PP No. 1 locations would increase considerably for some months such
26 that the long-term risk of pesticide-related toxicity to aquatic life could substantially increase.

27 The assessment of Alternative 7 effects on pesticides in the SWP/CVP Export Service Areas is based
28 on assessment of changes predicted at Banks and Jones pumping plants. Sacramento River source
29 water fractions would increase substantially at both Banks and Jones pumping plants and would
30 generally represent an improvement in export water quality respective to pesticides.

31 Based on the above, Alternative 7 would not result in any substantial change in long-term average
32 pesticide concentration or result in substantial increase in the anticipated frequency with which
33 long-term average pesticide concentrations would exceed aquatic life toxicity thresholds or other
34 beneficial use effect thresholds upstream of the Delta or the SWP/CVP service area. Numerous
35 pesticides are currently used throughout the affected environment, and while some of these
36 pesticides may be bioaccumulative, those present-use pesticides for which there is sufficient
37 evidence for their presence in waters affected by SWP and CVP operations (i.e., diazinon,
38 chlorpyrifos, diuron, and pyrethroids) are not considered bioaccumulative, and thus changes in their
39 concentrations would not directly cause bioaccumulative problems in aquatic life or humans.
40 Furthermore, while there are numerous 303(d) listings throughout the affected environment that
41 name pesticides as the cause for beneficial use impairment, the modeled changes in upstream river
42 flows and Delta source water fractions would not be expected to make any of these beneficial use
43 impairments measurably worse, with principal exception to locations in the Delta that would receive
44 a substantially greater fraction San Joaquin River water under Alternative 7. Long-term average San

1 Joaquin River source water fractions at Franks Tract, Rock Slough and Contra Costa PP No. 1
 2 locations would change considerably for some months such that the long-term risk of pesticide-
 3 related toxicity to aquatic life could substantially increase. Additionally, the potential for increased
 4 incidence of pesticide related toxicity could include pesticides such as chlorpyrifos and diazinon for
 5 which existing 303(d) listings exist for the Delta, and thus existing beneficial use impairment could
 6 be made discernibly worse. The impact is considered to be significant and unavoidable. There is no
 7 feasible mitigation available to reduce the effect of this significant impact.

8 **Impact WQ-22: Effects on Pesticide Concentrations Resulting from Implementation of CM2-
 9 CM22**

10 **NEPA Effects:** Conservation Measures 2-22 under Alternative 7 would be similar to those under
 11 Alternative 1A, but 40 linear miles rather than 20 linear miles of channel margin habitat would be
 12 enhanced, and 20,000 acres rather than 10,000 acres of seasonally inundated floodplain would be
 13 restored. Effects on pesticides resulting from the implementation of CM2-CM22 would be similar to
 14 that previously discussed for Alternative 1A. In summary, CM13 proposes the use of herbicides to
 15 control invasive aquatic vegetation around habitat restoration sites. Herbicides directly applied to
 16 water could include adverse effects on non-target aquatic life, such as aquatic invertebrates and
 17 beneficial aquatic plants. As such, aquatic life toxicity objectives could be exceeded with sufficient
 18 frequency and magnitude such that beneficial uses would be impacted, thus constituting an adverse
 19 effect on water quality.

20 In summary, based on the discussion above, the effects on pesticides from implementing CM2-CM22
 21 are considered to be adverse. Mitigation Measure WQ-22 would be available to reduce this adverse
 22 effect.

23 **CEQA Conclusion:** Effects of CM2-CM22 on pesticides under Alternative 7 are similar to those
 24 discussed for Alternative 1A. Potential environmental effects related only to CM13 are considered to
 25 be significant. Mitigation is required. While Mitigation Measure WQ-22 is available to partially
 26 reduce this impact of pesticides, no feasible mitigation is available that would reduce it to a level
 27 that would be less than significant.

28 **Mitigation Measure WQ-22: Implement Least Toxic Integrated Pest Management
 29 Strategies**

30 Please see Mitigation Measure WQ-22 under Impact WQ-22 in the discussion of Alternative 1A.

31 **Impact WQ-23: Effects on Phosphorus Concentrations Resulting from Facilities Operations
 32 and Maintenance (CM1)**

33 **NEPA Effects:** Effects of water facilities and operations (CM1) on phosphorus levels in water bodies
 34 of the affected environment under Alternative 7 would be very similar (i.e., nearly the same) to
 35 those discussed for Alternative 1A. Consequently, the environmental consequences to phosphorus
 36 levels discussed in detail for Alternative 1A also adequately represent the effects under Alternative
 37 7, which are considered to be not adverse.

38 **CEQA Conclusion:** Key findings discussed in the effects assessment relative to Existing Conditions is
 39 provided above are summarized here, and are then compared to the CEQA thresholds of significance
 40 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this

1 constituent. For additional details on the effects assessment findings that support this CEQA impact
2 determination, see the effects assessment discussion that immediately precedes this conclusion.

3 Because phosphorus loading to waters upstream of the Delta is not anticipated to change, and
4 because changes in flows do not necessarily result in changes in concentrations or loading of
5 phosphorus to these water bodies, substantial changes in phosphorus concentration upstream of the
6 Delta are not anticipated for Alternative 7, relative to Existing Conditions.

7 Because phosphorus concentrations in the major source waters to the Delta are similar for much of
8 the year, phosphorus concentrations in the Delta are not anticipated to change substantially on a
9 long term-average basis under Alternative 7, relative to Existing Conditions. Algal growth rates are
10 limited by availability of light in the Delta, and therefore any minor increases in phosphorus levels
11 that may occur at some locations and times within the Delta would be expected to have little effect
12 on primary productivity in the Delta.

13 The assessment of effects of phosphorus under Alternative 7 in the SWP and CVP Export Service
14 Areas is based on effects on phosphorus at the Banks and Jones pumping plants. As noted above,
15 phosphorus concentrations in the Delta (including Banks and Jones pumping plants) are not
16 anticipated to change substantially on a long term-average basis.

17 Based on the above, there would be no substantial, long-term increase in phosphorus concentrations
18 in the rivers and reservoirs upstream of the Delta, in the Delta Region, or the waters exported to the
19 CVP and SWP service areas under Alternative 7 relative to Existing Conditions. As such, this
20 alternative is not expected to cause additional exceedance of applicable water quality objectives/
21 criteria by frequency, magnitude, and geographic extent that would cause adverse effects on any
22 beneficial uses of waters in the affected environment. Because phosphorus concentrations are not
23 expected to increase substantially, no long-term water quality degradation is expected to occur and,
24 thus, no adverse effects to beneficial uses would occur. Phosphorus is not 303(d) listed within the
25 affected environment and thus any minor increases that may occur in some areas would not make
26 any existing phosphorus-related impairment measurably worse because no such impairments
27 currently exist. Because phosphorus is not bioaccumulative, minor increases that may occur in some
28 areas would not bioaccumulate to greater levels in aquatic organisms that would, in turn, pose
29 substantial health risks to fish, wildlife, or humans. This impact is considered to be less than
30 significant. No mitigation is required.

31 **Impact WQ-24: Effects on Phosphorus Concentrations Resulting from Implementation of** 32 **CM2–CM22**

33 **NEPA Effects:** Effects of CM2–CM22 on phosphorus levels in water bodies of the affected
34 environment under Alternative 7 would be very similar (i.e., nearly the same) to those discussed for
35 Alternative 1A. Consequently, the environmental consequences to phosphorus levels from
36 implementing CM2–CM22 discussed in detail for Alternative 1A also adequately represent the
37 effects of these same actions under Alternative 7, which are considered to be not adverse.

38 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 7 would be similar to
39 those proposed under Alternative 1A. As such, effects on phosphorus resulting from the
40 implementation of CM2–CM22 would be similar to that previously discussed for Alternative 1A. This
41 impact is considered to be less than significant. No mitigation is required.

1 **Impact WQ-25: Effects on Selenium Concentrations Resulting from Facilities Operations and** 2 **Maintenance (CM1)**

3 ***Upstream of the Delta***

4 For the same reasons stated for the No Action Alternative, Alternative 7 would have negligible, if
5 any, effect on selenium concentrations in the rivers and reservoirs upstream of the Delta relative to
6 Existing Conditions and the No Action Alternative. Any negligible increases in selenium
7 concentrations that could occur in the water bodies of the affected environment located upstream of
8 the Delta would not be of frequency, magnitude and geographic extent that would adversely affect
9 any beneficial uses or substantially degrade the quality of these water bodies, with regard to
10 selenium.

11 ***Delta***

12 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
13 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
14 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
15 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
16 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
17 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

18 Alternative 7 would result in small to moderate changes in average selenium concentrations in
19 water at all modeled Delta assessment locations relative to Existing Conditions and the No Action
20 Alternative (Appendix 8M, Table M-10A). Changes in selenium concentrations in water are reflected
21 in small (10% or less) to moderate (between 11% and 50%) percent changes in available
22 assimilative capacity for selenium (based on 2 µg/L ecological risk benchmark) for all years. Relative
23 to Existing Conditions, Alternative 7 would result in the largest modeled increases in available
24 assimilative capacity at Buckley Cove (4%); relative to the No Action Alternative, the largest
25 increase would be at Staten Island (1%), and the largest decreases for Existing Conditions and the
26 No Action Alternative would be at Rock Slough and Contra Costa PP (12%) (Figures 8-59 and 8-60).
27 Although moderate negative changes in assimilative capacity would occur at two locations (Rock
28 Slough and Contra Costa PP), the changes are minimal at the other locations and the available
29 assimilative capacity at all locations would remain substantial; therefore, the effect of Alternative 7
30 is generally minimal for the Delta. Furthermore, the ranges of modeled selenium concentrations in
31 water (Appendix 8M, Table M-10A) for Alternative 7 (range 0.24–0.71 µg/L), Existing Conditions
32 (range 0.21–0.76 µg/L), and the No Action Alternative (range 0.21–0.69 µg/L) are similar, and
33 would be well below the ecological risk benchmark (2 µg/L).

34 Relative to Existing Conditions and the No Action Alternative, Alternative 7 would generally result in
35 small changes in estimated selenium concentrations in biota (whole-body fish, bird eggs
36 [invertebrate diet], bird eggs [fish diet], and fish fillets) (Appendix 8M, Table M-18 and Addendum
37 M.A to Appendix 8M, Table M.A-2). Relative to Existing Conditions and the No Action Alternative, the
38 largest increase of selenium concentrations in biota would be at Contra Costa PP for drought years
39 and in sturgeon at the two western Delta locations in all as well as drought years. Relative to
40 Existing Conditions, the largest decrease would be at Buckley Cove for drought years. Relative to the
41 No Action Alternative, the largest decrease would be at Staten Island for drought years (except for
42 bird eggs [assuming a fish diet] at Buckley Cove for drought years). Except for sturgeon in the
43 western Delta, concentrations of selenium in whole-body fish and bird eggs (invertebrate and fish
44 diets) would exceed only the lower benchmarks (4 and 6 mg/kg dry weight, respectively, indicating

1 a low potential for effects), under drought conditions, at Buckley Cove for Alternative 7 and Existing
2 Conditions and the No Action Alternative (Figures 8-61 through 8-63). Exceedance Quotients for
3 these exceedances of the lower benchmarks are between 1.0 and 1.5, indicating a low risk to biota in
4 the Delta and no substantial difference for Alternative 7 from Existing Conditions and the No Action
5 Alternative. Selenium concentrations in fish fillets would not exceed the screening value for
6 protection of human health (Figure 8-64). For sturgeon in the western Delta, whole-body selenium
7 concentrations would increase from 12.3 mg/kg under Existing Conditions and the No Action
8 Alternative to 14.7 mg/kg under Alternative 7, a 20% increase (Table M.A-2). All of these values
9 exceed both the low and high toxicity benchmarks. These increases are high enough that they may
10 represent a measurable increase in body burdens of sturgeon, which would constitute an adverse
11 impact (see also the discussion of results provided in Addendum M.A to Appendix 8M).

12 ***SWP/CVP Export Service Areas***

13 Alternative 7 would result in small to moderate changes in average selenium concentrations relative
14 to the Existing Conditions and the No Action Alternative (Appendix 8M, Table M-10A). These
15 changes in selenium concentrations in water are reflected in small (10% or less) to moderate
16 (between 11% and 50%) percent changes in available assimilative capacity for selenium for all
17 years. Relative to Existing Conditions and the No Action Alternative, Alternative 7 would result in
18 modeled increases in available assimilative capacity at Jones PP (14% and 15%, respectively) and at
19 Banks PP (8%) (Figures 8-59 and 8-60) and would have a positive effect at the Export Service Area
20 locations. The ranges of modeled selenium concentrations in water (Appendix 8M, Table M-10A) for
21 Alternative 7 (range 0.32–0.37 µg/L), Existing Conditions (range 0.37–0.58 µg/L), and the No Action
22 Alternative (range 0.37–0.59 µg/L) are similar, and all would be well below the ecological risk
23 benchmark (2 µg/L).

24 Relative to Existing Conditions and the No Action Alternative, Alternative 7 would result in small
25 changes in estimated selenium concentrations in biota (Appendix 8M, Table M-18). Relative to
26 Existing Conditions and the No Action Alternative, the largest increase of selenium concentrations in
27 biota would be at Banks PP for drought years (except for bird eggs [assuming a fish diet] at Banks PP
28 for all years), and the largest decrease would be at Jones PP for drought years. However,
29 concentrations in biota would not exceed any benchmarks for Alternative 7 (Figures 8-61 through 8-
30 64).

31 Thus, relative to Existing Conditions and the No Action Alternative, Alternative 7 would result in
32 small to moderate changes in selenium concentrations in water and minimal changes in selenium
33 concentrations in biota at the Export Service Area locations. Selenium concentrations in water and
34 biota generally would decrease under Alternative 7 and would not exceed ecological benchmarks at
35 either location, whereas the lower benchmark for bird eggs (fish diet) would be exceeded under
36 Existing Conditions and the No Action Alternative at Jones PP for drought years. This small positive
37 change in selenium concentrations under Alternative 7 would be expected to slightly decrease the
38 frequency with which applicable benchmarks would be exceeded or slightly improve the quality of
39 water in the Export Services Areas, with regard to selenium.

40 ***NEPA Effects:*** Based on the discussion above, the effects on selenium from Alternative 7 are
41 considered to be adverse. This determination is reached because selenium concentrations in whole-
42 body sturgeon modeled at two western Delta locations would increase by an estimated 20%, which
43 may represent a measurable increase in the environment. Because both low and high toxicity

1 benchmarks are already exceeded under the No Action Alternative, these potentially measurable
2 increases represent an adverse impact.

3 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
4 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
5 purpose of making the CEQA impact determination for selenium. For additional details on the effects
6 assessment findings that support this CEQA impact determination, see the effects assessment
7 discussion that immediately precedes this conclusion.

8 There are no substantial point sources of selenium in watersheds upstream of the Delta, and no
9 substantial nonpoint sources of selenium in the watersheds of the Sacramento River and the eastern
10 tributaries. Nonpoint sources in the San Joaquin Valley that contribute selenium to the Delta will be
11 controlled through a TMDL developed by the Central Valley Water Board (2001) for the lower San
12 Joaquin River, established limits for the Grassland Bypass Project, and Basin Plan objectives (Central
13 Valley Water Board 2010c) and State Water Board (2010d, 2010e) that are expected to result in
14 decreasing discharges of selenium from the San Joaquin River to the Delta. Consequently, any
15 modified reservoir operations and subsequent changes in river flows under Alternative 7, relative to
16 Existing Conditions, are expected to cause negligible changes in selenium concentrations in water.
17 Any negligible changes in selenium concentrations that may occur in the water bodies of the affected
18 environment located upstream of the Delta would not be of frequency, magnitude, and geographic
19 extent that would adversely affect any beneficial uses or substantially degrade the quality of these
20 water bodies as related to selenium.

21 Relative to Existing Conditions, modeling estimates indicate that Alternative 7 would increase
22 selenium concentrations in whole-body sturgeon modeled at two western Delta locations by an
23 estimated 20%, which may represent a measurable increase in the environment. Because both low
24 and high toxicity benchmarks are already exceeded under Existing Conditions, these potentially
25 measurable increases represent a potential impact to aquatic life beneficial uses.

26 Assessment of effects of selenium in the SWP and CVP Export Service Areas is based on effects on
27 selenium concentrations at the Banks and Jones pumping plants. Relative to Existing Conditions,
28 Alternative 7 would slightly decrease the frequency with which applicable benchmarks would be
29 exceeded or slightly improve the quality of water in selenium concentrations at the Banks and Jones
30 pumping plants locations.

31 Based on the above, although waterborne selenium concentrations would not exceed applicable
32 water quality objectives/criteria, significant impacts on some beneficial uses of waters in the Delta
33 could occur because both low and high toxicity benchmarks are already exceeded under Existing
34 Conditions, and uptake of selenium from water to biota may measurably increase. In comparison to
35 Existing Conditions, water quality conditions under this alternative would increase levels of
36 selenium (a bioaccumulative pollutant) by frequency, magnitude, and geographic extent such that
37 the affected environment may have measurably higher body burdens of selenium in aquatic
38 organisms, thereby substantially increasing the health risks to wildlife (including fish); however,
39 impacts to humans consuming those organisms are not expected to occur. Water quality conditions
40 under this alternative with respect to selenium would cause long-term degradation of water quality
41 in the western Delta. Except in the vicinity of the western Delta for sturgeon, water quality
42 conditions under this alternative would not increase levels of selenium by frequency, magnitude,
43 and geographic extent such that the affected environment would be expected to have measurably
44 higher body burdens of selenium in aquatic organisms. The greater level of selenium

1 bioaccumulation in the western Delta would further degrade water quality by measurable levels, on
2 a long-term basis, for selenium and, thus, cause the 303(d)-listed impairment of beneficial use to be
3 made discernibly worse. This impact is considered significant.

4 The need for, and the feasibility and effectiveness of, post-operation mitigation for the predicted
5 level of selenium bioaccumulation is uncertain. The first step shall be to determine the reliability of
6 the model in predicting biota selenium concentrations in the affected environment where effects are
7 predicted but selenium data are lacking. For that reason, the model shall be validated with site-
8 specific sampling before extensive mitigation measures relative to CM1 operations are developed
9 and evaluated for feasibility, as the measures and their evaluation for feasibility are likely to be
10 complex. Specifically, it remains to be determined whether the available existing data for transfer of
11 selenium from water to particulates and through different trophic levels of the food chain are
12 representative of conditions that may occur from implementation of Alternative 7. Therefore, the
13 proposed mitigation measure requires that sampling be conducted to characterize each step of data
14 inputs needed for the model, and then the refined model be validated for local conditions. This
15 impact is considered significant and unavoidable.

16 **Impact WQ-26: Effects on Selenium Concentrations Resulting from Implementation of CM2-** 17 **CM22**

18 *NEPA Effects:* In general, with the possible exception of changes in Delta hydrodynamics resulting
19 from habitat restoration, CM2–CM11 would not substantially increase selenium concentrations in
20 the water bodies of the affected environment. Modeling scenarios included assumptions regarding
21 how certain habitat restoration activities (CM2 and CM4) would affect Delta hydrodynamics, and
22 thus such effects of these restoration measures were included in the assessment of CM1 facilities
23 operations and maintenance (see Impact WQ-25).

24 However, implementation of these conservation measures may increase water residence time
25 within the restoration areas. Increased restoration area water residence times could potentially
26 increase the bioaccumulation of selenium in biota, thereby potentially increasing fish tissue and bird
27 egg concentrations of selenium, but models are not available to quantitatively estimate the level of
28 changes in residence time and the associated selenium bioavailability. If increases in fish tissue or
29 bird egg selenium were to occur, the increases would likely be of concern only where fish tissues or
30 bird eggs are already elevated in selenium to near or above thresholds of concern. That is, where
31 biota concentrations are currently low and not approaching thresholds of concern, changes in
32 residence time alone would not be expected to cause them to then approach or exceed thresholds of
33 concern. In consideration of this factor, although the Delta as a whole is a 303(d)-listed water body
34 for selenium, and although monitoring data of fish tissue or bird eggs in the Delta are sparse, the
35 most likely areas in which biota tissues would be at levels high enough that additional
36 bioaccumulation due to increased residence time from restoration areas would be a concern are the
37 western Delta and Suisun Bay, and the South Delta in areas that receive San Joaquin River water.

38 The western Delta and Suisun Bay receive elevated selenium loads from North San Francisco Bay
39 (including San Pablo Bay, Carquinez Strait, and Suisun Bay) and from the San Joaquin River. Point
40 sources of selenium in North San Francisco Bay (i.e., refineries) that contribute selenium to Suisun
41 Bay are expected to be reduced through a TMDL under development by the San Francisco Bay Water
42 Board (San Francisco Bay Water Board 2012) that is expected to result in decreasing discharges of
43 selenium. Nonpoint sources of selenium in the San Joaquin Valley that contribute selenium to the
44 San Joaquin River, and thus the Delta and Suisun Bay, will be controlled through a TMDL developed

1 by the Central Valley Water Board (2001) for the lower San Joaquin River, established limits for the
2 Grassland Bypass Project, and Basin Plan objectives (Central Valley Water Board 2010c, d) that are
3 expected to result in decreasing discharges of selenium from the San Joaquin River to the Delta. If
4 selenium levels are not sufficiently reduced via these efforts, it is expected that the State Water
5 Board and the San Francisco Bay and Central Valley Water Boards would initiate additional actions
6 to further control sources of selenium.

7 The South Delta receives elevated selenium loads from the San Joaquin River. In contrast to Suisun
8 Bay and possibly the western Delta in the future, the South Delta lacks the overbite clam (*Corbula*
9 [*Potamocorbula*] *amurensis*), which is considered a key driver of selenium bioaccumulation in
10 Suisun Bay, due to its high bioaccumulation of selenium and its role in the benthic food web that
11 includes long-lived sturgeon. The South Delta does have *Corbicula fluminea*, another bivalve that
12 bioaccumulates selenium, but it is not as invasive as the overbite clam and thus likely makes up a
13 smaller fraction of sturgeon diet. Also, as mentioned above, nonpoint sources of selenium in the San
14 Joaquin Valley that contribute selenium to the Delta will be controlled through a TMDL developed by
15 the Central Valley Water Board (2001) for the lower San Joaquin River, established limits for the
16 Grassland Bypass Project, and Basin Plan objectives (Central Valley Water Board 2010c, d) that are
17 expected to result in decreasing discharges of selenium from the San Joaquin River to the Delta.
18 Further, if selenium levels in the San Joaquin River are not sufficiently reduced via these efforts, it is
19 expected that the State Water Board and Central Valley Water Board would initiate additional
20 TMDLs to further control nonpoint sources of selenium.

21 Wetland restoration areas will not be designed such that water flows in and does not flow out.
22 Exchange of water between the restoration areas and existing Delta channels is an important design
23 factor, since one goal of the restoration areas is to export food produced in these areas to the rest of
24 the Delta (see BDCP Chapter 3, *Conservation Strategy*, Section 3.3, Biological Goals and Objectives).
25 Thus, these areas can be thought of as “flow-through” systems. Consequently, although water
26 residence times associated with BDCP restoration could increase, they are not expected to increase
27 without bound. and selenium concentrations in the water column would not continue to build up
28 and be recycled in sediments and organisms as may be the case within a closed system.

29 However, because increases in bioavailable selenium in the habitat restoration areas are uncertain,
30 proposed avoidance and minimization measures would require evaluating risks of selenium
31 exposure at a project level for each restoration area, minimizing to the extent practicable potential
32 risk of additional bioaccumulation, and monitoring selenium levels in fish and/or wildlife to
33 establish whether, or to what extent, additional bioaccumulation is occurring. See Appendix 3B,
34 *Environmental Commitments* for a description of the environmental commitment BDCP proponents
35 are making with respect to Selenium Management; and Appendix 3.C. of the BDCP for additional
36 detail on this avoidance and minimization measure (AMM27). Data generated as part of the
37 avoidance and minimization measures will assist the State and Regional Water Boards in
38 determining whether beneficial uses are being impacted by selenium, and thus will provide the data
39 necessary to support regulatory actions (including additional TMDL development), should such
40 actions be warranted.

41 Given the factors discussed in the assessment above, any increases in bioaccumulation rates from
42 water-borne selenium that could occur in some areas as a result of increased water residence time
43 would not be of sufficient magnitude and geographic extent that any portion of the Delta would be
44 expected to have measurably higher body burdens of selenium in aquatic organisms and, therefore,
45 would not substantially increase risk for adverse effects to beneficial uses. Furthermore, although

1 the Delta is a 303(d)-listed water body for selenium, given the discussion in the assessment above, it
2 is unlikely that restoration areas would result in measurable increases in selenium in fish tissues or
3 bird eggs such that the beneficial use impairment would be made discernibly worse.

4 Because it is unlikely that substantial increases in selenium in fish tissues or bird eggs would occur
5 such that effects on aquatic life beneficial uses would be anticipated, and because of the avoidance
6 and minimization measures that are designed to further minimize and evaluate the risk of such
7 increases, the effects of WQ-26 are considered not adverse.

8 **CEQA Conclusion:** There would be no substantial, long-term increase in selenium concentrations in
9 water in the rivers and reservoirs upstream of the Delta, water in the Delta, or the waters exported
10 to the CVP and SWP service areas due to implementation of CM2–CM22 relative to Existing
11 Conditions. Waterborne selenium concentrations under this alternative would not exceed applicable
12 water quality objectives/criteria.

13 Given the factors discussed in the assessment above, any increases in bioaccumulation rates from
14 water-borne selenium that could occur in some areas as a result of increased water residence times
15 would not be of sufficient magnitude and geographic extent that any portion of the Delta would be
16 expected to have measurably higher body burdens of selenium in aquatic organisms, and therefore
17 would not substantially increase risk for adverse effects to beneficial uses. CM2-22 would not cause
18 long-term degradation of water quality resulting in sufficient use of available assimilative capacity
19 such that occasionally exceeding water quality objectives/criteria would be likely. Also, CM2-22
20 would not result in substantially increased risk for adverse effects to any beneficial uses.
21 Furthermore, although the Delta is a 303(d)-listed water body for selenium, given the discussion in
22 the assessment above, it is unlikely that restoration areas would result in measurable increases in
23 selenium in fish tissues or bird eggs such that the beneficial use impairment would be made
24 discernibly worse.

25 Since it is unlikely that substantial increases in selenium in fish tissues or bird eggs would occur
26 such that effects on aquatic life beneficial uses would be anticipated, and because of the avoidance
27 and minimization measures that are designed to further minimize and evaluate the risk of such
28 increases (see Appendix 3.C. of the BDCP for more detail on AMM27) as well as the Selenium
29 Management environmental commitment (see Appendix 3B, *Environmental Commitments*), this
30 impact is considered less than significant. No mitigation is required.

31 **Impact WQ-27: Effects on Trace Metal Concentrations Resulting from Facilities Operations** 32 **and Maintenance (CM1)**

33 ***Upstream of the Delta***

34 For the same reasons stated for the No Action Alternative, Alternative 7 would result in negligible,
35 and likely immeasurable, increases in trace metal concentrations in the rivers and reservoirs
36 upstream of the Delta, relative to Existing Conditions and the No Action Alternative. Effects due to
37 the operation and maintenance of the conveyance facilities are expected to be immeasurable, on an
38 annual and long-term average basis. As such, Alternative 7 would not be expected to substantially
39 increase the frequency with which applicable Basin Plan objectives or CTR criteria would be
40 exceeded in water bodies of the affected environment located upstream of the Delta or substantially
41 degrade the quality of these water bodies, with regard to trace metals.

1 **Delta**

2 For the same reasons stated for the No Action Alternative, Alternative 7 would not result in
3 substantial increases in trace metal concentrations in the Delta relative to Existing Conditions and
4 the No Action Alternative. However, substantial changes in source water fraction would occur in the
5 south Delta (Appendix 8D, Source Water Fingerprinting). Throughout much of the south Delta, San
6 Joaquin River water would replace Sacramento River water, with the future trace metals profile
7 largely reflecting that of the San Joaquin River. As discussed for the No Action Alternative, trace
8 metal concentration profiles between the San Joaquin and Sacramento Rivers are very similar and
9 currently meet Basin Plan objectives and CTR criteria. While the change in trace metal
10 concentrations in the south Delta would likely be measurable, Alternative 7 would not be expected
11 to substantially increase the frequency with which applicable Basin Plan objectives or CTR criteria
12 would be exceeded in the Delta or substantially degrade the quality of Delta waters with regard to
13 trace metals.

14 **SWP/CVP Export Service Areas**

15 For the same reasons stated for the No Action Alternative, Alternative 7 would not result in
16 substantial increases in trace metal concentrations in the water exported from the Delta or diverted
17 from the Sacramento River through the proposed conveyance facilities. As such, there is not
18 expected to be substantial changes in trace metal concentrations in the SWP/CVP export service
19 area waters under Alternative 7, relative to Existing Conditions and the No Action Alternative. As
20 such, Alternative 7 would not be expected to substantially increase the frequency with which
21 applicable Basin Plan objectives or CTR criteria would be exceeded in the water bodies of the
22 affected environment in the SWP and CVP Service Area or substantially degrade the quality of these
23 water bodies, with regard to trace metals.

24 **NEPA Effects:** In summary, Alternative 7, relative to the No Action Alternative, would not cause a
25 substantial increase in long-term average trace metals concentrations within the affected
26 environment, nor would it cause an increased frequency of water quality objective/criteria
27 exceedances within the affected environment. The effect on trace metals is determined not to be
28 adverse.

29 **CEQA Conclusion:** Effects of CM1 on trace metals under Alternative 7 would be similar to those
30 discussed for Alternative 1A, and are summarized here, then compared to the CEQA thresholds of
31 significance (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for
32 this constituent. For additional details on the effects assessment findings that support this CEQA
33 impact determination, see the effects assessment discussion under Alternative 1A.

34 While greater water demands under the Alternative 7 would alter the magnitude and timing of
35 reservoir releases north, south and east of the Delta, these activities would have no substantial effect
36 on the various watershed sources of trace metals. Moreover, long-term average flow and trace
37 metals at Sacramento River at Hood and San Joaquin River at Vernalis are poorly correlated;
38 therefore, changes in river flows would not be expected to cause a substantial long-term change in
39 trace metal concentrations upstream of the Delta.

40 Average and 95th percentile trace metal concentrations are very similar across the primary source
41 waters to the Delta. Given this similarity, very large changes in source water fraction would be
42 necessary to effect a relatively small change in trace metal concentration at a particular Delta
43 location. Moreover, average and 95th percentile trace metal concentrations for these primary source

1 waters are all below their respective water quality criteria, including those that are hardness-based
2 without a WER adjustment. No mixing of these three source waters could result in a metal
3 concentration greater than the highest source water concentration, and given that trace metals do
4 not already exceed water quality criteria, more frequent exceedances of criteria in the Delta would
5 not be expected to occur under the Alternative 7.

6 The assessment of the Alternative 7 effects on trace metals in the SWP/CVP Export Service Areas is
7 based on assessment of changes in trace metal concentrations at Banks and Jones pumping plants.
8 As just discussed regarding similarities in Delta source water trace metal concentrations, the
9 Alternative 7 is not expected to result in substantial changes in trace metal concentrations in Delta
10 waters, including Banks and Jones pumping plants, therefore effects on trace metal concentrations
11 in the SWP/CVP Export Service Area are expected to be negligible.

12 Based on the above, there would be no substantial long-term increase in trace metal concentrations
13 in the rivers and reservoirs upstream of the Delta, in the Delta Region, or the SWP/CVP export
14 service area waters under Alternative 7 relative to Existing Conditions. As such, this alternative is
15 not expected to cause additional exceedance of applicable water quality objectives by frequency,
16 magnitude, and geographic extent that would cause adverse effects on any beneficial uses of waters
17 in the affected environment. Because trace metal concentrations are not expected to increase
18 substantially, no long-term water quality degradation for trace metals is expected to occur and, thus,
19 no adverse effects to beneficial uses would occur. Furthermore, any negligible changes in long-term
20 trace metal concentrations that may occur in water bodies of the affected environment would not be
21 expected to make any existing beneficial use impairments measurably worse. The trace metals
22 discussed in this assessment are not considered bioaccumulative, and thus would not directly cause
23 bioaccumulative problems in aquatic life or humans. This impact is considered to be less than
24 significant. No mitigation is required.

25 **Impact WQ-28: Effects on Trace Metal Concentrations Resulting from Implementation of** 26 **CM2–CM22**

27 **NEPA Effects:** Conservation Measures 2–22 under Alternative 7 would be similar to those under
28 Alternative 1A, but 40 linear miles rather than 20 linear miles of channel margin habitat would be
29 enhanced, and 20,000 acres rather than 10,000 acres of seasonally inundated floodplain would be
30 restored. Effects on trace metals resulting from the implementation of CM2–CM22 would be similar
31 to that previously discussed for Alternative 1A. As they pertain to trace metals, implementation of
32 CM2–CM22 would not be expected to adversely affect beneficial uses of the affected environment or
33 substantially degrade water quality with respect to trace metals.

34 In summary, implementation of CM2–CM22 under Alternative 7, relative to the No Action
35 Alternative, would have negligible, if any, effect on trace metals concentrations. The effect on trace
36 metals from implementing CM2–CM22 is determined not to be adverse.

37 **CEQA Conclusion:** Implementation of CM2–CM22 under Alternative 7 would not cause substantial
38 long-term increase in trace metal concentrations in the rivers and reservoirs upstream of the Delta,
39 in the Delta Region, or the SWP/CVP export service area. As such, this alternative is not expected to
40 cause additional exceedance of applicable water quality objectives by frequency, magnitude, and
41 geographic extent that would cause adverse effects on any beneficial uses of waters in the affected
42 environment. Because trace metal concentrations are not expected to increase substantially, no
43 long-term water quality degradation for trace metals is expected to occur and, thus, no adverse
44 effects to beneficial uses would occur. Furthermore, any negligible changes in long-term trace metal

1 concentrations that may occur throughout the affected environment would not be expected to make
2 any existing beneficial use impairments measurably worse. The trace metals discussed in this
3 assessment are not considered bioaccumulative, and thus would not directly cause bioaccumulative
4 problems in aquatic life or humans. This impact is considered to be less than significant. No
5 mitigation is required.

6 **Impact WQ-29: Effects on TSS and Turbidity Resulting from Facilities Operations and**
7 **Maintenance (CM1)**

8 **NEPA Effects:** Effects of CM1 on TSS and turbidity under Alternative 7 are the same as those
9 discussed for Alternative 1A. The effects on TSS and turbidity from implementing CM1 is determined
10 to not be adverse.

11 **CEQA Conclusion:** Effects of CM1 on TSS and turbidity under Alternative 7 would be similar to those
12 discussed for Alternative 1A, and are summarized here, then compared to the CEQA thresholds of
13 significance (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for
14 this constituent. For additional details on the effects assessment findings that support this CEQA
15 impact determination, see the effects assessment discussion under Alternative 1A.

16 Changes river flow rate and reservoir storage that would occur under Alternative 7, relative to
17 Existing Conditions, would not be expected to result in a substantial adverse change in TSS
18 concentrations and turbidity levels in the reservoirs and rivers upstream of the Delta, given that
19 suspended sediment concentrations are more affected by season than flow. Site-specific and
20 temporal exceptions may occur due to localized temporary construction activities, dredging
21 activities, development, or other land use changes would be site-specific and temporal, which would
22 be regulated to limit both their short-term and long-term effects on TSS and turbidity levels to less
23 than substantial levels.

24 Within the Delta, geomorphic changes associated with sediment transport and deposition are
25 usually gradual, occurring over years, and high storm event inflows would not be substantially
26 affected. Thus, it is expected that the TSS concentrations and turbidity levels in the affected channels
27 would not be substantially different from the levels under Existing Conditions. Consequently, this
28 alternative is expected to have minimal effect on TSS concentrations and turbidity levels in the Delta
29 region, relative to Existing Conditions.

30 There is not expected to be substantial, if even measurable, changes in TSS concentrations and
31 turbidity levels in the SWP/CVP Export Service Areas waters under Alternative 7, relative to Existing
32 Conditions, because as stated above, this alternative is not expected to result in substantial changes
33 in TSS concentrations and turbidity levels at the south Delta export pumps, relative to Existing
34 Conditions.

35 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
36 objectives where such objectives are not exceeded under Existing Conditions. Because TSS
37 concentrations and turbidity levels are not expected to be substantially different, long-term water
38 quality degradation is not expected, and, thus, beneficial uses are not expected to be adversely
39 affected. Finally, TSS and turbidity are neither bioaccumulative nor Clean Water Act section 303(d)
40 listed constituents. This impact is considered to be less than significant. No mitigation is required.

1 **Impact WQ-30: Effects on TSS and Turbidity Resulting from Implementation of CM2–CM22**

2 **NEPA Effects:** Effects of CM2–CM22 on TSS and turbidity under Alternative 7 are the same as those
3 discussed for Alternative 1A. The effects on TSS and turbidity from implementing CM2–CM22 is
4 determined to not be adverse.

5 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 7 would be similar to
6 those proposed under Alternative 1A. As such, effects on TSS and turbidity resulting from the
7 implementation of CM2–CM22 would be similar to that previously discussed for Alternative 1A. This
8 impact is considered to be less than significant. No mitigation is required.

9 **Impact WQ-31: Water Quality Effects Resulting from Construction-Related Activities (CM1–** 10 **CM22)**

11 The conveyance features for CM1 under Alternative 7 would be very similar to those discussed for
12 Alternative 1A. The primary difference between Alternative 7 and Alternative 1A is that under
13 Alternative 7, there would be two fewer intakes and two fewer pumping plant locations, which
14 would result in a reduced level of construction activity. Additional construction activity also would
15 occur to restore channel margin and seasonally inundated floodplain habitats. However,
16 construction techniques and locations of major features of the conveyance system within the Delta
17 would be similar. The remainder of the facilities constructed under Alternative 7, including CM2–
18 CM22, would be very similar to, or the same as, those to be constructed for Alternative 1A. However,
19 under Alternative 7, there would be up to 20,000 acres of inundated floodplain habitat restored (as
20 opposed to 10,000 acres under the majority of the other alternatives), thus resulting in increased
21 construction-related disturbances.

22 **NEPA Effects:** The types and magnitude of potential construction-related water quality effects
23 associated with implementation of CM1–CM22 under Alternative 7 would be very similar to the
24 effects discussed for Alternative 1A, and the effects anticipated with implementation of CM2–CM22
25 would be essentially identical. Nevertheless, the construction of CM1, and any individual
26 components necessitated by CM2, and CM4–CM10, with the implementation of the BMPs specified in
27 Appendix 3B, *Environmental Commitments*, and other agency permitted construction requirements
28 would result in the potential water quality effects being largely avoided and minimized. The specific
29 environmental commitments that would be implemented under Alternative 7 would be similar to
30 those described for Alternative 1A. Consequently, relative to Existing Conditions, Alternative 7
31 would not be expected to cause exceedance of applicable water quality objectives/criteria or
32 substantial water quality degradation with respect to constituents of concern, and thus would not
33 adversely affect any beneficial uses upstream of the Delta, in the Delta, or in the SWP and CVP
34 service area.

35 In summary, with implementation of environmental commitments in Appendix 3B, the potential
36 construction-related water quality effects are considered to be not adverse.

37 **CEQA Conclusion:** Because environmental commitments would be implemented under Alternative 7
38 for construction-related activities along with agency-issued permits that also contain construction
39 requirements to protect water quality, the construction-related effects, relative to Existing
40 Conditions, would not be expected to cause or contribute to substantial alteration of existing
41 drainage patterns which would result in substantial erosion or siltation on- or off-site, substantial
42 increased frequency of exceedances of water quality objectives/criteria, or substantially degrade
43 water quality with respect to the constituents of concern on a long-term average basis, and thus

1 would not adversely affect any beneficial uses in water bodies upstream of the Delta, within the
 2 Delta, or in the SWP and CVP service area. Moreover, because the construction-related activities
 3 would be temporary and intermittent in nature, the construction would involve negligible
 4 discharges, if any, of bioaccumulative or 303(d) listed constituents to water bodies of the affected
 5 environment. As such, construction activities would not contribute measurably to bioaccumulation
 6 of contaminants in organisms or humans or cause 303(d) impairments to be discernibly worse.
 7 Based on these findings, this impact is determined to be less than significant. No mitigation is
 8 required.

9 **8.4.3.15 Alternative 8—Dual Conveyance with Pipeline/Tunnel, Intakes 2,** 10 **3, and 5 and Increased Delta Outflow (9,000 cfs; Operational** 11 **Scenario F)**

12 Alternative 8 would comprise physical/structural components similar to those under Alternative 1A
 13 with the principal exceptions that Alternative 8 would construct only three intakes and intake
 14 pumping plants (i.e., Intakes 2, 3, and 5). Alternative 8 would convey up to 9,000 cfs of water from
 15 the north Delta to the south Delta through pipelines/tunnels from three screened intakes on the east
 16 bank of the Sacramento River between Clarksburg and Walnut Grove. A 750 acre intermediate
 17 forebay and pumping plant would be constructed near Hood. A new 600 acre Byron Tract Forebay,
 18 adjacent to and south of Clifton Court Forebay, would be constructed which would provide water to
 19 the south Delta pumping plants. Water supply and conveyance operations would follow the
 20 guidelines described as Scenario F, which includes fall X2. The alternative would provide up to 1.5
 21 MAF in increased Delta outflow. Conservation Measures 2–22 (CM2–22) would be implemented
 22 under this alternative, and would be the same as those under Alternative 1A. See Chapter 3,
 23 *Description of Alternatives*, Section 3.5.15, for additional details on Alternative 8.

24 **Effects of the Alternative on Delta Hydrodynamics**

25 Under the No Action Alternative and Alternatives 1–9, the following two primary factors can
 26 substantially affect water quality within the Delta:

- 27 • Within the south, west, and interior Delta, a decrease in the percentage of Sacramento River-
 28 sourced water and a concurrent increase in San Joaquin River-sourced water can increase the
 29 concentrations of numerous constituents (e.g., boron, bromide, chloride, electrical conductivity,
 30 nitrate, organic carbon, some pesticides, selenium). This source water replacement is caused by
 31 decreased exports of San Joaquin River water (due to increased Sacramento River water
 32 exports), or effects of climate change on timing of flows in the rivers. Changes in channel flows
 33 also can affect water residence time and many related physical, chemical, and biological
 34 variables.
- 35 • Particularly in the west Delta, sea water intrusion as a result of sea level rise or decreased Delta
 36 outflow can increase the concentration of salts (bromide, chloride) and levels of electrical
 37 conductivity. Conversely, increased Delta outflow (e.g., as a result of Fall X2 operations in wet
 38 and above normal water years) will decrease levels of these constituents, particularly in the
 39 west Delta.

40 Under Alternative 8, over the long term, average annual delta exports are anticipated to decrease by
 41 2,046 TAF relative to Existing Conditions, and by 1,342 TAF relative to the No Action Alternative.
 42 Since, over the long-term, approximately 70% of the exported water will be from the new north
 43 Delta intakes, average monthly diversions at the south Delta intakes would be decreased because of

1 the shift in diversions to the north Delta intakes (see Chapter 5, *Water Supply*, for more
 2 information). The result of this is greatly increased San Joaquin River water influence throughout
 3 the south, west, and interior Delta, and a corresponding decrease in Sacramento River water
 4 influence. This can be seen, for example, in Appendix 8D, ALT 8–Old River at Rock Slough for ALL
 5 years (1976–1991), which shows increased San Joaquin River (SJR) percentage and decreased
 6 Sacramento River (SAC) percentage under the alternative, relative to Existing Conditions and the No
 7 Action Alternative.

8 Under Alternative 8, long-term average annual Delta outflow is anticipated to increase 2,195 TAF
 9 relative to Existing Conditions, due to both changes in operations (including north Delta intake
 10 capacity of 9,000 cfs and numerous other operational components of Scenario F) and climate
 11 change/sea level rise (see Chapter 5, *Water Supply*, for more information). The result of this is
 12 decreased sea water intrusion in the west Delta. The decrease of sea water intrusion in the west
 13 Delta under Alternative 8 is greater relative to the Existing Conditions because it does not include
 14 operations to meet Fall X2, whereas the No Action alternative and Alternative 8 do. Long-term
 15 average annual Delta outflow is anticipated to increase under Alternative 8 by 1,445 TAF relative to
 16 the No Action Alternative, due only to changes in operations. The decreases in sea water intrusion
 17 (represented by an decrease in San Francisco Bay (BAY) percentage) can be seen, for example, in
 18 Appendix 8D, ALT 8–Sacramento River at Mallard Island for ALL years (1976–1991).

19 **Impact WQ-1: Effects on Ammonia Concentrations Resulting from Facilities Operations and** 20 **Maintenance (CM1)**

21 ***Upstream of the Delta***

22 For the same reasons stated for the No Action Alternative, Alternative 8 would have negligible, if
 23 any, effect on ammonia concentrations in the rivers and reservoirs upstream of the Delta relative to
 24 Existing Conditions and the No Action Alternative. Any negligible increases in ammonia-N
 25 concentrations that could occur in the water bodies of the affected environment located upstream of
 26 the Delta would not be of frequency, magnitude and geographic extent that would adversely affect
 27 any beneficial uses or substantially degrade the quality of these water bodies, with regard to
 28 ammonia.

29 ***Delta***

30 Assessment of effects of ammonia under Alternative 8 is the same as discussed under Alternative
 31 1A, except that because flows in the Sacramento River at Freeport are different between the two
 32 alternatives, estimated monthly average and long term annual average predicted ammonia-N
 33 concentrations in the Sacramento River downstream of Freeport are different.

34 As Table 8-71 shows, estimated ammonia-N concentrations in the Sacramento River downstream of
 35 Freeport (upon full mixing of the SRWTP discharge with river water) under Alternative 8 and the No
 36 Action Alternative are expected to be similar. Minor increases in ammonia-N concentrations would
 37 occur during July through December, and remaining months would be unchanged or have a minor
 38 decrease. A minor increase in the annual average concentration would occur under Alternative 8,
 39 compared to the No Action Alternative. Moreover, the estimated concentrations downstream of
 40 Freeport under Alternative 8 would be similar to existing source water concentrations for the San
 41 Francisco Bay and San Joaquin River. Consequently, changes in source water fraction anticipated
 42 under Alternative 8, relative to the No Action Alternative, are not expected to substantially increase
 43 ammonia concentrations at any Delta locations.

1 **Table 8-71. Estimated Ammonia-N (mg-L as N) Concentrations in the Sacramento River Downstream of**
 2 **the Sacramento Regional Wastewater Treatment Plant for the No Action Alternative and Alternative 8**

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual Average
No Action Alternative	0.074	0.084	0.069	0.060	0.057	0.060	0.058	0.064	0.067	0.060	0.067	0.064	0.065
Alternative 8	0.081	0.089	0.070	0.060	0.057	0.059	0.055	0.059	0.066	0.072	0.078	0.070	0.068

3

4 Any negligible increases in ammonia-N concentrations that could occur at certain locations in the
 5 Delta would not be of frequency, magnitude and geographic extent that would adversely affect any
 6 beneficial uses or substantially degrade the water quality at these locations, with regards to
 7 ammonia.

8 ***SWP/CVP Export Service Areas***

9 The assessment of effects on ammonia in the SWP/CVP Export Service Area is based on assessment
 10 of ammonia-N concentrations at Banks and Jones pumping plants. Similar to the discussion for
 11 Alternative 1A, under Alternative 8 for areas of the Delta that are influenced by Sacramento River
 12 water, including Banks and Jones pumping plants, ammonia-N concentrations are expected to
 13 decrease, relative to Existing Conditions (in association with less diversion of water influenced by
 14 the SRWTP). This decrease in ammonia-N concentrations for water exported via the south Delta
 15 pumps is not expected to result in adverse effects on beneficial uses or substantially degrade water
 16 quality of exported water, with regards to ammonia.

17 Furthermore, as discussed above for the Plan Area, for all areas of the Delta, including Banks and
 18 Jones pumping plants, ammonia-N concentrations are not expected to be substantially different
 19 under Alternative 8, relative to the No Action Alternative. Any negligible increases in ammonia-N
 20 concentrations that could occur at Banks and Jones pumping plants would not be of frequency,
 21 magnitude and geographic extent that would adversely affect any beneficial uses or substantially
 22 degrade the water quality at these locations, with regards to ammonia.

23 ***NEPA Effects:*** In summary, based on the discussion above, effects on ammonia from implementation
 24 of CM1 are considered to be not adverse.

25 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
 26 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
 27 purpose of making the CEQA impact determination for this constituent. For additional details on the
 28 effects assessment findings that support this CEQA impact determination, see the effects assessment
 29 discussion that immediately precedes this conclusion.

30 Ammonia-N concentrations are generally low in the reservoirs and rivers of the watersheds, owing
 31 to the lack of substantial point and nonpoint sources of ammonia-N upstream of the SRWTP in the
 32 Sacramento River watershed, in the watersheds of the eastern tributaries (Cosumnes, Mokelumne,
 33 and Calaveras Rivers), or upstream of the Delta in the San Joaquin River watershed. Consequently,
 34 any modified reservoir operations and subsequent changes in river flows under Alternative 8,
 35 relative to Existing Conditions, are expected to have negligible, if any, effects on reservoir and river
 36 ammonia-N concentrations upstream of Freeport in the Sacramento River watershed and upstream
 37 of the Delta in the San Joaquin River watershed.

1 Ammonia-N concentrations in the Sacramento River downstream of the SRWTP would be
 2 substantially lower under Alternative 8, relative to Existing Conditions, due to upgrades to the
 3 SRWTP that are assumed to be in place, and thus, ammonia concentrations for all areas of the Delta
 4 that are influenced by Sacramento River water are expected to decrease. At locations which are not
 5 influenced notably by Sacramento River water, concentrations are expected to remain relatively
 6 unchanged, due to the similarity in SJR and BAY concentrations and the lack of expected changes in
 7 either of these concentrations.

8 The assessment of effects on ammonia in the SWP/CVP Export Service Areas is based on assessment
 9 of ammonia-N concentrations at Banks and Jones pumping plants. As discussed above for the Plan
 10 Area, for areas of the Delta that are influenced by Sacramento River water, including Banks and
 11 Jones pumping plants, ammonia-N concentrations are expected to decrease under Alternative 8,
 12 relative to Existing Conditions.

13 Based on the above, there would be no substantial, long-term increase in ammonia-N concentrations
 14 in the rivers and reservoirs upstream of the Delta, in the Plan Area, or the waters exported to the
 15 CVP and SWP service areas under Alternative 8 relative to Existing Conditions. As such, this
 16 alternative is not expected to cause additional exceedance of applicable water quality
 17 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
 18 on any beneficial uses of waters in the affected environment. Because ammonia concentrations are
 19 not expected to increase substantially, no long-term water quality degradation is expected to occur
 20 and, thus, no adverse effects on beneficial uses would occur. Ammonia is not 303(d) listed within the
 21 affected environment and thus any minor increases that could occur in some areas would not make
 22 any existing ammonia-related impairment measurably worse because no such impairments
 23 currently exist. Because ammonia-N is not bioaccumulative, minor increases that could occur in
 24 some areas would not bioaccumulate to greater levels in aquatic organisms that would, in turn, pose
 25 substantial health risks to fish, wildlife, or humans. This impact is considered to be less than
 26 significant. No mitigation is required.

27 **Impact WQ-2: Effects on Ammonia Concentrations Resulting from Implementation of CM2-**
 28 **CM22**

29 **NEPA Effects:** Effects of CM2-CM22 on ammonia under Alternative 8 are the same as those
 30 discussed for Alternative 1A and are considered to be not adverse.

31 **CEQA Conclusion:** Conservation Measures 2-22 proposed under Alternative 8 would be similar to
 32 those proposed under Alternative 1A. As such, effects on ammonia resulting from the
 33 implementation of CM2-CM22 would be similar to that previously discussed for Alternative 1A. This
 34 impact is considered to be less than significant. No mitigation is required.

35 **Impact WQ-3: Effects on Boron Concentrations Resulting from Facilities Operations and**
 36 **Maintenance (CM1)**

37 ***Upstream of the Delta***

38 Effects of CM1 on boron under Alternative 8 in areas upstream of the Delta would be very similar to
 39 the effects discussed for Alternative 1A. There would be no expected change to the sources of boron
 40 in the Sacramento and east-side tributary watersheds, and resultant changes in flows from altered
 41 system-wide operations would have negligible, if any, effects on the concentration of boron in the
 42 rivers and reservoirs of these watersheds. The modeled long-term annual average lower San Joaquin

1 River flow at Vernalis would decrease slightly compared to Existing Conditions (in association with
2 project operations, climate change, and increased water demands) and the No Action Alternative
3 considering only changes due to Alternative 8 operations. The reduced flow would result in possible
4 increases in long-term average boron concentrations of up to about 3% relative to the Existing
5 Conditions (Appendix 8F, Table 24). The increased boron concentrations would not increase the
6 frequency of exceedances of any applicable objectives or criteria and would not be expected to cause
7 further degradation at measurable levels in the lower San Joaquin River, and thus would not cause
8 the existing impairment there to be discernibly worse. Consequently, Alternative 8 would not be
9 expected to cause exceedance of boron objectives/criteria or substantially degrade water quality
10 with respect to boron, and thus would not adversely affect any beneficial uses of the Sacramento
11 River, the east-side tributaries, associated reservoirs upstream of the Delta, or the San Joaquin River.

12 ***Delta***

13 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
14 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
15 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
16 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
17 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
18 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

19 Effects of CM1 on boron under Alternative 8 in the Delta would be similar to the effects discussed for
20 Alternative 1A. Relative to the Existing Conditions and No Action Alternative, Alternative 8 would
21 result in increased long-term average boron concentrations for the 16-year period modeled at
22 interior Delta locations (by as much as 10% at the SF Mokelumne River at Staten Island, 35% at
23 Franks Tract, 58% at Old River at Rock Slough) (Appendix 8F, Table Bo-20). The comparison to
24 Existing Conditions reflects changes due to both Alternative 8 operations (including north Delta
25 intake capacity of 9,000 cfs and numerous other operational components of Scenario E) and climate
26 change/sea level rise. The comparison to the No Action Alternative reflects changes due only to
27 operations.

28 Implementation of tidal habitat restoration under CM4 also may contribute to increased boron
29 concentrations at western Delta assessment locations (more discussion of this phenomenon is
30 included in Section 8.3.1.3), and thus would not be anticipated to substantially affect agricultural
31 diversions which occur primarily at interior Delta locations.

32 The long-term annual average and monthly average boron concentrations, for either the 16-year
33 period or drought period modeled, would never exceed the 2,000 µg/L human health advisory
34 objective (i.e., for children) or 500 µg/L agricultural objective at any of the eleven Delta assessment
35 locations, which represents no change from the Existing Conditions and No Action Alternative
36 (Appendix 8F, Table Bo-3A). The increased concentrations at interior Delta locations would result in
37 moderate reductions in the long-term average assimilative capacity of up to 16% at Franks Tract
38 and up to 34% at Old River at Rock Slough locations (Appendix 8F, Table Bo-21). However, because
39 the absolute boron concentrations would still be well below the lowest 500 µg/L objective for the
40 protection of the agricultural beneficial use under Alternative 8, the levels of boron degradation
41 would not be of sufficient magnitude to substantially increase the risk of exceeding objectives or
42 cause adverse effects to municipal and agricultural water supply beneficial uses, or any other
43 beneficial uses, in the Delta (Appendix 8F, Figure Bo-5).

1 **SWP/CVP Export Service Areas**

2 Effects of CM1 on boron under Alternative 8 in the Delta would be similar to the effects discussed for
3 Alternative 1A. Under Alternative 8, long-term average boron concentrations would decrease by as
4 much as 37% at the Banks Pumping Plant and by as much as 47% at Jones Pumping Plant relative to
5 Existing Conditions and No Action Alternative (Appendix 8F, Table Bo-20) as a result of export of a
6 greater proportion of low-boron Sacramento River water. Commensurate with the decrease in
7 exported boron concentrations, boron concentrations in the lower San Joaquin River may be
8 reduced and would likely alleviate or lessen any expected increase in boron concentrations at
9 Vernalis associated with flow reductions (see discussion of Upstream of the Delta), as well as
10 locations in the Delta receiving a large fraction of San Joaquin River water. Reduced export boron
11 concentrations also may contribute to reducing the existing 303(d) impairment in the lower San
12 Joaquin River and associated TMDL actions for reducing boron loading.

13 Maintenance of SWP and CVP facilities under Alternative 8 would not be expected to create new
14 sources of boron or contribute towards a substantial change in existing sources of boron in the
15 affected environment. Maintenance activities would not be expected to cause any substantial
16 increases in boron concentrations or degradation with respect to boron such that objectives would
17 be exceeded more frequently, or any beneficial uses would be adversely affected anywhere in the
18 affected environment.

19 **NEPA Effects:** In summary, relative to the No Action Alternative conditions, Alternative 8 would
20 result in relatively small long-term average increases in boron levels in the San Joaquin River and
21 moderate increases in the interior and western Delta locations Delta. However, the predicted
22 changes in the Delta would not be expected to result in exceedances of applicable objectives or
23 further water quality degradation such that objectives would likely be exceeded or there would be
24 substantially increased risk of adverse effects on water quality.

25 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
26 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
27 purpose of making the CEQA impact determination for this constituent. For additional details on the
28 effects assessment findings that support this CEQA impact determination, see the effects assessment
29 discussion that immediately precedes this conclusion.

30 Boron is not a constituent of concern in the Sacramento River watershed upstream of the Delta, thus
31 river flow rate and reservoir storage reductions that would occur under the Alternative 8, relative to
32 Existing Conditions, would not be expected to result in a substantial adverse change in boron levels.
33 Additionally, relative to Existing Conditions, Alternative 8 would not result in reductions in river
34 flow rates (i.e., less dilution) or increased boron loading such that there would be any substantial
35 increases in boron concentration upstream of the Delta in the San Joaquin River watershed.

36 Moderate increased boron levels (i.e., up to 58% increased concentration) and degradation
37 predicted for interior and western Delta locations in response to a shift in the Delta source water
38 percentages and tidal habitat restoration under this alternative would not be expected to cause
39 exceedances of objectives. Alternative 8 maintenance also would not result in any substantial
40 increases in boron concentrations in the affected environment. Boron concentrations would be
41 reduced in water exported from the Delta to the CVP/SWP Export Service Areas, thus reflecting a
42 potential improvement to boron loading in the lower San Joaquin River.

1 Boron is not a bioaccumulative constituent, thus any increased concentrations under Alternative 8
2 would not result in adverse boron bioaccumulation effects to aquatic life or humans. Relative to
3 Existing Conditions, Alternative 8 would not result in substantially increased boron concentrations
4 such that frequency of exceedances of municipal and agricultural water supply objectives would
5 increase. The levels of boron degradation that may occur under Alternative 8, while widespread in
6 particular at interior Delta locations, would not be of sufficient magnitude to cause substantially
7 increased risk for adverse effects to municipal or agricultural beneficial uses within the affected
8 environment. Long-term average boron concentrations would decrease in Delta water exports to the
9 SWP and CVP service area, which may contribute to reducing the existing 303(d) impairment of
10 agricultural beneficial uses in the lower San Joaquin River. Consequently, Alternative 8 would not be
11 expected to cause any substantial increases in boron concentrations or degradation with respect to
12 boron such that objectives would be exceeded more frequently, or any beneficial uses would be
13 adversely affected anywhere in the affected environment. Based on these findings, this impact is
14 determined to be less than significant. No mitigation is required.

15 **Impact WQ-4: Effects on Boron Concentrations Resulting from Implementation of CM2–CM22**

16 **NEPA Effects:** Effects of CM2–CM22 on boron under Alternative 8 are the same as those discussed
17 for Alternative 1A and are determined to be not adverse.

18 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 8 would be similar to
19 those proposed under Alternative 1A. As such, effects on boron resulting from the implementation
20 of CM2–CM22 would be similar to that previously discussed for Alternative 1A. This impact is
21 considered to be less than significant. No mitigation is required.

22 **Impact WQ-5: Effects on Bromide Concentrations Resulting from Facilities Operations and** 23 **Maintenance (CM1)**

24 ***Upstream of the Delta***

25 Under Alternative 8 there would be no expected change to the sources of bromide in the Sacramento
26 and eastside tributary watersheds. Bromide loading in these watersheds would remain unchanged
27 and resultant changes in flows from altered system-wide operations under Alternative 8 would have
28 negligible, if any, effects on the concentration of bromide in the rivers and reservoirs of these
29 watersheds. Consequently, Alternative 8 would not be expected to adversely affect the MUN
30 beneficial use, or any other beneficial uses, of the Sacramento River, the eastside tributaries, or their
31 associated reservoirs upstream of the Delta.

32 Under Alternative 8, modeling indicates that long-term annual average flows on the San Joaquin
33 River would decrease by 6%, relative to Existing Conditions, and would remain virtually the same
34 relative to No Action Alternative (Appendix 5A). These decreases in flow would result in possible
35 increases in long-term average bromide concentrations of about 3%, relative to Existing Conditions
36 and less than <1% relative to the No Action Alternative (Appendix 8E, Bromide Table 22). The small
37 increases in lower San Joaquin River bromide levels that could occur under Alternative 8, relative to
38 existing and No Action Alternative conditions would not be expected to adversely affect the MUN
39 beneficial use, or any other beneficial uses, of the lower San Joaquin River.

1 Delta

2 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
3 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
4 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
5 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
6 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
7 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

8 Using the mass-balance modeling approach for bromide (see Section 8.3.1.3), relative to Existing
9 Conditions, Alternative 8 would result in increases in long-term average bromide concentrations at
10 Staten Island and Barker Slough, while long-term average concentrations would decrease at the
11 other assessment locations (Appendix 8E, *Bromide*, Table 18). At Barker Slough, predicted long-term
12 average bromide concentrations would increase from 51 µg/L to 54 µg/L (4% relative increase) for
13 the modeled 16-year hydrologic period, and would increase from 54 µg/L to 80 µg/L (50% relative
14 increase) for the modeled drought period. At Barker Slough, the predicted 50 µg/L exceedance
15 frequency would decrease from 49% under Existing Conditions to 34% under Alternative 8, but
16 would increase slightly from 55% to 62% during the drought period. At Barker Slough, the predicted
17 100 µg/L exceedance frequency would increase from 0% under Existing Conditions to 10% under
18 Alternative 8, and would increase from 0% to 27% during the drought period. At Staten Island,
19 predicted long-term average bromide concentrations would increase from 50 µg/L to 64 µg/L (29%
20 relative increase) for the modeled 16-year hydrologic period and would increase from 51 µg/L to 65
21 µg/L (26% relative increase) for the modeled drought period. At Staten Island, increases in average
22 bromide concentrations would correspond to an increased frequency of 50 µg/l threshold
23 exceedance, from 47% under Existing Conditions to 80% under Alternative 8 (52% to 87% for the
24 modeled drought period), and an increase from 1% to 2% (0% to 0% for the modeled drought
25 period) for the 100 µg/L threshold. Changes in exceedance frequency of the 50 µg/L and 100 µg/L
26 concentration thresholds at other assessment locations would be less considerable, with exception
27 to Franks Tract. Although long-term average bromide concentrations were modeled to decrease at
28 Franks Tract, exceedances of the 100 µg/L threshold would increase slightly, from 82% under
29 Existing Conditions to 98% under Alternative 8 (78% to 93% for the modeled drought period). This
30 comparison to Existing Conditions reflects changes in bromide due to both Alternative 8 operations
31 (including north Delta intake capacity of 9,000 cfs and numerous other operational components of
32 Scenario F) and climate change/sea level rise.

33 Due to the relatively small differences between modeled Existing Conditions and the No Action
34 baseline, changes in long-term average bromide concentrations and changes in exceedance
35 frequencies relative to the No Action Alternative are generally of similar magnitude to those
36 previously described for the existing condition comparison (Appendix 8E, *Bromide*, Table 18).
37 Modeled long-term average bromide concentration at Barker Slough is predicted to increase by 8%
38 (50% for the modeled drought period) relative to the No Action Alternative. Modeled long-term
39 average bromide concentration increases at Staten Island are predicted to increase by 33% (30% for
40 the modeled drought period) relative to the No Action Alternative. However, unlike the Existing
41 Conditions comparison, long-term average bromide concentrations at Buckley Cove would increase
42 relative to the No Action Alternative, although the increases would be relatively small ($\leq 2\%$). Unlike
43 the comparison to Existing Conditions, this comparison to the No Action Alternative reflects changes
44 in bromide due only to Alternative 8 operations.

1 At Barker Slough, modeled long-term average bromide concentrations for the two baseline
2 conditions are very similar (Appendix 8E, *Bromide*, Table 18). Such similarity demonstrates that the
3 modeled Alternative 8 change in bromide is almost entirely due to Alternative 8 operations, and not
4 climate change/sea level rise. Therefore, operations are the primary driver of effects on bromide at
5 Barker Slough, regardless whether Alternative 8 is compared to Existing Conditions, or compared to
6 the No Action Alternative.

7 Results of the modeling approach which used relationships between EC and chloride and between
8 chloride and bromide (see Section 8.3.1.3) differed somewhat from what is presented above for the
9 mass-balance approach (see Appendix 8E, *Bromide*, Table 19). For most locations, the frequency of
10 exceedance of the 50 µg/L and 100 µg/L were similar. The greatest difference between the methods
11 was predicted for Barker Slough. The increases in frequency of exceedance of the 100 µg/L
12 threshold, relative to Existing Conditions and the No Action Alternative, were not as great using this
13 alternative EC to chloride and chloride to bromide relationship modeling approach as compared to
14 that presented above from the mass-balance modeling approach. Results indicate 4% exceedance
15 over the modeled period under Alternative 8, as compared to 1% under Existing Conditions and 2%
16 under the No Action Alternative. For the drought period, exceedance frequency increased from 0%
17 under Existing Conditions and the No Action Alternative, to 12% under Alternative 8. Because the
18 mass-balance approach predicts a greater level of impact at Barker Slough, determination of impacts
19 was based on the mass-balance results.

20 While the increase in long-term average bromide concentrations at Barker Slough are relatively
21 small when modeled over a representative 16-year hydrologic period, increases during the modeled
22 drought period, principally the relative increase in 100 µg/L exceedance frequency, would represent
23 a substantial change in source water quality during a season of drought. As discussed for Alternative
24 1A, drinking water treatment plants obtaining water via the North Bay Aqueduct utilize a variety of
25 conventional and enhanced treatment technologies in order to achieve DBP drinking water criteria.
26 While the implications of such a modeled drought period change in bromide concentrations at
27 Barker Slough is difficult to predict, the substantial modeled increases could lead to adverse changes
28 in the formation of disinfection byproducts such that considerable treatment plant upgrades may be
29 necessary in order to achieve equivalent levels of health protection during seasons of drought.
30 Increases at Staten Island are also considerable, although there are no existing or foreseeable
31 municipal intakes in the immediate vicinity. Because many of the other modeled locations already
32 frequently exceed the 100 µg/L threshold under Existing Conditions and the No Action Alternative,
33 these locations likely already require treatment plant technologies to achieve equivalent levels of
34 health protection, and thus no additional treatment technologies would be triggered by the small
35 increases in the frequency of exceeding the 100 µg/L threshold. Hence, no further impact on the
36 drinking water beneficial use would be expected at these locations.

37 The seasonal intakes at Mallard Slough and City of Antioch are infrequently used due to water
38 quality constraints related to sea water intrusion. On a long-term average basis, bromide at these
39 locations is in excess of 3,000 µg/L, but during seasonal periods of high Delta outflow can be <300
40 µg/L. Based on modeling using the mass-balance approach, use of the seasonal intakes at Mallard
41 Slough and City of Antioch under Alternative 8 would experience a period average increase in
42 bromide during the months when these intakes would most likely be utilized. For those wet and
43 above normal water year types where mass balance modeling would predict water quality typically
44 suitable for diversion, predicted long-term average bromide would increase from 103 µg/L to 146
45 µg/L (42% increase) at City of Antioch and would increase from 150 µg/L to 193 µg/L (29%
46 increase) at Mallard Slough relative to Existing Conditions (Appendix 8E, *Bromide*, Table 23).

1 Increases would be similar for the No Action Alternative comparison. Modeling results using the EC
2 to chloride and chloride to bromide relationships show increases during these months, but the
3 relative magnitude of the increases is much lower (Appendix 8E, Bromide Table 24). Regardless of
4 the differences in the data between the two modeling approaches, the decisions surrounding the use
5 of these seasonal intakes is largely driven by acceptable water quality, and thus have historically
6 been opportunistic. Opportunity to use these intakes would remain, and the predicted increases in
7 bromide concentrations at the City of Antioch and Mallard Slough intake would not be expected to
8 adversely affect MUN beneficial uses, or any other beneficial use, at these locations.

9 Based on modeling using the mass-balance approach, relative to existing and No Action Alternative
10 conditions, Alternative 8 would lead to predicted improvements in long-term average bromide
11 concentrations at Franks Tract, Rock Slough, and Contra Costa PP No. 1, in addition to Banks and
12 Jones (discussed below). At these locations, long-term average bromide concentrations would be
13 predicted to decrease by as much as 11–37%, depending on baseline comparison. Modeling results
14 using the EC to chloride and chloride to bromide relationships generally do not show similar
15 decreases for Rock Slough and Contra Costa PP No. 1, but rather, predict small increases. Based on
16 the small magnitude of increases predicted, these increases would not adversely affect beneficial
17 uses at those locations.

18 ***SWP/CVP Export Service Areas***

19 Under Alternative 8, improvement in long-term average bromide concentrations would occur at the
20 Banks and Jones pumping plants. Long-term average bromide concentrations for the modeled 16-
21 year hydrologic period at these locations would decrease by as much as 75% relative to Existing
22 Conditions and 69% relative to the No Action Alternative (Appendix 8E, *Bromide*, Table 18). As a
23 result, exceedances of the 50 µg/L and 100 µg/L assessment thresholds would be substantially
24 reduced, resulting in considerable overall improvement in Export Service Areas water quality
25 respective to bromide. Commensurate with the decrease in exported bromide, an improvement in
26 lower San Joaquin River bromide would also be observed since bromide in the lower San Joaquin
27 River is principally related to irrigation water deliveries from the Delta. While the magnitude of this
28 expected lower San Joaquin River improvement in bromide is difficult to predict, the relative
29 decrease in overall loading of bromide to the Export Service Areas would likely alleviate or lessen
30 any expected increase in bromide concentrations at Vernalis (see discussion of Upstream of the
31 Delta) as well as locations in the Delta receiving a large fraction of San Joaquin River water, such as
32 much of the south Delta.

33 The discussion above is based on results of the mass-balance modeling approach. Results of the
34 modeling approach which used relationships between EC and chloride and between chloride and
35 bromide (see Section 8.3.1.3) were consistent with the discussion above, and assessment of bromide
36 using these data results in the same conclusions as are presented above for the mass-balance
37 approach (see Appendix 8E, *Bromide*, Table 19).

38 Similar to the discussion pertaining to the No Action Alternative, maintenance of SWP and CVP
39 facilities under Alternative 8 would not be expected to create new sources of bromide or contribute
40 towards a substantial change in existing sources of bromide in the affected environment.
41 Maintenance activities would not be expected to cause any substantial change in bromide such that
42 MUN beneficial uses, or any other beneficial use, would be adversely affected anywhere in the
43 affected environment.

1 **NEPA Effects:** In summary, Alternative 8 operations and maintenance, relative to the No Action
2 Alternative, would result in small increases (i.e., <1%) in long-term average bromide concentrations
3 at Vernalis related to relatively small declines in long-term average flow on the San Joaquin River.
4 However, Alternative 8 operation and maintenance activities would cause substantial degradation
5 to water quality with respect to bromide at Barker Slough, source of the North Bay Aqueduct.
6 Resultant substantial change in long-term average bromide at Barker Slough could necessitate
7 changes in water treatment plant operations or require treatment plant upgrades in order to
8 maintain DBP compliance, and thus would constitute an adverse effect on water quality. Mitigation
9 Measure WQ-5 is available to reduce these effects (implementation of this measure along with a
10 separate, non-environmental commitment as set forth in EIR/EIS Appendix 3B, *Environmental*
11 *Commitments*, relating to the potential increased treatment costs associated with bromide-related
12 changes would reduce these effects).

13 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
14 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
15 purpose of making the CEQA impact determination for this constituent. For additional details on the
16 effects assessment findings that support this CEQA impact determination, see the effects assessment
17 discussion that immediately precedes this conclusion.

18 Under Alternative 8 there would be no expected change to the sources of bromide in the Sacramento
19 and eastside tributary watersheds. Bromide loading in these watersheds would remain unchanged
20 and resultant changes in flows from altered system-wide operations under Alternative 8 would have
21 negligible, if any, effects on the concentration of bromide in the rivers and reservoirs of these
22 watersheds. However, south of the Delta, the San Joaquin River is a substantial source of bromide,
23 primarily due to the use of irrigation water imported from the southern Delta. Concentrations of
24 bromide at Vernalis are inversely correlated to net river flow. Under Alternative 8, long-term
25 average flows at Vernalis would decrease only slightly, resulting in less than substantial predicted
26 increases in long-term average bromide of about 3% relative to Existing Conditions.

27 Relative to Existing Conditions, Alternative 8 would result in increases in long-term average
28 bromide concentration at Staten Island and Barker Slough. There are no existing or foreseeable
29 municipal drinking water intakes in the vicinity of Staten Island, but Barker Slough is the source of
30 the North Bay Aqueduct. While the increase in long-term average bromide concentrations at Barker
31 Slough are predicted to be relatively small when modeled over a representative 16-year hydrologic
32 period, increases during the modeled drought period would represent a substantial change in
33 source water quality during a season of drought. These predicted drought season related increases
34 in bromide at Barker Slough could lead to adverse changes in the formation of disinfection
35 byproducts at drinking water treatment plants such that considerable water treatment plant
36 upgrades would be necessary in order to achieve equivalent levels of drinking water health
37 protection.

38 The assessment of effects on bromide in the SWP/CVP Export Service Areas is based on assessment
39 of changes in bromide concentrations at Banks and Jones pumping plants. Under Alternative 8,
40 substantial improvement would occur at the Banks and Jones pumping plants, where predicted
41 long-term average bromide concentrations are predicted to decrease by as much as 75% relative to
42 Existing Conditions. An overall improvement in bromide-related water quality would be predicted
43 in the SWP/CVP Export Service Areas.

1 Based on the above, Alternative 8 operation and maintenance would not result in any substantial
2 change in long-term average bromide concentration upstream of the Delta. Furthermore, under
3 Alternative 8, water exported from the Delta to the SWP/CVP service area would be substantially
4 improved relative to bromide. Bromide is not bioaccumulative, therefore change in long-term
5 average bromide concentrations would not directly cause bioaccumulative problems in aquatic life
6 or humans. Additionally, bromide is not a constituent related to any 303(d) listings. Alternative 8
7 operation and maintenance activities would not cause substantial long-term degradation to water
8 quality respective to bromide with the exception of water quality at Barker Slough (drought period
9 only) and at Staten Island in the eastern Delta. There are no existing or foreseeable municipal
10 intakes in the vicinity of Staten Island, but Barker Slough is the source of the North Bay Aqueduct. At
11 Barker Slough, modeled long-term annual average concentrations of bromide would increase by
12 50% during the modeled drought period. For the modeled drought period the frequency of
13 predicted bromide concentrations exceeding 100 µg/L would increase from 0% under Existing
14 Conditions to 27% under Alternative 8. Substantial changes in long-term average bromide during
15 seasons of drought could necessitate changes in treatment plant operation or require treatment
16 plant upgrades in order to maintain DBP compliance. The model predicted change at Barker Slough
17 during the drought period is substantial and, therefore, would represent a substantially increased
18 risk for adverse effects on existing MUN beneficial uses should treatment upgrades not be
19 undertaken. The impact is considered significant.

20 Implementation of Mitigation Measure WQ-5 along with a separate, non-environmental
21 commitment relating to the potential increased treatment costs associated with bromide-related
22 changes would reduce these effects. While mitigation measures to reduce these water quality effects
23 in affected water bodies to less than significant levels are not available, implementation of
24 Mitigation Measure WQ-5 is recommended to attempt to reduce the effect that increased bromide
25 concentrations may have on Delta beneficial uses. However, because the effectiveness of this
26 mitigation measure to result in feasible measures for reducing water quality effects is uncertain, this
27 impact is considered to remain significant and unavoidable. Please see Mitigation Measure WQ-5
28 under Impact WQ-5 in the discussion of Alternative 1A.

29 In addition to and to supplement Mitigation Measure WQ-5, the BDCP proponents have incorporated
30 into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*, a separate, non-
31 environmental commitment to address the potential increased water treatment costs that could
32 result from bromide-related concentration effects on municipal water purveyor operations.
33 Potential options for making use of this financial commitment include funding or providing other
34 assistance towards implementation of the North Bay Aqueduct AIP, acquiring alternative water
35 supplies, or other actions to indirectly reduce the effects of elevated bromide and DOC in existing
36 water supply diversion facilities. Please refer to Appendix 3B, *Environmental Commitments*, for the
37 full list of potential actions that could be taken pursuant to this commitment in order to reduce the
38 water quality treatment costs associated with water quality effects relating to chloride, electrical
39 conductivity, and bromide.

40 **Mitigation Measure WQ-5: Avoid, Minimize, or Offset, as Feasible, Adverse Water Quality**
41 **Conditions**

42 Please see Mitigation Measure WQ-5 under Impact WQ-5 in the discussion of Alternative 1A.

1 **Impact WQ-6: Effects on Bromide Concentrations Resulting from Implementation of CM2–**
 2 **CM22**

3 **NEPA Effects:** Conservation Measures 2–22 under Alternative 8 would be similar to those under
 4 Alternative 1A. As discussed for Alternative 1A, implementation of the CM2–CM22 would not
 5 present new or substantially changed sources of bromide to the study area. Some conservation
 6 measures may replace or substitute for existing irrigated agriculture in the Delta. This replacement
 7 or substitution is not expected to substantially increase or present new sources of bromide. CM2–
 8 CM22 would not be expected to cause any substantial change in bromide such that MUN beneficial
 9 uses, or any other beneficial use, would be adversely affected anywhere in the affected environment.

10 In summary, implementation of CM2–CM22 under Alternative 8, relative to the No Action
 11 Alternative, would have negligible, if any, effects on bromide concentrations. The effects on bromide
 12 from implementing CM2–CM22 are determined to not be adverse.

13 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 8 would be similar to
 14 those proposed under Alternative 1A. As discussed for Alternative 1A, implementation of CM2–
 15 CM22 would not present new or substantially changed sources of bromide to the study area. As
 16 such, effects on bromide resulting from the implementation of CM2–CM22 would be similar to that
 17 previously discussed for Alternative 1A. This impact is considered to be less than significant. No
 18 mitigation is required.

19 **Impact WQ-7: Effects on Chloride Concentrations Resulting from Facilities Operations and**
 20 **Maintenance (CM1)**

21 ***Upstream of the Delta***

22 Under Alternative 8 there would be no expected change to the sources of chloride in the Sacramento
 23 and eastside tributary watersheds. Chloride loading in these watersheds would remain unchanged
 24 and resultant changes in flows from altered system-wide operations would have negligible, if any,
 25 effects on the concentration of chloride in the rivers and reservoirs of these watersheds. The
 26 modeled long-term annual average flows on the lower San Joaquin River at Vernalis would decrease
 27 slightly compared to Existing Conditions and be similar compared to the No Action Alternative (as a
 28 result of climate change). The reduced flow would result in possible increases in long-term average
 29 chloride concentrations of about 2%, relative to the Existing Conditions and no change relative to No
 30 Action Alternative (Appendix 8G, Table Cl-62). Consequently, Alternative 8 would not be expected to
 31 cause exceedance of chloride objectives/criteria or substantially degrade water quality with respect
 32 to chloride, and thus would not adversely affect any beneficial uses of the Sacramento River, the
 33 eastside tributaries, associated reservoirs upstream of the Delta, or the San Joaquin River.

34 ***Delta***

35 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 36 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 37 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 38 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 39 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
 40 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

41 Relative to the Existing Conditions and No Action Alternative, Alternative 8 would result in similar
 42 or reduced long-term average chloride concentrations for the 16-year period modeled at most of the

1 assessment locations, and, depending on the modeling approach (see Section 8.3.1.3), increased
2 concentrations at the North Bay Aqueduct at Barker Slough (i.e., up to 6% compared to No Action
3 Alternative), Contra Costa Canal at Pumping Plant #1 (i.e., up to 24% compared to No Action
4 Alternative), Rock Slough (i.e., up to 18% compared to No Action Alternative), and the San Joaquin
5 River at Staten Island (i.e., up to 29% compared to No Action Alternative) (Appendix 8G, *Chloride*,
6 Table Cl-49 and Table Cl-50). Moreover, the direction and magnitude of predicted changes for
7 Alternative 8 are similar between the alternatives, thus, the effects relative to Existing Conditions
8 and the No Action Alternative are discussed together. Additionally, implementation of tidal habitat
9 restoration under CM4 would increase the tidal exchange volume in the Delta, and thus may
10 contribute to increased chloride concentrations in the Bay source water as a result of increased
11 salinity intrusion. More discussion of this phenomenon is included in Section 8.3.1.3. Consequently,
12 while uncertain, the magnitude of chloride increases may be greater than indicated herein and
13 would affect the western Delta assessment locations the most which are influenced to the greatest
14 extent by the Bay source water. The comparison to Existing Conditions reflects changes in chloride
15 due to both Alternative 8 operations (including north Delta intake capacity of 9,000 cfs and
16 numerous other operational components of Scenario E) and climate change/sea level rise. The
17 comparison to the No Action Alternative reflects changes in chloride due only to operations. The
18 following outlines the modeled chloride changes relative to the applicable objectives and beneficial
19 uses of Delta waters.

20 *Municipal Beneficial Uses*

21 Estimates of chloride concentrations generated using EC-chloride relationships and DSM2 EC output
22 (see Section 8.3.1.3) were used to evaluate the 150 mg/L Bay-Delta WQCP objective for municipal
23 and industrial beneficial uses on a basis of the percent of years the chloride objective is exceeded for
24 the modeled 16-year period. The objective is exceeded if chloride concentrations exceed 150 mg/L
25 for a specified number of days in a given water year at both the Antioch and Contra Costa Pumping
26 Plant #1 locations. For Alternative 8, the modeled frequency of objective exceedance would increase
27 from 6% of years under Existing Conditions and 6% under the No Action Alternative to 19% of years
28 under Alternative 8 (Appendix 8G, Table Cl-64).

29 Similarly, estimates of chloride concentrations generated using EC-chloride relationships and DSM2
30 EC output (see Section 8.3.1.3) were also used to evaluate the 250 mg/L Bay-Delta WQCP objective
31 for chloride at Contra Costa Pumping Plant #1 where daily average objectives apply. The basis for
32 the evaluation was the predicted number of days the objective was exceeded for the modeled 16-
33 year period. For Alternative 8, the modeled frequency of objective exceedance would decrease, from
34 6% of modeled days under Existing Conditions and 5% under the No Action Alternative to 1% of
35 modeled days under Alternative 8 (Appendix 8G, Table Cl-63).

36 Given the limitations inherent to estimating future chloride concentrations (see Section 8.3.1.3),
37 estimation of chloride concentrations through both a mass balance approach and an EC-chloride
38 relationship approach was used to evaluate the 250 mg/L Bay-Delta WQCP objectives in terms of
39 both frequency of exceedance and use of assimilative capacity. When utilizing the mass balance
40 approach to model monthly average chloride concentrations for the 16-year period, the predicted
41 frequency of exceeding the 250 mg/L objective would decrease up to 15% (i.e., 24% for Existing
42 Conditions to 9%) at the Contra Costa Canal at Pumping Plant #1 (Appendix 8G, Table Cl-51 and
43 Figure Cl-13). The frequency of exceedances would decrease at the San Joaquin River at Antioch (i.e.,
44 from 66% under Existing Conditions to 58%) with no substantial change predicted for Mallard
45 Island (i.e., maximum increase of 1%) (Appendix 8G, Table Cl-51) and no substantial long-term

1 degradation (Appendix 8G, Table Cl-53). However, relative to the No Action conditions, available
2 assimilative capacity for chloride at the Contra Costa Canal at Pumping Plant #1 would be
3 substantially reduced in September and October (i.e., up to 100%, or eliminated, for the drought
4 period modeled) (Appendix 8G, Table Cl-53), reflecting substantial degradation when
5 concentrations would be near, or exceed, the objective.

6 In comparison, when utilizing the chloride-EC relationship to model monthly average chloride
7 concentrations for the 16-year period, trends in frequency of exceedance generally agreed, but use
8 of assimilative capacity were predicted to be larger at some locations (Appendix 8G, Table Cl-52 and
9 Table Cl-54). Specifically, while the model predicted exceedance frequency would decrease at the
10 Contra Costa Canal at Pumping Plant #1 and Rock Slough locations, use of assimilative capacity
11 would increase substantially for the months of February through June as well as September (i.e.,
12 maximum of 82% in March for the modeled drought period). Due to such seasonal long-term
13 average water quality degradation at these locations, the potential exists for substantial adverse
14 effects on the municipal and industrial beneficial uses through reduced opportunity for diversion of
15 water with acceptable chloride levels. Moreover, due to the increased frequency of exceeding the
16 150 mg/L Bay-Delta WQCP objective, the potential exists for adverse effects on the municipal and
17 industrial beneficial uses at Contra Costa Pumping Plant #1 and Antioch.

18 *303(d) Listed Water Bodies*

19 With respect to the 303(d) listing for chloride in Tom Paine Slough, the monthly average chloride
20 concentrations for the 16-year period modeled at Old River at Tracy Road would generally be
21 similar compared to Existing Conditions, and thus, would not be further degraded on a long-term
22 basis (Appendix 8G, Figure Cl-14). With respect to Suisun Marsh, the monthly average chloride
23 concentrations for the 16-year period modeled would generally be similar, or decrease, compared to
24 Existing Conditions in some months during October through May at the Sacramento River at
25 Collinsville (Appendix 8G, Figure Cl-15), Mallard Island (Appendix 8G, Figure Cl-13). However,
26 chloride concentrations would increase substantially at Montezuma Slough at Beldon's Landing (i.e.,
27 over a doubling of concentration in December through February) (Appendix 8G, Figure Cl-16),
28 thereby contributing to additional, measureable long-term degradation that potentially would
29 adversely affect the necessary actions to reduce chloride loading for any TMDL that is developed.

30 ***SWP/CVP Export Service Areas***

31 Under Alternative 8, long-term average chloride concentrations based on the mass balance analysis
32 of modeling results for the 16-year period modeled at the Banks and Jones pumping plants would
33 decrease by as much as 73% relative to Existing Conditions and 70% compared to No Action
34 Alternative (Appendix 8G, *Chloride*, Table Cl-49). The modeled frequency of exceedances of
35 applicable water quality objectives/criteria would decrease relative to Existing Conditions and No
36 Action Alternative, for both the 16-year period and the drought period modeled (Appendix 8G,
37 *Chloride*, Table Cl-51). Consequently, water exported into the SWP/CVP service area would
38 generally be of similar or better quality with regards to chloride relative to Existing Conditions and
39 the No Action Alternative conditions.

40 Results of the modeling approach which used relationships between EC and chloride (see Section
41 8.3.1.3) were consistent with the discussion above, and assessment of chloride using these data
42 results in the same conclusions as are presented above for the mass-balance approach (Appendix
43 8G, Table Cl-50 and Table Cl-52).

1 Commensurate with the reduced chloride concentrations in water exported to the service area,
2 reduced chloride loading in the lower San Joaquin River would be anticipated which would likely
3 alleviate or lessen any expected increase in chloride at Vernalis related to decreased annual average
4 San Joaquin River flows (see discussion of Upstream of the Delta).

5 Maintenance of SWP and CVP facilities would not be expected to create new sources of chloride or
6 contribute towards a substantial change in existing sources of chloride in the affected environment.
7 Maintenance activities would not be expected to cause any substantial change in chloride such that
8 any long-term water quality degradation would occur, thus, beneficial uses would not be adversely
9 affected anywhere in the affected environment.

10 **NEPA Effects:** In summary, relative to the No Action Alternative conditions, Alternative 8 would
11 result in substantial increased water quality degradation relative to the 150 mg/L Bay-Delta WCCP
12 objective at Contra Costa Pumping Plant #1 and Antioch, substantial seasonal use of assimilative
13 capacity at Contra Costa Pumping Plant #1 and Rock Slough, and measureable water quality
14 degradation relative to the 303(d) impairment in Suisun Marsh. The predicted chloride increases
15 constitute an adverse effect on water quality (see Mitigation Measure WQ-7 below; implementation
16 of this measure along with a separate, non-environmental commitment relating to the potential
17 increased chloride treatment costs would reduce these effects). Additionally, the predicted changes
18 relative to the No Action Alternative conditions indicate that in addition to the effects of climate
19 change/sea level rise, implementation of CM1 and CM4 under Alternative 8 would contribute
20 substantially to the adverse water quality effects.

21 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
22 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
23 purpose of making the CEQA impact determination for this constituent. For additional details on the
24 effects assessment findings that support this CEQA impact determination, see the effects assessment
25 discussion that immediately precedes this conclusion.

26 Chloride is not a constituent of concern in the Sacramento River watershed upstream of the Delta,
27 thus river flow rate and reservoir storage reductions that would occur under the Alternative 8,
28 relative to Existing Conditions, would not be expected to result in a substantial adverse change in
29 chloride levels. Additionally, relative to Existing Conditions, the Alternative 8 would not result in
30 reductions in river flow rates (i.e., less dilution) or increased chloride loading such that there would
31 be any substantial increase in chloride concentrations upstream of the Delta in the San Joaquin River
32 watershed.

33 Relative to Existing Conditions, Alternative 8 operations would result in reduced chloride
34 concentrations in the Delta such that exceedances of the 250 mg/L Bay-Delta WQCP objective at
35 interior and western Delta locations would be reduced. Nevertheless, due to the predicted increased
36 frequency of exceeding the 150 mg/L Bay-Delta WQCP objective at Contra Costa Pumping Plant #1
37 and Antioch as well as substantial seasonal use of assimilative capacity at Contra Costa Pumping
38 Plant #1, the potential exists for adverse effects on the municipal and industrial beneficial uses at
39 Contra Costa Pumping Plant #1 and Antioch (see Mitigation Measure WQ-7 below; implementation
40 of this measure along with a separate, non-environmental commitment relating to the potential
41 increased chloride treatment costs would reduce these effects). Moreover, the modeled increased
42 chloride concentrations and degradation in the western Delta could further contribute, at
43 measurable levels (i.e., over a doubling of concentration), to the existing 303(d) listed impairment
44 due to chloride in Suisun Marsh for the protection of fish and wildlife.

1 Chloride concentrations would be reduced in water exported from the Delta to the CVP/SWP Export
 2 Service Areas, thus reflecting a potential improvement to chloride loading in the lower San Joaquin
 3 River.

4 Chloride is not a bioaccumulative constituent, thus any increased concentrations under Alternative
 5 8 would not result in substantial chloride bioaccumulation impacts on aquatic life or humans.
 6 Alternative 8 maintenance would not result in any substantial changes in chloride concentration
 7 upstream of the Delta or in the SWP/CVP Export Service Areas. However, based on these findings,
 8 this impact is determined to be significant due to increased chloride concentrations and frequency
 9 of objective exceedance in the western Delta, as well as potential adverse effects on fish and wildlife
 10 beneficial uses in Suisun Marsh.

11 While mitigation measures to reduce these water quality effects in affected water bodies to less than
 12 significant levels are not available, implementation of Mitigation Measure WQ-7 is recommended to
 13 attempt to reduce the effect that increased chloride concentrations may have on Delta beneficial
 14 uses. However, because the effectiveness of this mitigation measure to result in feasible measures
 15 for reducing water quality effects is uncertain, this impact is considered to remain significant and
 16 unavoidable. Please see Mitigation Measure WQ-7 under Impact WQ-7 in the discussion of
 17 Alternative 1A.

18 In addition to and to supplement Mitigation Measure WQ-7, the BDCP proponents have incorporated
 19 into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*, a separate, non-
 20 environmental commitment to address the potential increased water treatment costs that could
 21 result from chloride concentration effects on municipal, industrial and agricultural water purveyor
 22 operations. Potential options for making use of this financial commitment include funding or
 23 providing other assistance towards acquiring alternative water supplies or towards modifying
 24 existing operations when chloride concentrations at a particular location reduce opportunities to
 25 operate existing water supply diversion facilities. Please refer to Appendix 3B, *Environmental*
 26 *Commitments*, for the full list of potential actions that could be taken pursuant to this commitment in
 27 order to reduce the water quality treatment costs associated with water quality effects relating to
 28 chloride, electrical conductivity, and bromide.

29 **Mitigation Measure WQ-7: Conduct Additional Evaluation and Modeling of Increased**
 30 **Chloride Levels and Develop and Implement Phased Mitigation Actions**

31 Please see Mitigation Measure WQ-7 under Impact WQ-7 in the discussion of Alternative 1A.

32 **Impact WQ-8: Effects on Chloride Concentrations Resulting from Implementation of CM2-**
 33 **CM22**

34 **NEPA Effects:** Under Alternative 8, the types and geographic extent of effects on chloride
 35 concentrations in the Delta as a result of implementation of the other conservation measures (i.e.,
 36 CM2–CM22) would be similar to, and undistinguishable from, those effects previously described for
 37 Alternative 1A. The conservation measures would present no new direct sources of chloride to the
 38 affected environment. Moreover, some habitat restoration conservation measures (CM4–10) would
 39 occur on lands within the Delta currently used for irrigated agriculture, thus replacing agricultural
 40 land uses with restored tidal wetlands, floodplain, and related channel margin and off-channel
 41 habitats. The potential reduction in irrigated lands within the Delta may result in reduced
 42 discharges of agricultural field drainage with elevated chloride concentrations, which would be
 43 considered an improvement compared to Existing Conditions and No Action Alternative conditions.

1 In summary, based on the discussion above, the effects on chloride from implementing CM2-CM22
2 are considered to be not adverse.

3 **CEQA Conclusion:** Implementation of the CM2–CM22 for Alternative 8 would not present new or
4 substantially changed sources of chloride to the affected environment upstream of the Delta, within
5 Delta, or in the SWP/CVP service area. Replacement of irrigated agricultural land uses in the Delta
6 with habitat restoration conservation measures may result in some reduction in discharge of
7 agricultural field drainage with elevated chloride concentrations, thus resulting in improved water
8 quality conditions. Based on these findings, this impact is considered to be less than significant. No
9 mitigation is required.

10 **Impact WQ-9: Effects on Dissolved Oxygen Resulting from Facilities Operations and** 11 **Maintenance (CM1)**

12 **NEPA Effects:** Effects of CM1 on dissolved oxygen under Alternative 8 are the same as those
13 discussed for Alternative 1A and are considered not to be adverse.

14 **CEQA Conclusion:** Effects of CM1 on DO under Alternative 8 would be similar to those discussed for
15 Alternative 1A, and are summarized here, then compared to the CEQA thresholds of significance
16 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this
17 constituent. For additional details on the effects assessment findings that support this CEQA impact
18 determination, see the effects assessment discussion under Alternative 1A.

19 River flow rate and reservoir storage reductions that would occur under Alternative 8, relative to
20 Existing Conditions, would not be expected to result in a substantial adverse change in DO levels in
21 the reservoirs and rivers upstream of the Delta, given that mean monthly flows would remain within
22 the ranges historically seen under Existing Conditions and the affected river are large and turbulent.
23 Any reduced DO saturation level that may be caused by increased water temperature would not be
24 expected to cause DO levels to be outside of the range seen historically. Finally, amounts of oxygen
25 demanding substances and salinity would not be expected to change sufficiently to affect DO levels.

26 It is expected there would be no substantial change in Delta DO levels in response to a shift in the
27 Delta source water percentages under this alternative or substantial degradation of these water
28 bodies, with regard to DO. DO levels would be affected by nutrient loading, which the state has
29 begun to aggressively regulate the discharges of, and this loading would not be expected to lower DO
30 levels relative to Existing Conditions based on historical DO levels. Further, the anticipated changes
31 in salinity would have relatively minor effects on DO levels, and tidal exchange, which contribute to
32 the reaeration of Delta waters would not be expected to change substantially.

33 There is not expected to be substantial, if even measurable, changes in DO levels in the SWP/CVP
34 Export Service Areas waters under Alternative 8, relative to Existing Conditions, because the
35 biochemical oxygen demand of the exported water would not be expected to substantially differ
36 from that under Existing Conditions (due to ever increasing water quality regulations), canal
37 turbulence and exposure of the water to the atmosphere and the algal communities that exist within
38 the canals would establish an equilibrium for DO levels within the canals. The same would occur in
39 downstream reservoirs.

40 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
41 objectives by frequency, magnitude, and geographic extent that would result in significant impacts
42 on any beneficial uses within affected water bodies. Because no substantial changes in DO levels are

1 expected, long-term water quality degradation would not be expected to occur, and, thus, beneficial
 2 uses would not be adversely affected. Various Delta waterways are 303(d)-listed for low DO, but
 3 because no substantial decreases in DO levels would be expected, greater degradation and DO-
 4 related impairment of these areas would not be expected. This impact would be less than significant.
 5 No mitigation is required.

6 **Impact WQ-10: Effects on Dissolved Oxygen Resulting from Implementation of CM2–CM22**

7 **NEPA Effects:** Effects of CM2–CM22 on DO under Alternative 8 are the same as those discussed for
 8 Alternative 1A and are considered not to be adverse.

9 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 8 would be similar to
 10 those proposed under Alternative 1A. As such, effects on DO resulting from the implementation of
 11 CM2–CM22 would be similar to that previously discussed for Alternative 1A. This impact is
 12 considered to be less than significant. No mitigation is required.

13 **Impact WQ-11: Effects on Electrical Conductivity Concentrations Resulting from Facilities** 14 **Operations and Maintenance (CM1)**

15 ***Upstream of the Delta***

16 For the same reasons stated for the No Action Alternative, EC levels (highs, lows, typical conditions)
 17 in the Sacramento River and its tributaries, the eastside tributaries, their associated reservoirs, and
 18 the San Joaquin River upstream of the Delta under Alternative 8 are not expected to be outside the
 19 ranges occurring under Existing Conditions or would occur under the No Action Alternative. Any
 20 minor changes in EC levels that could occur under Alternative 8 in water bodies upstream of the
 21 Delta would not be of sufficient magnitude, frequency and geographic extent that would cause
 22 adverse effects on beneficial uses or substantially degrade water quality with regard to EC.

23 ***Delta***

24 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 25 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 26 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 27 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 28 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
 29 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

30 Relative to Existing Conditions, Alternative 8 would result in an increase in the number of days the
 31 Bay-Delta WQCP EC objectives would be exceeded in the Sacramento River at Emmaton, and the San
 32 Joaquin River at Vernalis, Prisoners Point, and Brandt Bridge, and in the Old River near Middle River
 33 (Appendix 8H, Table EC-8). The percent of days the Emmaton EC objective would be exceeded for
 34 the entire period modeled (1976–1991) would increase from 6% under Existing Conditions to 16%
 35 under Alternative 8, and the percent of days out of compliance would increase from 11% under
 36 Existing Conditions to 28% under Alternative 7. The increase in the percent of days the Vernalis EC
 37 objective would be exceeded would be <1%, and the percent of days out of compliance with the EC
 38 objective would increase from 7% under Existing Conditions to 8% under Alternative 8. The percent
 39 of days the Prisoners Point EC objective would be exceeded for the entire period modeled would
 40 increase from 6% under Existing Conditions to 32% under Alternative 8, and the percent of days out
 41 of compliance with the EC objective would increase from 10% under Existing Conditions to 32%

1 under Alternative 8. In the San Joaquin River at Brandt Bridge, the percent of days exceeding the EC
2 objective would increase from 3% under Existing Conditions to 4% under Alternative 8; the percent
3 of days out of compliance would increase from 8% under Existing Conditions to 9% under
4 Alternative 8. The increase in the percent of days the Old River EC objective would be exceeded and
5 out of compliance for the entire period modeled (1976–1991) would be <1%. Average EC levels at
6 the western and southern Delta compliance locations and San Joaquin River at San Andreas Landing
7 (an interior Delta location) would decrease from 0–44% for the entire period modeled and 2–43%
8 during the drought period modeled (1987–1991) (Appendix 8H, Table EC-19). In the S. Fork
9 Mokelumne River at Terminous, average EC would increase 5% for the entire period modeled and
10 drought period modeled. Average EC in the S. Fork Mokelumne River at Terminous would increase
11 during all months (Appendix 8H, Table EC-19). Given that the western and southern Delta are Clean
12 Water Act section 303(d) listed as impaired due to elevated EC, the increase in the incidence of
13 exceedance of EC objectives under Alternative 8, relative to Existing Conditions has the potential to
14 contribute to additional impairment and potentially adversely affect beneficial uses. The comparison
15 to Existing Conditions reflects changes in EC due to both Alternative 8 operations (including north
16 Delta intake capacity of 9,000 cfs and numerous other operational components of Scenario F) and
17 climate change/sea level rise.

18 Relative to the No Action Alternative, the change in percent compliance with Bay-Delta WQCP EC
19 objectives under Alternative 8 would be similar to that described above relative to Existing
20 Conditions. The exception is that there would also be a slight increase (<1%) in the percent of days
21 the EC objective would be exceeded in the Old River at Tracy for the entire period modeled. Also, Old
22 River at Tracy also would have an increase in the number of days out of compliance with the EC
23 objectives. The percent of days out of compliance with Tracy Bridge EC objectives would increase
24 from 8% to 9% for the entire period modeled. For the entire period modeled, average EC levels
25 would increase at all Delta compliance locations relative to the No Action Alternative, except in
26 Three Mile Slough near the Sacramento River, and the San Joaquin River at San Andreas Landing and
27 Jersey Point. The greatest average EC increase would occur in the San Joaquin River at Prisoners
28 Point (7%); the increase at the other locations would be <1–6% (Appendix 8H, Table EC-19).
29 Similarly, during the drought period modeled, average EC would increase at all locations, except
30 Three Mile Slough and San Joaquin River at San Andreas Landing and Jersey Point. The greatest
31 average EC increase during the drought period modeled would occur in the S. Fork Mokelumne
32 River at Terminous (6%); the increases at the other locations would be 1–4% (Appendix 8H, Table
33 EC-19). Given that the western and southern Delta are Clean Water Act section 303(d) listed as
34 impaired due to elevated EC, the increase in the incidence of exceedance of EC objectives under
35 Alternative 7, relative to the No Action Alternative, has the potential to contribute to additional
36 impairment and potentially adversely affect beneficial uses. The comparison to the No Action
37 Alternative reflects changes in EC due only to Alternative 8 operations (including north Delta intake
38 capacity of 9,000 cfs and numerous other operational components of Scenario F).

39 For Suisun Marsh, October–May is the period when Bay-Delta WQCP EC objectives for protection of
40 fish and wildlife apply. Long-term average EC would decrease under Alternative 8, relative to
41 Existing Conditions, during October–May in the Sacramento River at Collinsville and Montezuma
42 Slough at National Steel (Appendix 8H, Table EC-21). The most substantial increase would occur
43 near Beldon Landing, with long-term average EC levels increasing by 0.1–3.5 mS/cm, depending on
44 the month (Appendix 8H, Table EC-23). Sunrise Duck Club would have long-term average EC
45 increases of 0.2–0.8 mS/cm (Appendix 8H, Table EC-24) and Volanti Slough would have long-term
46 average EC increases of 0.1–1.1 mS/cm. The degree to which the long-term average EC increases

1 would cause exceedance of Bay-Delta WQCP objectives is unknown, because objectives are
2 expressed as a monthly average of daily high tide EC, which does not have to be met if it can be
3 demonstrated “equivalent or better protection will be provided at the location” (State Water
4 Resources Control Board 2006:14). The described long-term average EC increase may, or may not,
5 contribute to adverse effects on beneficial uses, depending on how and when wetlands are flooded,
6 soil leaching cycles, and how agricultural use of water is managed, and future actions taken with
7 respect to the marsh. However, the EC increases at certain locations would be substantial and it is
8 uncertain the degree to which current management plans for the Suisun Marsh would be able to
9 address these substantially higher EC levels and protect beneficial uses. Thus, these increased EC
10 levels in Suisun Marsh are considered to have a potentially adverse effect on marsh beneficial uses.
11 Long-term average EC increases in Suisun Marsh under Alternative 8 relative to the No Action
12 Alternative would be similar to the increases relative to Existing Conditions. Suisun Marsh is section
13 303(d) listed as impaired due to elevated EC, and the potential increases in long-term average EC
14 concentrations could contribute to additional impairment relative to Existing Conditions and the No
15 Action Alternative.

16 ***SWP/CVP Export Service Areas***

17 At the Banks and Jones pumping plants, Alternative 8 would result in no exceedances of the Bay-
18 Delta WQCP’s 1,000 $\mu\text{mhos/cm}$ EC objective for the entire period modeled (Appendix 8H, Table EC-
19 10). Thus, there would be no adverse effect on the beneficial uses in the SWP/CVP Export Service
20 Areas using water pumped at this location under the Alternative 8.

21 At the Banks pumping plant, relative to Existing Conditions, average EC levels under Alternative 8
22 would decrease substantially: 49% for the entire period modeled and 53% during the drought
23 period modeled. Relative to the No Action Alternative, average EC levels would decrease by 45% for
24 the entire period modeled and 50% during the drought period modeled. (Appendix 8H, Table EC-19)

25 At the Jones pumping plant, relative to Existing Conditions, average EC levels under Alternative 8
26 would also decrease substantially: 53% for the entire period modeled and 62% during the drought
27 period modeled. Relative to the No Action Alternative, average EC levels would decrease by 51% for
28 the entire period modeled and 60% during the drought period modeled. (Appendix 8H, Table EC-19)

29 Based on the decreases in long-term average EC levels that would occur at the Banks and Jones
30 pumping plants, Alternative 8 would not cause degradation of water quality with respect to EC in
31 the SWP/CVP Export Service Areas; rather, Alternative 8 would improve long-term average EC
32 conditions in the SWP/CVP Export Service Areas.

33 Commensurate with the EC decrease in exported waters, an improvement in lower San Joaquin
34 River average EC levels would be expected since EC in the lower San Joaquin River is, in part, related
35 to irrigation water deliveries from the Delta. While the magnitude of this expected lower San
36 Joaquin River improvement in EC is difficult to predict, the relative decrease in overall loading of EC-
37 elevating constituents to the Export Service Areas would likely alleviate or lessen any expected
38 increase in EC at Vernalis related to decreased annual average San Joaquin River flows (see EC
39 impact discussion under the No Action Alternative).

40 The export area of the Delta is listed on the state’s CWA Section 303(d) list as impaired due to
41 elevated EC. Alternative 8 would result in lower average EC levels relative to Existing Conditions and
42 the No Action Alternative and, thus, would not contribute to additional beneficial use impairment
43 related to elevated EC in the SWP/CVP Export Service Areas waters.

1 **NEPA Effects:** In summary, the increased frequency of exceedance of EC objectives and increased
 2 long-term and drought period average EC levels that would occur at southern Delta compliance
 3 locations, and increased frequency of exceedance of EC objectives in the western Delta under
 4 Alternative 8, relative to the No Action Alternative, would contribute to adverse effects on the
 5 agricultural beneficial uses. In addition, the increased frequency of exceedance of the San Joaquin
 6 River at Prisoners Point EC objective and long-term and drought period average EC could contribute
 7 to adverse effects on fish and wildlife beneficial uses. Given that the western and southern Delta are
 8 Clean Water Act section 303(d) listed as impaired due to elevated EC, the increase in the incidence
 9 of exceedance of EC objectives and long-term average and drought period average EC in these
 10 portions of the Delta has the potential to contribute to additional beneficial use impairment. The
 11 increases in long-term average EC levels that would occur in Suisun Marsh would further degrade
 12 existing EC levels and could contribute additional to adverse effects on the fish and wildlife
 13 beneficial uses. Suisun Marsh is section 303(d) listed as impaired due to elevated EC, and the
 14 potential increases in long-term average EC levels could contribute to additional beneficial use
 15 impairment. These increases in EC constitute an adverse effect on water quality. Mitigation Measure
 16 WQ-11 would be available to reduce these effects (implementation of this measure along with a
 17 separate, non-environmental commitment as set forth in EIR/EIS Appendix 3B, *Environmental*
 18 *Commitments*, relating to the potential EC-related changes would reduce these effects).

19 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
 20 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
 21 purpose of making the CEQA impact determination for this constituent. For additional details on the
 22 effects assessment findings that support this CEQA impact determination, see the effects assessment
 23 discussion that immediately precedes this conclusion.

24 River flow rate and reservoir storage reductions that would occur under Alternative 8, relative to
 25 Existing Conditions, would not be expected to result in a substantial adverse change in EC levels in
 26 the reservoirs and rivers upstream of the Delta, given that: changes in the quality of watershed
 27 runoff and reservoir inflows would not be expected to occur in the future; the state's aggressive
 28 regulation of point-source discharge effects on Delta salinity-elevating parameters and the expected
 29 further regulation as salt management plans are developed; the salt-related TMDLs adopted and
 30 being developed for the San Joaquin River; and the expected improvement in lower San Joaquin
 31 River average EC levels commensurate with the lower EC of the irrigation water deliveries from the
 32 Delta.

33 Relative to Existing Conditions, Alternative 8 would not result in any substantial increases in long-
 34 term average EC levels in the SWP/CVP Export Service Areas. There would be no exceedance of the
 35 EC objective at the Jones and Banks pumping plants. Average EC levels for the entire period modeled
 36 would decrease at both plants and, thus, this alternative would not contribute to additional
 37 beneficial use impairment related to elevated EC in the SWP/CVP Export Service Areas waters.
 38 Rather, this alternative would improve long-term EC levels in the SWP/CVP Export Service Areas,
 39 relative to Existing Conditions.

40 In the Plan Area, Alternative 8 would result in an increase in the frequency with which Bay-Delta
 41 WQCP EC objectives are exceeded in the Sacramento River at Emmaton (agricultural objective; 10%
 42 increase), San Joaquin River at Vernalis (agricultural objective; <1% increase) and Brandt Bridge
 43 (agricultural objective; 1% increase), and in the Old River near Middle River (agricultural objective;
 44 <1% increase), all in the southern Delta, and Prisoners Point (fish and wildlife objective; 26%
 45 increase) in the interior Delta for the entire period modeled (1976–1991). The increased frequency

1 of exceedance of the fish and wildlife objective at Prisoners Point could contribute to adverse effects
 2 on aquatic life, and the increased frequency of the EC exceedance at Emmaton could contribute to
 3 adverse effects on agricultural uses. Because EC is not bioaccumulative, the increases in long-term
 4 average EC levels would not directly cause bioaccumulative problems in aquatic life or humans. The
 5 western and southern Delta are Clean Water Act section 303(d) listed for elevated EC and the
 6 increased frequency of exceedance of EC objectives that would occur in these portions of the Delta
 7 could make beneficial use impairment measurably worse. This impact is considered to be significant.

8 Further, relative to Existing Conditions, Alternative 8 would result in substantial increases in long-
 9 term average EC during the months of October through May in Suisun Marsh. The increases in long-
 10 term average EC levels that would occur in Suisun Marsh could further degrade existing EC levels
 11 and thus contribute additionally to adverse effects on the fish and wildlife beneficial uses. Because
 12 EC is not bioaccumulative, the increases in long-term average EC levels would not directly cause
 13 bioaccumulative problems in wildlife. Suisun Marsh is Clean Water Act section 303(d) listed for
 14 elevated EC and the increases in long-term average EC that would occur in the marsh could make
 15 beneficial use impairment measurably worse. This impact is considered to be significant.

16 Implementation of Mitigation Measure WQ-11 along with a separate, non-environmental
 17 commitment relating to the potential increased costs associated with EC-related changes would
 18 reduce these effects. While mitigation measures to reduce these water quality effects in affected
 19 water bodies to less than significant levels are not available, implementation of Mitigation Measure
 20 WQ-11 is recommended to attempt to reduce the effect that increased EC concentrations may have
 21 on Delta beneficial uses. However, because the effectiveness of this mitigation measure to result in
 22 feasible measures for reducing water quality effects is uncertain, this impact is considered to remain
 23 significant and unavoidable. Please see Mitigation Measure WQ-11 under Impact WQ-11 in the
 24 discussion of Alternative 1A.

25 In addition to and to supplement Mitigation Measure WQ-11, the BDCP proponents have
 26 incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*, a
 27 separate, non-environmental commitment to address the potential increased water treatment costs
 28 that could result from EC concentration effects on municipal, industrial and agricultural water
 29 purveyor operations. Potential options for making use of this financial commitment include funding
 30 or providing other assistance towards acquiring alternative water supplies or towards modifying
 31 existing operations when EC concentrations at a particular location reduce opportunities to operate
 32 existing water supply diversion facilities. Please refer to Appendix 3B, *Environmental Commitments*,
 33 for the full list of potential actions that could be taken pursuant to this commitment in order to
 34 reduce the water quality treatment costs associated with water quality effects relating to chloride,
 35 electrical conductivity, and bromide.

36 **Mitigation Measure WQ-11: Avoid, Minimize, or Offset, as Feasible, Reduced Water**
 37 **Quality Conditions**

38 Please see Mitigation Measure WQ-11 under Impact WQ-11 in the discussion of Alternative 1A.

39 **Impact WQ-12: Effects on Electrical Conductivity Resulting from Implementation of CM2–**
 40 **CM22**

41 **NEPA Effects:** Effects of CM2–CM22 on EC under Alternative 8 are the same as those discussed for
 42 Alternative 1A and are considered not to be adverse.

1 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 8 would be similar to
2 those proposed under Alternative 1A. As such, effects on EC resulting from the implementation of
3 CM2–CM22 would be similar to that previously discussed for Alternative 1A. This impact is
4 considered to be less than significant. No mitigation is required.

5 **Impact WQ-13: Effects on Mercury Concentrations Resulting from Facilities Operations and**
6 **Maintenance (CM1)**

7 ***Upstream of the Delta***

8 Under Alternative 8, the magnitude and timing of reservoir releases and river flows upstream of the
9 Delta in the Sacramento River watershed and east-side tributaries would be altered, relative to
10 Existing Conditions and the No Action Alternative.

11 The Sacramento River at Freeport and San Joaquin River at Vernalis (as summarized for water
12 quality average concentrations in Tables 8-48 and 8-49) were examined for flow/concentration
13 relationships for mercury and methylmercury. No significant, predictive regression relationships
14 were discovered for mercury or methylmercury, except for total mercury with flow at Freeport
15 (monthly or annual)(Figures 8I-10 through 8I-13, Appendix 8I). Such a positive relationship
16 between total mercury and flow is to be expected based on the association of mercury with
17 suspended sediment and the mobilization of sediments during storm flows. However, the changes in
18 flow in the Sacramento River under Alternative 8 relative to Existing Conditions and the No Action
19 Alternative are not of the magnitude of storm flows, in which substantial sediment-associated
20 mercury is mobilized. Therefore mercury loading should not be substantially different due to
21 changes in flow. In addition, even though it may be flow-affected, total mercury concentrations
22 remain well below criteria at upstream locations. Any negligible changes in mercury concentrations
23 that may occur in the water bodies of the affected environment located upstream of the Delta would
24 not be of frequency, magnitude, and geographic extent that would adversely affect any beneficial
25 uses or substantially degrade the quality of these water bodies as related to mercury. Both
26 waterborne methylmercury concentrations and largemouth bass fillet mercury concentrations are
27 expected to remain above guidance levels at upstream of Delta locations, but will not change
28 substantially relative to Existing Conditions or the No Action Alternative due to changes in flows
29 under Alternative 8.

30 The upstream of Delta areas in the north will benefit from the implementation of the Cache Creek,
31 Sulfur Creek, Harley Gulch, and Clear Lake Mercury TMDLs and the American River methylmercury
32 TMDL. These projects will target specific sources of mercury and methylation upstream of the Delta
33 and could result in net improvement to Delta mercury loading in the future. The implementation of
34 these projects could help to ensure that upstream of Delta environments will not be substantially
35 degraded for water quality with respect to mercury or methylmercury.

36 ***Delta***

37 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
38 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
39 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
40 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
41 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
42 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

1 The water quality impacts of waterborne concentrations of mercury and methylmercury and fish
2 tissue mercury concentrations were evaluated for 9 Delta locations. The analysis of percentage
3 change in assimilative capacity of waterborne total mercury of Alternative 8 relative to the 25 ng/L
4 ecological risk benchmark as compared to Existing Conditions showed the greatest decrease of 7%
5 for the Contra Costa Pumping Plant, and 6.9% at the same location for the No Action Alternative
6 (Figures 8-53 and 8-54). Similarly, changes in methylmercury concentration are expected to be
7 relatively small. The highest methylmercury concentration is 0.229 ng/L at the North Bay Aqueduct
8 at Barker Slough, which is about 100% greater than Existing Conditions or the No Action Alternative
9 (Appendix 8I, Figure I-9). All modeled input concentrations exceeded the methylmercury TMDL
10 guidance objective of 0.06 ng/L, therefore percentage change in assimilative capacity was not
11 evaluated for methylmercury.

12 Fish tissue estimates show more substantial percentage increases in concentration and exceedance
13 quotients for mercury at some Delta locations. The highest exceedance quotients for any modeled
14 location are predicted for the North Bay Aqueduct pump site at Barker Slough (EQ = 7.6), with an
15 increase relative to Existing Conditions, and the No Action Alternative ranging from 221 to 224% at
16 that location (Figure 8-55, Appendix 8I, Table I-15b). As mentioned above, these changes mirror and
17 enhance the pattern of increased concentrations in methylmercury projected for that location. The
18 Sacramento River at Emmaton site also shows a relatively large percentage increase in tissue
19 concentrations over Existing Conditions and the No Action Alternative (122 to 124%) and a
20 relatively elevated exceedance quotient of 4.6 (Appendix 8I, Table I-15b).

21 ***SWP/CVP Export Service Areas***

22 The analysis of mercury and methylmercury in the SWP/CVP Export Service Areas was based on
23 concentrations estimated at the Banks and Jones pumping plants. Both waterborne total and
24 methylmercury concentrations for Alternative 8 are projected to be lower than Existing Conditions
25 and the No Action Alternative at the Jones and Banks pumping plants (Appendix 8I, Figures 8I-8 and
26 8I-9). Therefore, mercury shows an increased assimilative capacity at these locations (Figures 8-53
27 and 8-54).

28 The largest improvements in bass tissue mercury concentrations and exceedance quotients for
29 Alternative 8, relative to Existing Conditions and the No Action Alternative at any location within the
30 Delta are expected for the export pump locations (specifically, at Jones Pumping plant, 27%
31 improvement relative to Existing Conditions, 31% relative to the No Action Alternative) (Figure 8-
32 55, Appendix 8I, Table I-15b).

33 ***NEPA Effects:*** Based on the above discussion, the effects of mercury and methylmercury in
34 comparison of Alternative 8 to the No Action Alternative (as waterborne and bioaccumulated forms)
35 are considered to be adverse for the case of fish tissue bioaccumulation at some locations.

36 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
37 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
38 purpose of making the CEQA impact determination for this constituent. For additional details on the
39 effects assessment findings that support this CEQA impact determination, see the effects assessment
40 discussion that immediately precedes this conclusion.

41 Under Alternative 8, greater water demands and climate change would alter the magnitude and
42 timing of reservoir releases and river flows upstream of the Delta in the Sacramento River
43 watershed and east-side tributaries, relative to Existing Conditions. Concentrations of mercury and

1 methylmercury upstream of the Delta will not be substantially different relative to Existing
2 Conditions due to the lack of important relationships between mercury/methylmercury
3 concentrations and flow for the major rivers.

4 Methylmercury concentrations exceed criteria at all locations in the Delta and no assimilative
5 capacity exists. However, monthly average waterborne concentrations of total and methylmercury,
6 over the period of record, are very similar to Existing Conditions. Estimates of fish tissue mercury
7 concentrations show substantial increases under Alternative 8, relative to Existing Conditions,
8 particularly at North Bay Aqueduct and Sacramento River at Emmaton.

9 Assessment of effects of mercury in the SWP and CVP Export Service Areas were based on effects on
10 mercury concentrations and fish tissue mercury concentrations at the Banks and Jones pumping
11 plants. The Banks and Jones pumping plants are expected to show increased assimilative capacity
12 for waterborne mercury and decreased fish tissue concentrations of mercury for Alternative 8 as
13 compared to Existing Conditions.

14 As such, this alternative is not expected to cause additional exceedance of applicable water quality
15 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
16 on any beneficial uses of waters in the affected environment. However, increases in fish tissue
17 mercury concentrations are substantial, and changes in fish tissue mercury concentrations would
18 make existing mercury-related impairment in the Delta measurably worse. In comparison to
19 Existing Conditions, Alternative 8 would increase levels of mercury by frequency, magnitude, and
20 geographic extent such that the affected environment would be expected to have measurably higher
21 body burdens of mercury in aquatic organisms, thereby substantially increasing the health risks to
22 wildlife (including fish) or humans consuming those organisms.

23 This impact is considered to be significant. Feasible or effective actions to reduce the effects on
24 mercury resulting from CM1 are unknown. General mercury management measures through CM12,
25 or actions taken by other entities or programs such as TMDL implementation, may minimize or
26 reduce sources and inputs of mercury to the Delta and methylmercury formation. However, it is
27 uncertain whether this impact would be reduced to a level that would be less than significant as a
28 result of CM12 or other future actions. Therefore, the impact would be significant and unavoidable.

29 **Impact WQ-14: Effects on Mercury Concentrations Resulting from Implementation of CM2-** 30 **CM22**

31 **NEPA Effects:** Some habitat restoration activities under Alternative 8 would occur on lands in the
32 Delta formerly used for irrigated agriculture. Tidal and other restoration proposed under
33 Alternative 8 have the potential to increase water residence times and increase accumulation of
34 organic sediments that are known to enhance methylmercury bioaccumulation in biota in the
35 restored habitat. Therefore, increases in mercury methylation in the habitat restoration areas is
36 possible but uncertain depending on the specific restoration design implemented at a particular
37 Delta location. Models to estimate the potential for methylmercury formation in restored areas are
38 not currently available. However, DSM2 modeling for Alternative 8 operations does incorporate
39 assumptions for certain habitat restoration activities proposed under CM2 and CM4 (see Section
40 8.3.1.3) that result in changes to Delta hydrodynamics compared to the No Action Alternative. These
41 modeled restoration assumptions provide some insight into potential hydrodynamic changes that
42 could be expected related to implementing CM2 and CM4 and are considered in the evaluation of the
43 potential for increased mercury and methylmercury concentrations under Alternative 8.

1 BDCP Conservation Measure 12 (CM12) addresses the potential for methylmercury bioaccumulation
 2 associated with restoration activities and acknowledges the uncertainties associated with mitigating
 3 or minimizing this potential effect. CM12 proposes project-specific mercury management plans for
 4 restoration actions that will incorporate relevant approaches recommended in Phase 1
 5 Methylmercury TMDL control studies. Specific approaches recommended under CM12 that are
 6 intended to minimize or mitigate for potential increases in methylmercury bioaccumulation at
 7 future restoration sites include:

- 8 • Characterizing mercury, methylmercury, organic carbon, iron, and sulfate concentrations to
 9 better inform restoration design,
- 10 • Sequestering methylmercury at restoration sites using low intensity chemical dosing
 11 techniques,
- 12 • Minimizing microbial methylation associated with anoxic conditions by reducing the amount of
 13 organic material at a restoration site,
- 14 • Designing restoration sites to enhance photo degeneration that converts methylmercury into a
 15 biologically unavailable, inorganic form of mercury,
- 16 • Remediating restoration site soils with iron to reduce methylation in sulfide rich soils, and
- 17 • Considering capping mercury laden sediments, where possible to reduce methylation potential
 18 at a site.

19 Because of the uncertainties associated with site-specific estimates of methylmercury
 20 concentrations and the uncertainties in source modeling and tissue modeling, the effectiveness of
 21 methylmercury management proposed under CM12 to reduce methylmercury concentrations would
 22 need to be evaluated separately for each restoration effort, as part of design and implementation.
 23 Because of this uncertainty and the known potential for methylmercury creation in the Delta this
 24 potential effect of implementing CM2–CM22 is considered adverse.

25 **CEQA Conclusion:** There would be no substantial, long-term increase in mercury or methylmercury
 26 concentrations or loads in the rivers and reservoirs upstream of the Delta or the waters exported to
 27 the CVP and SWP service areas due to implementation of CM2–CM22 relative to Existing Conditions.
 28 However, uptake of mercury from water and/or methylation of inorganic mercury may increase to
 29 an unquantified degree as part of the creation of new, marshy, shallow, or organic-rich restoration
 30 areas. Methylmercury is 303(d)-listed within the affected environment, and therefore any potential
 31 measurable increase in methylmercury concentrations would make existing mercury-related
 32 impairment measurably worse. Because mercury is bioaccumulative, increases in water-borne
 33 mercury or methylmercury that could occur in some areas could bioaccumulate to somewhat
 34 greater levels in aquatic organisms and would, in turn, pose health risks to fish, wildlife, or humans.
 35 Design of restoration sites under Alternative 8 would be guided by CM12 which requires
 36 development of site specific mercury management plans as restoration actions are implemented.
 37 The effectiveness of minimization and mitigation actions implemented according to the mercury
 38 management plans is not known at this time although the potential to reduce methylmercury
 39 concentrations exists based on current research. Although the BDCP will implement CM12 with the
 40 goal to reduce this potential effect the uncertainties related to site specific restoration conditions
 41 and the potential for increases in methylmercury concentrations in the Delta result in this potential
 42 impact being considered significant. No mitigation measures would be available until specific
 43 restoration actions are proposed. Therefore this programmatic impact is considered significant and
 44 unavoidable.

1 **Impact WQ-15: Effects on Nitrate Concentrations Resulting from Facilities Operations and**
2 **Maintenance (CM1)**

3 ***Upstream of the Delta***

4 For the same reasons stated for the No Action Alternative, Alternative 8 would have negligible, if
5 any, impact on nitrate concentrations in the rivers and reservoirs upstream of the Delta in the
6 Sacramento River watershed relative to Existing Conditions and the No Action Alternative.

7 Under Alternative 8, modeling indicates that long-term annual average flows on the San Joaquin
8 River would decrease by an estimated 6%, relative to Existing Conditions, and would remain
9 virtually the same relative to No Action (Appendix 5A). Given these relatively small decreases in
10 flows and the weak correlation between nitrate and flows in the San Joaquin River (see Nitrate
11 Appendix 8J, Figure 2), it is expected that nitrate concentrations in the San Joaquin River would be
12 minimally affected, if at all, by changes in flow rates under Alternative 8.

13 Any negligible changes in nitrate-N concentrations that may occur in the water bodies of the affected
14 environment located upstream of the Delta would not be of frequency, magnitude and geographic
15 extent that would adversely affect any beneficial uses or substantially degrade the quality of these
16 water bodies, with regards to nitrate.

17 ***Delta***

18 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
19 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
20 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
21 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
22 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
23 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

24 Results of the mixing calculations indicate that under Alternative 8, relative to Existing Conditions
25 and the No Action Alternative, nitrate concentrations throughout the Delta are anticipated to remain
26 low (<1.4 mg/L-N) relative to adopted objectives (Nitrate Appendix 8J, Table 28 and 29). Long-term
27 average nitrate concentrations are anticipated to increase at most locations in the Delta. The
28 increase would be greatest at Franks Tract, Old River at Rock Slough, and Contra Costa Pumping
29 Plant #1 (all >85% increase). Long-term average concentrations were estimated to increase to 0.68,
30 1.06 and 1.13 mg/L-N for Franks Tract, Old River at Rock Slough, and Contra Costa Pumping Plant
31 #1, respectively, due primarily to increased San Joaquin River water percentage at these locations
32 (see Fingerprinting Appendix 8D). Although changes at specific Delta locations and for specific
33 months may be substantial on a relative basis, the absolute concentration of nitrate in Delta waters
34 would remain low (<1.4 mg/L-N) in relation to the drinking water MCL of 10 mg/L-N, as well as all
35 other thresholds identified in Table 8-50. No additional exceedances of the MCL are anticipated at
36 any location (Nitrate Appendix 8J, Table 28). On a monthly average basis and on a long term annual
37 average basis, for all modeled years and for the drought period (1987–1991) only, use of
38 assimilative capacity available under Existing Conditions and the No Action Alternative, relative to
39 the drinking water MCL of 10 mg/L-N, was up to approximately 13% at Old River at Rock Slough
40 and Contra Costa Pumping Plant #1, and averaged approximately 6% on a long-term average basis
41 (Nitrate Appendix 8J, Table 30). Similarly, the use of available assimilative capacity at Franks Tract
42 was up to approximately 6%, and averaged 3% over the long term. The concentrations estimated for
43 these locations would not increase the likelihood of exceeding the 10 mg/L-N MCL, nor would they

1 increase the risk for adverse effects to beneficial uses. At all other locations, use of assimilative
2 capacity was negligible (<5%) (Nitrate Appendix 8J, Table 30).

3 Nitrate concentrations will likely be higher than the modeling results indicate in certain locations.
4 This includes in the Sacramento River between Freeport and Mallard Island and other areas in the
5 Delta downstream of Freeport that are influenced by Sacramento River water. These increases are
6 associated with ammonia and nitrate that are discharged from the SRWTP, which are not included in
7 the modeling.

- 8 • Under Existing Conditions, most of the ammonia discharged from the SRWTP is converted to
9 nitrate downstream of the facility's discharge at Freeport, and thus, nitrate concentrations
10 under Existing Conditions in these areas are expected to be higher than the modeling
11 predicts, the increase becoming greater with increasing distance downstream. However, the
12 increase in nitrate concentrations downstream of the SRWTP is expected to be small—the
13 existing increase appears to be from approximately 0.1 mg/L-N to approximately 0.4–0.5
14 mg/L-N over this reach, due to approximately a 1:1 conversion of ammonia-N to nitrate-N
15 (Central Valley Water Board 2010a:32).
- 16 • Under Alternative 8, the planned upgrades to the SRWTP, which include nitrification/partial
17 denitrification, would substantially decrease ammonia concentrations in the discharge, but
18 would increase nitrate concentrations in the discharge up to 10 mg/L-N, which is
19 substantially higher than under Existing Conditions.
- 20 • Overall, under Alternative 8, the nitrogen load from the SRWTP discharge is expected to
21 decrease (by up to 50%), relative to Existing Conditions, due to nitrification/partial
22 denitrification upgrades at the SRWTP facility. Thus, while concentrations of nitrate
23 downstream of the facility are expected to be higher than modeling results indicate for both
24 Existing Conditions and Alternative 8, the increase is expected to be greater under Existing
25 Conditions than for Alternative 8 due to the upgrades that are assumed under Alternative 8.

26 The other areas in which nitrate concentrations will be higher than the modeling results indicate are
27 immediately downstream of other wastewater treatment plants that practice nitrification, but not
28 denitrification (e.g., City of Rio Vista Beach WWTF, Town of Discovery Bay WWTF, City of Stockton
29 RWCF). For all such facilities in the Delta, the Regional Water Boards have issued NPDES permits
30 that allow discharge of wastewater containing nitrate into the Delta, and under these permits, the
31 State has determined that no beneficial uses are adversely affected by the discharge, and that the
32 discharger's use of available assimilative capacity of the water body is acceptable. When dilution is
33 necessary in order for the discharge to be in compliance with the Basin Plans (which incorporate the
34 10 mg/L-N MCL by reference), not all of the assimilative capacity of the receiving water is granted to
35 the discharger. Thus, limited decreases in flows are not anticipated to result in systemic
36 exceedances of the MCLs by these POTWs. Furthermore, NPDES permits are renewed on a 5-year
37 basis, and thus, if under changes in flows, dilution was no longer sufficient to maintain nitrate below
38 the MCL in the receiving water, the NPDES permit renewal process would address such cases.

39 Therefore, any increases in nitrate-N concentrations that may occur at certain locations within the
40 Delta would not be of frequency, magnitude and geographic extent that would adversely affect any
41 beneficial uses or substantially degrade the water quality at these locations, with regards to nitrate.

1 **SWP/CVP Export Service Areas**

2 Assessment of effects of nitrate in the SWP and CVP Export Service Areas is based on effects on
3 nitrate-N at the Banks and Jones pumping plants.

4 Results of the mixing calculations indicate that under Alternative 8, relative to Existing Conditions
5 and the No Action Alternative, nitrate concentrations at Banks and Jones pumping plants are
6 anticipated to decrease on a long-term average annual basis (Nitrate Appendix 8J, Table 28 and 29).
7 During the late summer, particularly in the drought period assessed, concentrations are expected to
8 increase substantially on a relative basis (i.e., >50%), but the absolute value of these changes (i.e., in
9 mg/L-N) is small. Additionally, given the many factors that contribute to potential algal blooms in
10 the SWP and CVP canals within the Export Service Area, and the lack of studies that have shown a
11 direct relationship between nutrient concentrations in the canals and reservoirs and problematic
12 algal blooms in these water bodies, there is no basis to conclude that these small (i.e., generally <0.5
13 mg/L-N), seasonal increases in nitrate concentrations would increase the potential for problem algal
14 blooms in the SWP and CVP Export Service Area. No additional exceedances of the MCL are
15 anticipated (Nitrate Appendix 8J, Table 28). On a monthly average basis and on a long term annual
16 average basis, for all modeled years and for the drought period (1987–1991) only, use of
17 assimilative capacity available under Existing Conditions and the No Action Alternative, relative to
18 the 10 mg/L-N MCL, was negligible for both Banks and Jones pumping plants (Nitrate Appendix 8J,
19 Table 30).

20 Any increases in nitrate-N concentrations that may occur in water exported via Banks and Jones
21 pumping plants are not expected to result in adverse effects to beneficial uses or substantially
22 degrade the quality of exported water, with regards to nitrate.

23 **NEPA Effects:** In summary, based on the discussion above, the effects on nitrate from implementing
24 CM1 are considered to be not adverse.

25 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
26 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
27 purpose of making the CEQA impact determination for this constituent. For additional details on the
28 effects assessment findings that support this CEQA impact determination, see the effects assessment
29 discussion that immediately precedes this conclusion.

30 Nitrate-N concentrations are generally low in the reservoirs and rivers of the watersheds, owing to
31 substantial dilution available for point sources and the lack of substantial nonpoint sources of
32 nitrate-N upstream of the SRWTP in the Sacramento River watershed, and in the watersheds of the
33 eastern tributaries (Cosumnes, Mokelumne, and Calaveras Rivers). Although higher in the San
34 Joaquin River watershed, nitrate-N concentrations are not well-correlated with flow rates.
35 Consequently, any modified reservoir operations and subsequent changes in river flows under
36 Alternative 8, relative to Existing Conditions, are expected to have negligible, if any, effects on
37 reservoir and river nitrate-N concentrations upstream of Freeport in the Sacramento River
38 watershed and upstream of the Delta in the San Joaquin River watershed.

39 In the Delta, results of the mixing calculations indicate that under Alternative 8, relative to Existing
40 Conditions, long-term average nitrate concentrations are anticipated to increase at most locations.
41 The increase would be greatest at Franks Tract, Old River at Rock Slough, and Contra Costa Pumping
42 Plant #1 (all >85% increase), due primarily to increased San Joaquin River water percentage at
43 these locations. However, nitrate concentrations throughout the Delta are anticipated to remain low

1 (<1.4 mg/L-N) relative to adopted objectives, and no additional exceedances of the MCL are
 2 anticipated at any location. Use of assimilative capacity at locations throughout the Delta (up to
 3 13%) did not result in concentrations that would increase the likelihood of exceeding the 10 mg/L-N
 4 MCL, nor would they increase the risk for adverse effects to beneficial uses.

5 Assessment of effects of nitrate in the SWP and CVP Export Service Areas is based on effects on
 6 nitrate-N concentrations at the Banks and Jones pumping plants. Results of the mixing calculations
 7 indicate that under Alternative 8, relative to Existing Conditions, long-term average nitrate
 8 concentrations at Banks and Jones pumping plants are anticipated to decrease. No additional
 9 exceedances of the MCL are anticipated. Monthly average use of assimilative capacity available
 10 under Existing Conditions, relative to the MCL, for both Banks and Jones pumping plants in drought
 11 conditions was at times >50%, but the absolute value of these changes (i.e., in mg/L-N) was small.
 12 Additionally, given the many factors that contribute to potential algal blooms in the SWP and CVP
 13 canals within the Export Service Area, and the lack of studies that have shown a direct relationship
 14 between nutrient concentrations in the canals and reservoirs and problematic algal blooms in these
 15 water bodies, there is no basis to conclude that these small (i.e., generally <0.3 mg/L-N), seasonal
 16 increases in nitrate concentrations would increase the potential for problem algal blooms in the
 17 SWP and CVP Export Service Area.

18 Based on the above, this alternative is not expected to cause additional exceedance of applicable
 19 water quality objectives/criteria by frequency, magnitude, and geographic extent that would cause
 20 adverse effects on any beneficial uses of waters in the affected environment. No long-term water
 21 quality degradation is expected to occur such that exceedance of criteria is more likely or such that
 22 there is an increased risk of adverse impacts to beneficial uses. Nitrate is not 303(d) listed within
 23 the affected environment and thus any increases that may occur in some areas and months would
 24 not make any existing nitrate-related impairment measurably worse because no such impairments
 25 currently exist. Because nitrate is not bioaccumulative, increases that may occur in some areas and
 26 months would not bioaccumulate to greater levels in aquatic organisms that would, in turn, pose
 27 substantial health risks to fish, wildlife, or humans. This impact is considered to be less than
 28 significant. No mitigation is required.

29 **Impact WQ-16: Effects on Nitrate Concentrations Resulting from Implementation of CM2- 30 CM22**

31 **NEPA Effects:** Effects of CM2-CM22 on nitrate under Alternative 8 are the same as those discussed
 32 for Alternative 1A and are considered not to be adverse.

33 **CEQA Conclusion:** Conservation Measures 2-22 proposed under Alternative 8 would be similar to
 34 those proposed under Alternative 1A. As such, effects on nitrate resulting from the implementation
 35 of CM2-CM22 would be similar to that previously discussed for Alternative 1A. This impact is
 36 considered to be less than significant. No mitigation is required.

37 **Impact WQ-17: Effects on Dissolved Organic Carbon Concentrations Resulting from Facilities 38 Operations and Maintenance (CM1)**

39 ***Upstream of the Delta***

40 Under Alternative 8, there would be no substantial change to the sources of DOC within the
 41 watersheds upstream of the Delta. Moreover, long-term average flow and DOC levels in the
 42 Sacramento River at Hood and San Joaquin River at Vernalis are poorly correlated. Thus changes in

1 system operations and resulting reservoir storage levels and river flows would not be expected to
2 cause a substantial long-term change in DOC concentrations in the water bodies upstream of the
3 Delta. Any negligible changes in DOC levels in water bodies upstream of the Delta under
4 Alternative 8, relative to Existing Conditions and the No Action Alternative, would not be of
5 sufficient frequency, magnitude and geographic extent that would adversely affect any beneficial
6 uses or substantially degrade the quality of these water bodies, with regards to DOC.

7 **Delta**

8 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
9 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
10 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
11 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
12 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
13 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

14 Under Alternative 8 relative to Existing Conditions, the geographic extent of effects pertaining to
15 long-term average DOC concentrations in the Delta would be similar to that previously described for
16 Alternative 1A, although the magnitude of predicted long-term increase and relative frequency of
17 concentration threshold exceedances would be substantially greater. Modeled effects would be
18 greatest at Franks Tract, Rock Slough, and Contra Costa PP No. 1., where for the 16-year hydrologic
19 period and the modeled drought period, long-term average concentration increases ranging from
20 0.7–1.1 mg/L would be predicted ($\leq 32\%$ net increase), resulting in long-term average DOC
21 concentrations greater than 4 mg/L at Rock Slough and Contra Costa PP No. 1 (Appendix 8K, DOC
22 Table 9). Increases in long-term average concentrations would correspond to more frequent
23 concentration threshold exceedances, with the greatest change occurring at Rock Slough and Contra
24 Costa PP No. 1 locations. For Rock Slough, long-term average DOC concentrations exceeding 3 mg/L
25 would increase from 52% under Existing Conditions to 90% under the Alternative 8 (an increase
26 from 47% to 88% for the drought period), and concentrations exceeding 4 mg/L would increase
27 from 30% to 48% (32% to 57% for the drought period). For Contra Costa PP No. 1, long-term
28 average DOC concentrations exceeding 3 mg/L would increase from 52% under Existing Conditions
29 to 93% under Alternative 8 (45% to 95% for the drought period), and concentrations exceeding 4
30 mg/L would increase from 32% to 55% (35% to 60% for the drought period). Relative change in
31 frequency of threshold exceedance for other assessment locations would be similar or less. This
32 comparison to Existing Conditions reflects changes in DOC due to both Alternative 8 operations
33 (including north Delta intake capacity of 9,000 cfs and numerous other operational components of
34 Scenario F) and climate change/sea level rise.

35 In comparison, Alternative 8 relative to the No Action Alternative would generally result in a similar
36 magnitude of change to that discussed for the comparison to Existing Conditions. Maximum
37 increases of 0.7–1.0 mg/L DOC (i.e., $\leq 27\%$) would be predicted at Franks Tract, Rock Slough, and
38 Contra Costa PP No. 1 relative to No Action Alternative (Appendix 8K, DOC Table 9). Threshold
39 concentration exceedance frequency trends would also be similar to that discussed for the existing
40 condition comparison, with exception to the predicted 4 mg/L exceedance frequency at Buckley
41 Cove. In comparison to the No Action Alternative, the frequency which long-term average DOC
42 concentrations exceeded 4 mg/L at Buckley Cove would increase from 27% to 32% (42% to 58% for
43 the modeled drought period). Unlike the comparison to Existing Conditions, this comparison to the
44 No Action Alternative reflects changes in DOC due only to Alternative 8 operations.

1 The increases in long-term average DOC concentrations estimated to occur at Franks Tract, Rock
 2 Slough, and Contra Costa PP No. 1 are considered substantial and could potentially trigger
 3 significant changes in drinking water treatment plant design or operations. In particular, assessment
 4 locations at Rock Slough and Contra Costa PP No. 1 represent municipal intakes servicing existing
 5 drinking water treatment plants. Under Alternative 8, drinking water treatment plants obtaining
 6 water from these interior Delta locations would likely need to upgrade existing treatment systems in
 7 order to achieve EPA Stage 1 Disinfectants and Disinfection Byproduct Rule action thresholds. While
 8 treatment technologies sufficient to achieve the necessary DOC removals exist, implementation of
 9 such technologies would likely require substantial investment in new or modified infrastructure.

10 Relative to existing and No Action Alternative conditions, Alternative 8 would lead to predicted
 11 improvements in long-term average DOC concentrations at Barker Slough, as well as Banks and
 12 Jones pumping plants (discussed below). Predicted long-term average DOC concentrations at Barker
 13 Slough would decrease ≤ 0.1 mg/L, depending on baseline conditions comparison and modeling
 14 period.

15 ***SWP/CVP Export Service Areas***

16 Under Alternative 8, modeled long-term average DOC concentrations would decrease at Banks and
 17 Jones pumping plants for both the modeled 16-year hydrologic period and the modeled drought
 18 period. Modeled decreases would generally be similar between Existing Conditions and the No
 19 Action Alternative. Relative to Existing Conditions, long-term average DOC concentrations at Banks
 20 would be predicted to decrease by 1.0 mg/L (1.2 mg/L during drought period) (Appendix 8K, DOC
 21 Table 9). At Jones, long-term average DOC concentrations would be predicted to decrease by 1.0
 22 mg/L (1.1 mg/L during drought period). Such substantial improvement in long-term average DOC
 23 concentrations would include fewer exceedances of concentration thresholds. Average DOC
 24 concentrations exceeding the 2 mg/L concentration threshold would decrease from 100% under
 25 Existing Conditions and the No Action Alternative to 63% at Banks and 61% at Jones under
 26 Alternative 8 (62% and 57%, respectively during the drought period), while concentrations
 27 exceeding 4 mg/L would nearly be eliminated (i.e., $\leq 17\%$ exceedance frequency). Such modeled
 28 improvement would correspond to substantial improvement in Export Service Areas water quality,
 29 respective to DOC.

30 Similar to the discussion pertaining to the No Action Alternative, maintenance of SWP and CVP
 31 facilities under Alternative 8 would not be expected to create new sources of DOC or contribute
 32 towards a substantial change in existing sources of DOC in the affected area. Maintenance activities
 33 would not be expected to cause any substantial change in long-term average DOC concentrations
 34 such that MUN beneficial uses, or any other beneficial use, would be adversely affected.

35 ***NEPA Effects:*** In summary, Alternative 8, relative to the No Action Alternative, would not cause a
 36 substantial long-term change in DOC concentrations in the water bodies upstream of the Delta.
 37 Long-term average DOC concentrations at Banks and Jones pumping plants are predicted to
 38 decrease by as much as 1.3 mg/L, while long-term average DOC concentrations for some Delta
 39 interior locations, including Franks Tract, Rock Slough and Contra Costa PP #1, are predicted to
 40 increase by as much as 1.0 mg/L. Resultant substantial changes in long-term average DOC at these
 41 Delta interior locations could necessitate changes in water treatment plant operations or require
 42 treatment plant upgrades in order to maintain DBP compliance, and thus would constitute an
 43 adverse effect on water quality and MUN beneficial uses. Mitigation Measure WQ-17 is available to
 44 reduce these effects.

1 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
2 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
3 purpose of making the CEQA impact determination for this constituent. For additional details on the
4 effects assessment findings that support this CEQA impact determination, see the effects assessment
5 discussion that immediately precedes this conclusion.

6 While greater water demands under the Alternative 8 would alter the magnitude and timing of
7 reservoir releases north, south and east of the Delta, these activities would have no substantial effect
8 on the various watershed sources of DOC. Moreover, long-term average flow and DOC at Sacramento
9 River at Hood and San Joaquin River at Vernalis are poorly correlated; therefore, changes in river
10 flows would not be expected to cause a substantial long-term change in DOC concentrations
11 upstream of the Delta.

12 Relative to Existing Conditions, Alternative 8 would result in substantial increases (i.e., 0.7–1.1
13 mg/L) in long-term average DOC concentrations at some Delta interior locations, and would be
14 greatest at Franks Tract, Rock Slough, and Contra Costa PP No. 1. At these locations the predicted
15 changes in DOC would substantially increase the frequency with which long-term average
16 concentrations exceeds 2, 3, or 4 mg/L. Drinking water treatment plants obtaining water from these
17 interior Delta locations would likely need to upgrade existing treatment systems in order to achieve
18 EPA Stage 1 Disinfectants and Disinfection Byproduct Rule action thresholds. Such predicted
19 magnitude change in long-term average DOC concentrations would represent a substantially
20 increased risk for adverse effects on existing MUN beneficial.

21 The assessment of Alternative 8 effects on DOC in the SWP/CVP Export Service Areas is based on
22 assessment of changes in DOC concentrations at Banks and Jones pumping plants. Relative to the
23 existing condition, long-term average DOC concentrations would decrease by as much as 1.2 mg/L at
24 Banks and Jones pumping plants. The frequency with which long-term average DOC concentrations
25 would exceed 2, 3, or 4 mg/L would be substantially reduced, where predicted exceedances of >4
26 mg/L would be nearly eliminated (i.e., ≤17% exceedance frequency). As a result, substantial
27 improvement in DOC-related water quality would be predicted in the SWP/CVP Export Service
28 Areas.

29 Based on the above, Alternative 8 operation and maintenance would not result in any substantial
30 change in long-term average DOC concentration upstream of the Delta. Furthermore, under
31 Alternative 8, water exported from the Delta to the SWP/CVP service area would be substantially
32 improved relative to DOC. DOC is not bioaccumulative, therefore change in long-term average DOC
33 concentrations would not directly cause bioaccumulative problems in aquatic life or humans.
34 Additionally, DOC is not a constituent related to any 303(d) listings. Nevertheless, new and modified
35 conveyance facilities proposed under Alternative 8 would result in a substantial increase in long-
36 term average DOC concentrations (i.e., 0.7–1.1 mg/L, equivalent to ≤32% relative increase) at
37 Franks Tract, Rock Slough, and Contra Costa PP No. 1. In particular, under Alternative 8, model
38 predicted long-term average DOC concentrations would be greater than 4 mg/L at Rock Slough and
39 Contra Costa PP No. 1 with commensurate substantial increases in the frequency with which
40 average DOC concentrations exceed 2, 3, and 4 mg/L levels. Drinking water treatment plants
41 obtaining water from these interior Delta locations would likely need to upgrade existing treatment
42 systems in order to achieve EPA Stage 1 Disinfectants and Disinfection Byproduct Rule action
43 thresholds. Therefore, such a magnitude change in long-term average DOC concentrations would
44 represent a substantially increased risk for adverse effects on existing MUN beneficial uses at Rock
45 Slough and Contra Costa PP No. 1 should such treatment upgrades not be undertaken. The impact is

1 considered significant and mitigation is required. While Mitigation Measure WQ-17 is available to
 2 partially reduce this impact of DOC, the feasibility and effectiveness of this mitigation measure is
 3 uncertain and implementation would not necessarily reduce the identified impact to a level that
 4 would be less than significant, and therefore it is significant and unavoidable.

5 **Mitigation Measure WQ-17: Consult with Delta Water Purveyors to Identify Means to**
 6 **Avoid, Minimize, or Offset Increases in Long-Term Average DOC Concentrations**

7 Please see Mitigation Measure WQ-17 under Impact WQ-17 in the discussion of Alternative 6A.

8 **Impact WQ-18: Effects on Dissolved Organic Carbon Concentrations Resulting from**
 9 **Implementation of CM2–CM22**

10 **NEPA Effects:** Conservation Measures 2–22 under Alternative 8 would be similar to those under
 11 Alternative 1A. Effects on DOC resulting from the implementation of CM2–CM22 would be similar to
 12 that previously discussed for Alternative 1A. In total, CM4–CM7 and CM10 could contribute
 13 substantial amounts of DOC to raw drinking water supplies, largely depending on final design and
 14 operational criteria for the related restoration activities. Substantially increased long-term average
 15 DOC in raw water supplies could lead to a need for treatment plant upgrades in order to
 16 appropriately manage DBP formation in treated drinking water. This potential for future DOC
 17 increases would lead to substantially greater associated risk of long-term adverse effects on the
 18 MUN beneficial use.

19 In summary, the habitat restoration elements of CM4–CM7 and CM10 under Alternative 8 would
 20 present new localized sources of DOC to the study area, and in some circumstances would substitute
 21 for existing sources related to replaced agriculture. Depending on localized hydrodynamics and
 22 proximity to municipal drinking water intakes, such restoration activities could contribute
 23 substantial amounts of DOC to municipal raw water. Substantial increases in municipal raw water
 24 DOC could necessitate changes in water treatment plant operations or require treatment plant
 25 upgrades in order to maintain DBP compliance, and thus would constitute an adverse effect on
 26 water quality. Mitigation Measure WQ-18 is available to reduce these effects.

27 **CEQA Conclusion:** Effects of CM4–CM7 and CM10 on DOC under Alternative 8 are similar to, and
 28 possibly greater than, those discussed for Alternative 1A. Similar to the discussion for Alternative
 29 1A, this impact is considered to be significant. It is uncertain whether implementation of Mitigation
 30 Measure WQ-18 would reduce identified impacts to a less-than-significant level. Hence, this impact
 31 remains significant and unavoidable.

32 In addition to and to supplement Mitigation Measure WQ-18, the BDCP proponents have
 33 incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*, a
 34 separate, non-environmental commitment to address the potential increased water treatment costs
 35 that could result from DOC concentration effects on municipal and industrial water purveyor
 36 operations. Potential options for making use of this financial commitment include funding or
 37 providing other assistance towards implementing treatment for DOC and/or DBPs or DOC source
 38 control strategies. Please refer to Appendix 3B, *Environmental Commitments*, for the full list of
 39 potential actions that could be taken pursuant to this commitment in order to reduce the water
 40 quality treatment costs associated with water quality effects relating to DOC.

1 **Mitigation Measure WQ-18: Design Wetland and Riparian Habitat Features to Minimize**
2 **Effects on Municipal Intakes**

3 Please see Mitigation Measure WQ-18 under Impact WQ-18 in the discussion of Alternative 1A.

4 **Impact WQ-19: Effects on Pathogens Resulting from Facilities Operations and Maintenance**
5 **(CM1)**

6 **NEPA Effects:** Effects of CM1 on pathogens under Alternative 8 are the same as those discussed for
7 Alternative 1A and are considered to not be adverse.

8 **CEQA Conclusion:** Effects of CM1 on pathogens under Alternative 8 are the same as those discussed
9 for Alternative 1A, and are summarized here, then compared to the CEQA thresholds of significance
10 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this
11 constituent. For additional details on the effects assessment findings that support this CEQA impact
12 determination, see the effects assessment discussion under Alternative 1A.

13 River flow rate and reservoir storage reductions that would occur due to implementation of CM1
14 (water facilities and operations) under Alternative 8, relative to Existing Conditions, would not be
15 expected to result in a substantial adverse change in pathogen concentrations in the reservoirs and
16 rivers upstream of the Delta, given the small magnitude of urban runoff contributions relative to the
17 magnitude of river flows, that pathogen concentrations in the rivers have a minimal relationship to
18 river flow rate, and the expected reduced pollutant loadings in response to NPDES stormwater-
19 related regulations.

20 It is expected there would be no substantial change in Delta pathogen concentrations in response to
21 a shift in the Delta source water percentages under this alternative or substantial degradation of
22 these water bodies, with regard to pathogens. This conclusion is based on the Pathogens Conceptual
23 Model, which found that pathogen sources in close proximity to a Delta site appear to have the
24 greatest influence on pathogen levels at the site, rather than the primary source(s) of water to the
25 site. In-Delta potential pathogen sources, including water-based recreation, tidal habitat, wildlife,
26 and livestock-related uses, would continue under this alternative.

27 In the SWP/CVP Export Service Areas waters, relative to Existing Conditions, an increased
28 proportion of water coming from the Sacramento River would not adversely affect beneficial uses in
29 the SWP/CVP Export Service Areas. The pathogen levels in the Sacramento River are similar to or
30 lower than the water diverted at the Delta export pumps. Further, it is localized sources of
31 pathogens that appear to have the greatest influence on concentrations. Thus, an increased
32 proportion of Sacramento River water diverted to the SWP/CVP Export Service Areas would result
33 in minimal changes in pathogen levels in the SWP/CVP Export Service Areas waters.

34 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
35 objectives by frequency, magnitude, and geographic extent that would cause adverse effects on any
36 beneficial uses of waters in the affected environment. Because pathogen concentrations are not
37 expected to increase substantially, no long-term water quality degradation for pathogens is
38 expected to occur and, thus, no adverse effects on beneficial uses would occur. The San Joaquin
39 River in the Stockton Deep Water Ship Channel is Clean Water Act section 303(d) listed for
40 pathogens. Because no measurable increase in Deep Water Ship Channel pathogen concentrations
41 are expected to occur on a long-term basis, further degradation and impairment of this area is not

1 expected to occur. Finally, pathogens are not bioaccumulative constituents. This impact is
2 considered to be less than significant. No mitigation is required.

3 **Impact WQ-20: Effects on Pathogens Resulting from Implementation of CM2–CM22**

4 **NEPA Effects:** Effects of CM2–CM22 on pathogens under Alternative 8 are the same as those
5 discussed for Alternative 1A and are considered to not be adverse.

6 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 8 would be similar to
7 those proposed under Alternative 1A. As such, effects on pathogens resulting from the
8 implementation of CM2–CM22 would be similar to that previously discussed for Alternative 1A. This
9 impact is considered to be less than significant. No mitigation is required.

10 **Impact WQ-21: Effects on Pesticide Concentrations Resulting from Facilities Operations and** 11 **Maintenance (CM1)**

12 ***Upstream of the Delta***

13 For the same reasons stated for the No Action Alternative, under Alternative 8 no specific operations
14 or maintenance activity of the SWP or CVP would substantially drive a change in pesticide use, and
15 thus pesticide sources would remain unaffected upstream of the Delta. Nevertheless, changes in the
16 timing and magnitude of reservoir releases could have an effect on available dilution capacity along
17 river segments such as the Sacramento, Feather, American, and San Joaquin Rivers.

18 Under Alternative 8, winter (November–March) and summer (April–October) season average flow
19 rates on the Sacramento River at Freeport, American River at Nimbus, Feather River at Thermalito
20 and the San Joaquin River at Vernalis would change. Relative to existing condition and the No Action
21 Alternative, seasonal average flow rates on the Sacramento would decrease no more than 8% during
22 the summer and 1% during the winter (Appendix 8L, Seasonal average flows Tables 1-4). On the
23 Feather River, average flow rates would decrease no more than 18% during the summer, but would
24 increase as much as 30% in the winter. American River average flow rates would decrease by as
25 much as 15% in the summer but would increase by as much as 5% in the winter. Seasonal average
26 flow rates on the San Joaquin River would decrease by as much as 12% in the summer, but increase
27 by as much as 1% in the winter. For the same reasons stated for the No Action Alternative,
28 decreased seasonal average flow of $\leq 18\%$ is not considered to be of sufficient magnitude to
29 substantially increase pesticide concentrations or alter the long-term risk of pesticide-related
30 toxicity to aquatic life, nor adversely affect other beneficial uses of water bodies upstream of the
31 Delta.

32 ***Delta***

33 Sources of diuron, OP and pyrethroid insecticides to the Plan Area include direct input of surface
34 runoff from in-Delta agriculture and Delta urbanized areas as well as inputs from rivers upstream of
35 the Delta. Similar to Upstream of the Delta, CVP/SWP operations would not affect these sources.

36 Under Alternative 8, the distribution and mixing of Delta source waters would change. Percent
37 change in monthly average source water fraction were evaluated for the modeled 16-year (1976–
38 1991) hydrologic period and a representative drought period (1987–1991), with special attention
39 given to changes in San Joaquin River, Sacramento River and Delta Agriculture sources water
40 fractions. Relative to Existing Conditions, under Alternative 8 modeled San Joaquin River fractions
41 would increase greater than 10% at Franks Tract, Rock Slough, Contra Costa PP No. 1, and the San

1 Joaquin River at Antioch (Appendix 8D, Source Water Fingerprinting). At Antioch, San Joaquin River
2 source water fractions when modeled for the 16-year hydrologic period would increase by 11–14%
3 from November through May (no increase >10% for the modeled drought period). While this change
4 at Antioch is not considered substantial, changes in San Joaquin River source water fraction in the
5 Delta interior would be considerable. At Franks Tract, San Joaquin River source water fractions
6 would increase between 18–29% for October through June (11–25% for November through June of
7 the modeled drought period). Changes at Rock Slough and Contra Costa PP No. 1 would be very
8 similar, where modeled San Joaquin River source water fractions would increase from 28–72% (15–
9 71% for the modeled drought period) for October through June. Relative to Existing Conditions,
10 there would be no modeled increases in Sacramento River fractions greater than 15% (with
11 exception to Banks and Jones which are discussed below) and Delta agricultural fractions greater
12 than 8%. Increases in San Joaquin River source water fraction at Franks Tract, Rock Slough, and
13 Contra Costa PP NO. 1 would primarily balance through decreases in Sacramento River water, and
14 as a result the San Joaquin River would account for greater than 50% of the total source water
15 volume at Franks Tract between March through May (<50% for all months during the modeled
16 drought period), and would be ≥50%, and as much as 81% during November through May at Rock
17 Slough and Contra Costa PP No. 1 for both the modeled drought and 16-year hydrologic periods.
18 While the source water and potential pesticide related toxicity co-occurrence predictions do not
19 mean adverse effects would occur, such considerable modeled increases in early summer source
20 water fraction at Franks Tract and winter and summer source water fractions at Rock Slough and
21 Contra Costa PP No. 1 could substantially alter the long-term risk of pesticide-related toxicity to
22 aquatic life, given the apparent greater incidence of pesticides in the San Joaquin River.

23 When compared to the No Action Alternative, changes in source water fractions would be similar in
24 season, geographic extent, and magnitude to those discussed for Existing Conditions with exception
25 to Buckley Cove during the modeled drought period. At Buckley Cove, modeled drought period San
26 Joaquin River fractions would increase 23% in July and 28% in August when compared to No Action
27 Alternative (Appendix 8D, Source Water Fingerprinting). These increases would primarily balance
28 through decreases in Sacramento River water and eastside tributary waters. Nevertheless, the San
29 Joaquin River at Buckley Cove during the modeled drought period would only account for 44% of
30 the total source water volume in July and 39% in August. These changes at Buckley Cove are not
31 considered substantial, however, as discussed for Existing Conditions, under the No Action
32 Alternative the similar magnitude change at Franks Tract, Rock Slough, and Contra Costa PP No. 1
33 would be considered substantial and could substantially alter the long-term risk of pesticide-related
34 toxicity to aquatic life.

35 These predicted adverse effects on pesticides relative to Existing Conditions and the No Action
36 Alternative fundamentally assume that the present pattern of pesticide incidence in surface water
37 will occur at similar levels into the future. In reality, however, the makeup and character of the
38 pesticide use market in the late long-term (i.e., the year 2060) will not be exactly as it is today.
39 Current use of chlorpyrifos and diazinon is on the decline with their replacement by pyrethroids on
40 the rise, yet in this assessment it is the apparent greater incidence of diazinon and chlorpyrifos on
41 the San Joaquin River that serves as the basis for concluding that substantially increased San Joaquin
42 River source water fraction would correspond to an increased risk of pesticide-related toxicity to
43 aquatic life. By 2060, however, alternative pesticides, such as neonicotinoids and biologicals, will
44 likely be a more substantial contributing part of the existing mix of pesticides, and perhaps more
45 prominent. The trend in the development of future-use pesticides is towards reduced risk pesticides,
46 including more biopesticides, with greater targeted specificity, fewer residues, and lower overall

1 non-target toxicity. By 2060 existing chlorpyrifos and diazinon TMDLs for the Sacramento and San
2 Joaquin Rivers will have been in effect for more than 50 years. Moreover, it is reasonable to expect
3 that CWA section 303(d) listings and future additional listings will have developed TMDLs by 2060.
4 To the extent these existing and future TMDL's address current and future-use pesticides, a greater
5 degree of pesticide related source control can be anticipated. Nevertheless, forecasting whether
6 these various efforts will ultimately be successful at resolving current pesticide related impairments
7 requires considerable speculation. While the fundamental assumptions that have guided this
8 assessment of pesticides may be somewhat altered by 2060, these assumptions are informed by
9 actual studies and monitoring data collected from the recent past and, therefore, judging project
10 alternative effects in the future remain most accurate through use of these informed assumptions
11 rather than based on assumptions founded upon future speculative conditions.

12 ***SWP/CVP Export Service Areas***

13 Assessment of effects in SWP/CVP Export Service Areas is based on effects seen in the Plan Area at
14 the Banks and Jones pumping plants. Under Alternative 8, Sacramento River source water fractions
15 would increase substantially at both Banks and Jones pumping plants relative to Existing Conditions
16 and the No Action Alternative (Appendix 8D, Source Water Fingerprinting). At Banks pumping plant,
17 Sacramento source water fractions would generally increase from 26–78% for October through June
18 (6–45% for December through March of the modeled drought period) and at Jones pumping plant
19 Sacramento source water fractions would generally increase from 42–95% for October through June
20 (37–88% for October through June of the modeled drought period). These increases in Sacramento
21 source water fraction would primarily balance through equivalent decreases in San Joaquin River
22 water. Based on the general observation that San Joaquin River, in comparison to the Sacramento
23 River, is a greater contributor of OP insecticides in terms of greater frequency of incidence and
24 presence at concentrations exceeding water quality benchmarks, modeled increases in Sacramento
25 River fraction at Banks and Jones would generally represent an improvement in export water
26 quality respective to pesticides.

27 ***NEPA Effects:*** In summary, the changes in long-term average flows on the Sacramento, Feather,
28 American, and San Joaquin Rivers, under Alternative 8 relative to the No Action Alternative, are of
29 insufficient magnitude to substantially increase the long-term risk of pesticide-related water quality
30 degradation and related toxicity to aquatic life in these water bodies upstream of the Delta.
31 However, modeled increases in San Joaquin River fraction at Franks Tract, Rock Slough, and Contra
32 Costa PP No. 1 are of sufficient magnitude to substantially alter the long-term risk of pesticide-
33 related water quality degradation and related toxicity to aquatic life in the Delta. The effects on
34 pesticides from operations and maintenance (CM1) are determined to be adverse and unavoidable.

35 ***CEQA Conclusion:*** Key findings discussed in the effects assessment relative to Existing Conditions is
36 provided above are summarized here, and are then compared to the CEQA thresholds of significance
37 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this
38 constituent. For additional details on the effects assessment findings that support this CEQA impact
39 determination, see the effects assessment discussion that immediately precedes this conclusion.

40 Sources of pesticides upstream of the Delta include direct input of pesticide containing surface
41 runoff from agriculture and urbanized areas. Flows in rivers receiving these discharges dilute these
42 pesticide inputs. Relative to Existing Conditions, however, modeled changes in long-term average
43 flows on the Sacramento, Feather, American, and San Joaquin Rivers are of insufficient magnitude to

1 substantially increase the long-term risk of pesticide-related water quality degradation and related
2 toxicity to aquatic life in these water bodies upstream of the Delta.

3 In the Delta, sources of pesticides include direct input of surface runoff from Delta agriculture and
4 Delta urbanized areas as well as inputs from rivers upstream of the Delta. While facilities operations
5 and maintenance activities would not affect these sources, changes in Delta source water fraction
6 could change the relative risk associated with pesticide related toxicity to aquatic life. Under
7 Alternative 8, modeled long-term average San Joaquin River source water fractions at Franks Tract,
8 Rock Slough and Contra Costa PP No. 1 locations would increase considerably for some months such
9 that the long-term risk of pesticide-related toxicity to aquatic life could substantially increase.

10 The assessment of Alternative 8 effects on pesticides in the SWP/CVP Export Service Areas is based
11 on assessment of changes predicted at Banks and Jones pumping plants. Sacramento River source
12 water fractions would increase substantially at both Banks and Jones pumping plants and would
13 generally represent an improvement in export water quality respective to pesticides.

14 Based on the above, Alternative 8 would not result in any substantial change in long-term average
15 pesticide concentration or result in substantial increase in the anticipated frequency with which
16 long-term average pesticide concentrations would exceed aquatic life toxicity thresholds or other
17 beneficial use effect thresholds upstream of the Delta or the SWP/CVP service area. Numerous
18 pesticides are currently used throughout the affected environment, and while some of these
19 pesticides may be bioaccumulative, those present-use pesticides for which there is sufficient
20 evidence for their presence in waters affected by SWP and CVP operations (i.e., diazinon,
21 chlorpyrifos, diuron, and pyrethroids) are not considered bioaccumulative, and thus changes in their
22 concentrations would not directly cause bioaccumulative problems in aquatic life or humans.
23 Furthermore, while there are numerous 303(d) listings throughout the affected environment that
24 name pesticides as the cause for beneficial use impairment, the modeled changes in upstream river
25 flows and Delta source water fractions would not be expected to make any of these beneficial use
26 impairments measurably worse, with principal exception to locations in the Delta that would receive
27 a substantially greater fraction San Joaquin River water under Alternative 8. Long-term average San
28 Joaquin River source water fractions at Franks Tract, Rock Slough and Contra Costa PP No. 1
29 locations would change considerably for some months such that the long-term risk of pesticide-
30 related toxicity to aquatic life could substantially increase. Additionally, the potential for increased
31 incidence of pesticide related toxicity could include pesticides such as chlorpyrifos and diazinon for
32 which existing 303(d) listings exist for the Delta, and thus existing beneficial use impairment could
33 be made discernibly worse. The impact is considered to be significant and unavoidable. There is no
34 feasible mitigation available to reduce the effect of this significant impact.

35 **Impact WQ-22: Effects on Pesticide Concentrations Resulting from Implementation of CM2–** 36 **CM22**

37 **NEPA Effects:** Conservation Measures 2–22 under Alternative 8 would be similar to those under
38 Alternative 1A. Effects on pesticides resulting from the implementation of CM2–CM22 would be
39 similar to that previously discussed for Alternative 1A. In summary, CM13 proposes the use of
40 herbicides to control invasive aquatic vegetation around habitat restoration sites. Herbicides
41 directly applied to water could include adverse effects on non-target aquatic life, such as aquatic
42 invertebrates and beneficial aquatic plants. As such, aquatic life toxicity objectives could be
43 exceeded with sufficient frequency and magnitude such that beneficial uses would be impacted, thus
44 constituting an adverse effect on water quality.

1 In summary, based on the discussion above, the effects on pesticides from implementing CM2-CM22
2 are considered to be adverse. Mitigation Measure WQ-22 would be available to reduce this adverse
3 effect.

4 **CEQA Conclusion:** Effects of CM2–CM22 on pesticides under Alternative 8 are similar to those
5 discussed for Alternative 1A. Potential environmental effects related only to CM13 are considered to
6 be significant. Mitigation is required. While Mitigation Measure WQ-22 is available to partially
7 reduce this impact of pesticides, no feasible mitigation is available that would reduce it to a level
8 that would be less than significant.

9 **Mitigation Measure WQ-22: Implement Least Toxic Integrated Pest Management**
10 **Strategies**

11 Please see Mitigation Measure WQ-22 under Impact WQ-22 in the discussion of Alternative 1A.

12 **Impact WQ-23: Effects on Phosphorus Concentrations Resulting from Facilities Operations**
13 **and Maintenance (CM1)**

14 **NEPA Effects:** Effects of water facilities and operations (CM1) on phosphorus levels in water bodies
15 of the affected environment under Alternative 8 would be very similar (i.e., nearly the same) to
16 those discussed for Alternative 1A. Consequently, the environmental consequences to phosphorus
17 levels discussed in detail for Alternative 1A also adequately represent the effects under Alternative
18 8, which are considered to be not adverse.

19 **CEQA Conclusion:** Key findings discussed in the effects assessment relative to Existing Conditions is
20 provided above are summarized here, and are then compared to the CEQA thresholds of significance
21 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this
22 constituent. For additional details on the effects assessment findings that support this CEQA impact
23 determination, see the effects assessment discussion that immediately precedes this conclusion.

24 Because phosphorus loading to waters upstream of the Delta is not anticipated to change, and
25 because changes in flows do not necessarily result in changes in concentrations or loading of
26 phosphorus to these water bodies, substantial changes in phosphorus concentration upstream of the
27 Delta are not anticipated for Alternative 8, relative to Existing Conditions.

28 Because phosphorus concentrations in the major source waters to the Delta are similar for much of
29 the year, phosphorus concentrations in the Delta are not anticipated to change substantially on a
30 long term-average basis under Alternative 8, relative to Existing Conditions. Algal growth rates are
31 limited by availability of light in the Delta, and therefore any minor increases in phosphorus levels
32 that may occur at some locations and times within the Delta would be expected to have little effect
33 on primary productivity in the Delta.

34 The assessment of effects of phosphorus under Alternative 8 in the SWP and CVP Export Service
35 Areas is based on effects on phosphorus at the Banks and Jones pumping plants. As noted above,
36 phosphorus concentrations in the Delta (including Banks and Jones pumping plants) are not
37 anticipated to change substantially on a long term-average basis.

38 Based on the above, there would be no substantial, long-term increase in phosphorus concentrations
39 in the rivers and reservoirs upstream of the Delta, in the Delta Region, or the waters exported to the
40 CVP and SWP service areas under Alternative 8 relative to Existing Conditions. As such, this
41 alternative is not expected to cause additional exceedance of applicable water quality

1 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
 2 on any beneficial uses of waters in the affected environment. Because phosphorus concentrations
 3 are not expected to increase substantially, no long-term water quality degradation is expected to
 4 occur and, thus, no adverse effects to beneficial uses would occur. Phosphorus is not 303(d) listed
 5 within the affected environment and thus any minor increases that may occur in some areas would
 6 not make any existing phosphorus-related impairment measurably worse because no such
 7 impairments currently exist. Because phosphorus is not bioaccumulative, minor increases that may
 8 occur in some areas would not bioaccumulate to greater levels in aquatic organisms that would, in
 9 turn, pose substantial health risks to fish, wildlife, or humans. This impact is considered to be less
 10 than significant. No mitigation is required.

11 **Impact WQ-24: Effects on Phosphorus Concentrations Resulting from Implementation of**
 12 **CM2–CM22**

13 **NEPA Effects:** Effects of CM2–CM22 on phosphorus levels in water bodies of the affected
 14 environment under Alternative 8 would be very similar (i.e., nearly the same) to those discussed for
 15 Alternative 1A. Consequently, the environmental consequences to phosphorus levels from
 16 implementing CM2–CM22 discussed in detail for Alternative 1A also adequately represent the
 17 effects of these same actions under Alternative 8, which are considered to be not adverse.

18 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 8 would be similar to
 19 those proposed under Alternative 1A. As such, effects on phosphorus resulting from the
 20 implementation of CM2–CM22 would be similar to that previously discussed for Alternative 1A. This
 21 impact is considered to be less than significant. No mitigation is required.

22 **Impact WQ-25: Effects on Selenium Concentrations Resulting from Facilities Operations and**
 23 **Maintenance (CM1)**

24 ***Upstream of the Delta***

25 For the same reasons stated for the No Action Alternative, Alternative 8 would have negligible, if
 26 any, effect on selenium concentrations in the rivers and reservoirs upstream of the Delta relative to
 27 Existing Conditions and the No Action Alternative. Any negligible increases in selenium
 28 concentrations that could occur in the water bodies of the affected environment located upstream of
 29 the Delta would not be of frequency, magnitude and geographic extent that would adversely affect
 30 any beneficial uses or substantially degrade the quality of these water bodies, with regard to
 31 selenium.

32 ***Delta***

33 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 34 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 35 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 36 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 37 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
 38 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

39 Alternative 8 would result in small to moderate changes in average selenium concentrations in
 40 water at modeled Delta assessment locations relative to Existing Conditions and the No Action
 41 Alternative (Appendix 8M, Table M-10A). The changes in selenium concentrations in water are

1 reflected in small (10% or less) to moderate (between 11% and 50%) changes in available
2 assimilative capacity for selenium (based on 2 µg/L ecological risk benchmark) for all years. Relative
3 to Existing Conditions, Alternative 8 would result in the largest modeled increase in assimilative
4 capacity at Buckley Cove (3%) and the largest decreases at Rock Slough and Contra Costa PP (12%
5 and 13%, respectively) (Figure 8-59). Relative to the No Action Alternative, the largest modeled
6 increase in assimilative capacity would be at Staten Island (1%) and the largest decrease would be
7 at Rock Slough and Contra Costa PP (13% and 12%, respectively) (Figure 8-60). Although moderate
8 negative changes in assimilative capacity would be expected to occur at two locations (Rock Slough
9 and Contra Costa PP), the changes would be small at the other locations and the available
10 assimilative capacity at all locations would remain substantial; therefore, the effect of Alternative 8
11 is generally minimal for the Delta. Furthermore, the ranges of modeled selenium concentrations in
12 water (Appendix 8M, Table M-10A) for Alternative 8 (range 0.24–0.72 µg/L), Existing Conditions
13 (range 0.21–0.76 µg/L), and the No Action Alternative (range 0.21–0.69 µg/L) are similar, and all
14 would be below the ecological risk benchmark (2 µg/L).

15 Relative to Existing Conditions and the No Action Alternative, Alternative 8 would generally result in
16 small changes in estimated selenium concentrations in biota (whole-body fish, bird eggs
17 [invertebrate diet], bird eggs [fish diet], and fish fillets) (Appendix 8M, Table M-19 and Addendum
18 M.A to Appendix 8M, Table M.A-2). Relative to Existing Conditions and the No Action Alternative, the
19 largest increase of selenium concentrations in biota would be at Contra Costa PP for drought years
20 and in sturgeon at the two western Delta locations in all as well as drought years. Relative to
21 Existing Conditions, the largest decrease in selenium concentration in biota would be at Buckley
22 Cove for drought years; relative to the No Action Alternative, the largest decrease would be at Staten
23 Island for drought years. Except for sturgeon in the western Delta, concentrations of selenium in
24 whole-body fish and bird eggs (invertebrate and fish diets) would exceed only the lower
25 benchmarks (4 and 6 mg/kg dry weight, respectively, indicating a low potential for effects), under
26 drought conditions, at Buckley Cove for Alternative 8 and Existing Conditions and the No Action
27 Alternative (Figures 8-61 through 8-63). Exceedance Quotients for these exceedances of the lower
28 benchmarks are all between 1.0 and 1.5, indicating a low risk to biota in the Delta and the similarity
29 of Alternative 8 to Existing Conditions and the No Action Alternative. Selenium concentrations in
30 fish fillets would not exceed the screening value for protection of human health (Figure 8-64). For
31 sturgeon in the western Delta, whole-body selenium concentrations would increase from 12.3
32 mg/kg under Existing Conditions and the No Action Alternative to 14.7 mg/kg under Alternative 8, a
33 20% increase (Table M.A-2). All of these values exceed both the low and high toxicity benchmarks.
34 The predicted increases are high enough that they may represent a measurable increase in body
35 burdens of sturgeon, which would constitute an adverse impact (see also the discussion of results
36 provided in Addendum M.A to Appendix 8M). Relative to Existing Conditions and the No Action
37 Alternative, Alternative 8 would result in a minimal change in selenium concentrations throughout
38 the Delta. Alternative 8 would not be expected to substantially increase the frequency with which
39 applicable benchmarks would be exceeded in the Delta or substantially degrade the quality of water
40 in the Delta, with regard to selenium.

41 ***SWP/CVP Export Service Areas***

42 Alternative 8 would result in small to moderate changes in average selenium concentrations relative
43 to Existing Conditions and the No Action Alternative (Appendix 8M, Table M-10A). These changes in
44 selenium concentrations in water are reflected in small (10% or less) to moderate (between 11%
45 and 50%) changes in available assimilative capacity for selenium for all years. Relative to Existing
46 Conditions and the No Action Alternative, Alternative 8 would result in increases in assimilative

1 capacity at Jones PP (14% and 15%, respectively) and at Banks PP (7%) (Figures 8-59 and 8-60) and
2 would have a positive effect at the Export Service Area locations. The ranges of modeled selenium
3 concentrations in water (Appendix 8M, Table M-10Ae) for Alternative 8 (range 0.32–0.37 µg/L),
4 Existing Conditions (range 0.37–0.58 µg/L), and the No Action Alternative (range 0.37–0.59 µg/L)
5 are similar, and all would be well below the ecological risk benchmark (2 µg/L).

6 Relative to Existing Conditions and the No Action Alternative, Alternative 8 would result in small
7 changes in estimated selenium concentrations in biota (Appendix 8M, Table M-19). Relative to
8 Existing Conditions and the No Action Alternative, the largest increase of selenium concentrations in
9 biota would be at Banks PP for drought years (except for bird eggs [assuming a fish diet] at Banks PP
10 for all years), and the largest decrease would be at Jones PP for drought years. Concentrations in
11 biota would not exceed any benchmarks for Alternative 8 (Figures 8-61 through 8-64).

12 Thus, relative to Existing Conditions and the No Action Alternative, Alternative 8 would result in
13 small to moderate changes in selenium concentrations in water and minimal changes in selenium
14 concentrations in biota at the Export Service Area locations. Selenium concentrations in water and
15 biota generally would decrease under Alternative 8 and would not exceed ecological benchmarks at
16 either location, whereas the lower benchmark for bird eggs (fish diet) would be exceeded under
17 Existing Conditions and the No Action Alternative at Jones PP under drought conditions. This small
18 positive change in selenium concentrations under Alternative 8 would be expected to slightly
19 decrease the frequency with which applicable benchmarks would be exceeded or slightly improve
20 the quality of water at the Export Service Area locations, with regard to selenium.

21 **NEPA Effects:** Based on the discussion above, the effects on selenium from Alternative 8 are
22 considered to be adverse. This determination is reached because selenium concentrations in whole-
23 body sturgeon modeled at two western Delta locations would increase by an estimated 20%, which
24 may represent a measurable increase in the environment. Because both low and high toxicity
25 benchmarks are already exceeded under the No Action Alternative, these potentially measurable
26 increases represent an adverse impact.

27 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
28 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
29 purpose of making the CEQA impact determination for selenium. For additional details on the effects
30 assessment findings that support this CEQA impact determination, see the effects assessment
31 discussion that immediately precedes this conclusion.

32 There are no substantial point sources of selenium in watersheds upstream of the Delta, and no
33 substantial nonpoint sources of selenium in the watersheds of the Sacramento River and the eastern
34 tributaries. Nonpoint sources in the San Joaquin Valley that contribute selenium to the Delta will be
35 controlled through a TMDL developed by the Central Valley Water Board (2001) for the lower San
36 Joaquin River, established limits for the Grassland Bypass Project, and Basin Plan objectives (Central
37 Valley Water Board 2010c) and State Water Board (2010d, 2010e) that are expected to result in
38 decreasing discharges of selenium from the San Joaquin River to the Delta. Consequently, any
39 modified reservoir operations and subsequent changes in river flows under Alternative 8, relative to
40 Existing Conditions, are expected to cause negligible changes in selenium concentrations in water.
41 Any negligible changes in selenium concentrations that may occur in the water bodies of the affected
42 environment located upstream of the Delta would not be of frequency, magnitude, and geographic
43 extent that would adversely affect any beneficial uses or substantially degrade the quality of these
44 water bodies as related to selenium.

1 Relative to Existing Conditions, modeling estimates indicate that Alternative 8 would increase
2 selenium concentrations in whole-body sturgeon modeled at two western Delta locations by an
3 estimated 20%, which may represent a measurable increase in the environment. Because both low
4 and high toxicity benchmarks are already exceeded under Existing Conditions, these potentially
5 measurable increases represent a potential impact to aquatic life beneficial uses.

6 Assessment of effects of selenium in the SWP and CVP Export Service Areas is based on effects on
7 selenium concentrations at the Banks and Jones pumping plants. Relative to Existing Conditions,
8 Alternative 8 would slightly decrease the frequency with which applicable benchmarks would be
9 exceeded or slightly improve the quality of water in selenium concentrations at the Banks and Jones
10 pumping plants locations.

11 Based on the above, although waterborne selenium concentrations would not exceed applicable
12 water quality objectives/criteria, significant impacts on some beneficial uses of waters in the Delta
13 could occur because both low and high toxicity benchmarks are already exceeded under Existing
14 Conditions, and uptake of selenium from water to biota may measurably increase. In comparison to
15 Existing Conditions, water quality conditions under this alternative would increase levels of
16 selenium (a bioaccumulative pollutant) by frequency, magnitude, and geographic extent such that
17 the affected environment may have measurably higher body burdens of selenium in aquatic
18 organisms, thereby substantially increasing the health risks to wildlife (including fish); however,
19 impacts to humans consuming those organisms are not expected to occur. Water quality conditions
20 under this alternative with respect to selenium would cause long-term degradation of water quality
21 in the western Delta. Except in the vicinity of the western Delta for sturgeon, water quality
22 conditions under this alternative would not increase levels of selenium by frequency, magnitude,
23 and geographic extent such that the affected environment would be expected to have measurably
24 higher body burdens of selenium in aquatic organisms. The greater level of selenium
25 bioaccumulation in the western Delta would further degrade water quality by measurable levels, on
26 a long-term basis, for selenium and, thus, cause the 303(d)-listed impairment of beneficial use to be
27 made discernibly worse. This impact is considered significant.

28 The need for, and the feasibility and effectiveness of, post-operation mitigation for the predicted
29 level of selenium bioaccumulation is uncertain. The first step shall be to determine the reliability of
30 the model in predicting biota selenium concentrations in the affected environment where effects are
31 predicted but selenium data are lacking. For that reason, the model shall be validated with site-
32 specific sampling before extensive mitigation measures relative to CM1 operations are developed
33 and evaluated for feasibility, as the measures and their evaluation for feasibility are likely to be
34 complex. Specifically, it remains to be determined whether the available existing data for transfer of
35 selenium from water to particulates and through different trophic levels of the food chain are
36 representative of conditions that may occur from implementation of Alternative 8. Therefore, the
37 proposed mitigation measure requires that sampling be conducted to characterize each step of data
38 inputs needed for the model, and then the refined model be validated for local conditions. This
39 impact is considered significant and unavoidable.

40 **Impact WQ-26: Effects on Selenium Concentrations Resulting from Implementation of CM2- 41 CM22**

42 **NEPA Effects:** In general, with the possible exception of changes in Delta hydrodynamics resulting
43 from habitat restoration, CM2-CM11 would not substantially increase selenium concentrations in
44 the water bodies of the affected environment. Modeling scenarios included assumptions regarding

1 how certain habitat restoration activities (CM2 and CM4) would affect Delta hydrodynamics, and
2 thus such effects of these restoration measures were included in the assessment of CM1 facilities
3 operations and maintenance (see Impact WQ-25).

4 However, implementation of these conservation measures may increase water residence time
5 within the restoration areas. Increased restoration area water residence times could potentially
6 increase the bioaccumulation of selenium in biota, thereby potentially increasing fish tissue and bird
7 egg concentrations of selenium, but models are not available to quantitatively estimate the level of
8 changes in residence time and the associated selenium bioavailability. If increases in fish tissue or
9 bird egg selenium were to occur, the increases would likely be of concern only where fish tissues or
10 bird eggs are already elevated in selenium to near or above thresholds of concern. That is, where
11 biota concentrations are currently low and not approaching thresholds of concern, changes in
12 residence time alone would not be expected to cause them to then approach or exceed thresholds of
13 concern. In consideration of this factor, although the Delta as a whole is a 303(d)-listed water body
14 for selenium, and although monitoring data of fish tissue or bird eggs in the Delta are sparse, the
15 most likely areas in which biota tissues would be at levels high enough that additional
16 bioaccumulation due to increased residence time from restoration areas would be a concern are the
17 western Delta and Suisun Bay, and the South Delta in areas that receive San Joaquin River water.

18 The western Delta and Suisun Bay receive elevated selenium loads from North San Francisco Bay
19 (including San Pablo Bay, Carquinez Strait, and Suisun Bay) and from the San Joaquin River. Point
20 sources of selenium in North San Francisco Bay (i.e., refineries) that contribute selenium to Suisun
21 Bay are expected to be reduced through a TMDL under development by the San Francisco Bay Water
22 Board (San Francisco Bay Water Board 2012) that is expected to result in decreasing discharges of
23 selenium. Nonpoint sources of selenium in the San Joaquin Valley that contribute selenium to the
24 San Joaquin River, and thus the Delta and Suisun Bay, will be controlled through a TMDL developed
25 by the Central Valley Water Board (2001) for the lower San Joaquin River, established limits for the
26 Grassland Bypass Project, and Basin Plan objectives (Central Valley Water Board 2010c, d) that are
27 expected to result in decreasing discharges of selenium from the San Joaquin River to the Delta. If
28 selenium levels are not sufficiently reduced via these efforts, it is expected that the State Water
29 Board and the San Francisco Bay and Central Valley Water Boards would initiate additional actions
30 to further control sources of selenium.

31 The South Delta receives elevated selenium loads from the San Joaquin River. In contrast to Suisun
32 Bay and possibly the western Delta in the future, the South Delta lacks the overbite clam (*Corbula*
33 [*Potamocorbula*] *amurensis*), which is considered a key driver of selenium bioaccumulation in
34 Suisun Bay, due to its high bioaccumulation of selenium and its role in the benthic food web that
35 includes long-lived sturgeon. The South Delta does have *Corbicula fluminea*, another bivalve that
36 bioaccumulates selenium, but it is not as invasive as the overbite clam and thus likely makes up a
37 smaller fraction of sturgeon diet. Also, as mentioned above, nonpoint sources of selenium in the San
38 Joaquin Valley that contribute selenium to the Delta will be controlled through a TMDL developed by
39 the Central Valley Water Board (2001) for the lower San Joaquin River, established limits for the
40 Grassland Bypass Project, and Basin Plan objectives (Central Valley Water Board 2010c, d) that are
41 expected to result in decreasing discharges of selenium from the San Joaquin River to the Delta.
42 Further, if selenium levels in the San Joaquin River are not sufficiently reduced via these efforts, it is
43 expected that the State Water Board and Central Valley Water Board would initiate additional
44 TMDLs to further control nonpoint sources of selenium.

1 Wetland restoration areas will not be designed such that water flows in and does not flow out.
2 Exchange of water between the restoration areas and existing Delta channels is an important design
3 factor, since one goal of the restoration areas is to export food produced in these areas to the rest of
4 the Delta (see BDCP Chapter 3, *Conservation Strategy*, Section 3.3, Biological Goals and Objectives).
5 Thus, these areas can be thought of as “flow-through” systems. Consequently, although water
6 residence times associated with BDCP restoration could increase, they are not expected to increase
7 without bound. and selenium concentrations in the water column would not continue to build up
8 and be recycled in sediments and organisms as may be the case within a closed system.

9 However, because increases in bioavailable selenium in the habitat restoration areas are uncertain,
10 proposed avoidance and minimization measures would require evaluating risks of selenium
11 exposure at a project level for each restoration area, minimizing to the extent practicable potential
12 risk of additional bioaccumulation, and monitoring selenium levels in fish and/or wildlife to
13 establish whether, or to what extent, additional bioaccumulation is occurring. See Appendix 3B,
14 *Environmental Commitments* for a description of the environmental commitment BDCP proponents
15 are making with respect to Selenium Management; and Appendix 3.C. of the BDCP for additional
16 detail on this avoidance and minimization measure (AMM27). Data generated as part of the
17 avoidance and minimization measures will assist the State and Regional Water Boards in
18 determining whether beneficial uses are being impacted by selenium, and thus will provide the data
19 necessary to support regulatory actions (including additional TMDL development), should such
20 actions be warranted.

21 Given the factors discussed in the assessment above, any increases in bioaccumulation rates from
22 water-borne selenium that could occur in some areas as a result of increased water residence time
23 would not be of sufficient magnitude and geographic extent that any portion of the Delta would be
24 expected to have measurably higher body burdens of selenium in aquatic organisms and, therefore,
25 would not substantially increase risk for adverse effects to beneficial uses. Furthermore, although
26 the Delta is a 303(d)-listed water body for selenium, given the discussion in the assessment above, it
27 is unlikely that restoration areas would result in measurable increases in selenium in fish tissues or
28 bird eggs such that the beneficial use impairment would be made discernibly worse.

29 Because it is unlikely that substantial increases in selenium in fish tissues or bird eggs would occur
30 such that effects on aquatic life beneficial uses would be anticipated, and because of the avoidance
31 and minimization measures that are designed to further minimize and evaluate the risk of such
32 increases, the effects of WQ-26 are considered not adverse.

33 **CEQA Conclusion:** There would be no substantial, long-term increase in selenium concentrations in
34 water in the rivers and reservoirs upstream of the Delta, water in the Delta, or the waters exported
35 to the CVP and SWP service areas due to implementation of CM2–CM22 relative to Existing
36 Conditions. Waterborne selenium concentrations under this alternative would not exceed applicable
37 water quality objectives/criteria.

38 Given the factors discussed in the assessment above, any increases in bioaccumulation rates from
39 water-borne selenium that could occur in some areas as a result of increased water residence times
40 would not be of sufficient magnitude and geographic extent that any portion of the Delta would be
41 expected to have measurably higher body burdens of selenium in aquatic organisms, and therefore
42 would not substantially increase risk for adverse effects to beneficial uses. CM2-22 would not cause
43 long-term degradation of water quality resulting in sufficient use of available assimilative capacity
44 such that occasionally exceeding water quality objectives/criteria would be likely. Also, CM2-22

1 would not result in substantially increased risk for adverse effects to any beneficial uses.
2 Furthermore, although the Delta is a 303(d)-listed water body for selenium, given the discussion in
3 the assessment above, it is unlikely that restoration areas would result in measurable increases in
4 selenium in fish tissues or bird eggs such that the beneficial use impairment would be made
5 discernibly worse.

6 Since it is unlikely that substantial increases in selenium in fish tissues or bird eggs would occur
7 such that effects on aquatic life beneficial uses would be anticipated, and because of the avoidance
8 and minimization measures that are designed to further minimize and evaluate the risk of such
9 increases (see Appendix 3.C. of the BDCP for more detail on AMM27) as well as the Selenium
10 Management environmental commitment (see Appendix 3B, *Environmental Commitments*), this
11 impact is considered less than significant. No mitigation is required.

12 **Impact WQ-27: Effects on Trace Metal Concentrations Resulting from Facilities Operations** 13 **and Maintenance (CM1)**

14 ***Upstream of the Delta***

15 For the same reasons stated for the No Action Alternative, Alternative 8 would result in negligible,
16 and likely immeasurable, increases in trace metal concentrations in the rivers and reservoirs
17 upstream of the Delta, relative to Existing Conditions and the No Action Alternative. Effects due to
18 the operation and maintenance of the conveyance facilities are expected to be immeasurable, on an
19 annual and long-term average basis. As such, Alternative 8 would not be expected to substantially
20 increase the frequency with which applicable Basin Plan objectives or CTR criteria would be
21 exceeded in water bodies of the affected environment located upstream of the Delta or substantially
22 degrade the quality of these water bodies, with regard to trace metals.

23 ***Delta***

24 For the same reasons stated for the No Action Alternative, Alternative 8 would not result in
25 substantial increases in trace metal concentrations in the Delta relative to Existing Conditions and
26 the No Action Alternative. However, substantial changes in source water fraction would occur in the
27 south Delta (Appendix 8D, Source Water Fingerprinting). Throughout much of the south Delta, San
28 Joaquin River water would replace Sacramento River water, with the future trace metals profile
29 largely reflecting that of the San Joaquin River. As discussed for the No Action Alternative, trace
30 metal concentration profiles between the San Joaquin and Sacramento Rivers are very similar and
31 currently meet Basin Plan objectives and CTR criteria. While the change in trace metal
32 concentrations in the south Delta would likely be measurable, Alternative 8 would not be expected
33 to substantially increase the frequency with which applicable Basin Plan objectives or CTR criteria
34 would be exceeded in the Delta or substantially degrade the quality of Delta waters with regard to
35 trace metals.

36 ***SWP/CVP Export Service Areas***

37 For the same reasons stated for the No Action Alternative, Alternative 8 would not result in
38 substantial increases in trace metal concentrations in the water exported from the Delta or diverted
39 from the Sacramento River through the proposed conveyance facilities. As such, there is not
40 expected to be substantial changes in trace metal concentrations in the SWP/CVP export service
41 area waters under Alternative 8, relative to Existing Conditions and the No Action Alternative. As
42 such, Alternative 8 would not be expected to substantially increase the frequency with which

1 applicable Basin Plan objectives or CTR criteria would be exceeded in the water bodies of the
2 affected environment in the SWP and CVP Service Area or substantially degrade the quality of these
3 water bodies, with regard to trace metals.

4 **NEPA Effects:** In summary, Alternative 8, relative to the No Action Alternative, would not cause a
5 substantial increase in long-term average trace metals concentrations within the affected
6 environment, nor would it cause an increased frequency of water quality objective/criteria
7 exceedances within the affected environment. The effect on trace metals is determined not to be
8 adverse.

9 **CEQA Conclusion:** Effects of CM1 on trace metals under Alternative 8 would be similar to those
10 discussed for Alternative 1A, and are summarized here, then compared to the CEQA thresholds of
11 significance (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for
12 this constituent. For additional details on the effects assessment findings that support this CEQA
13 impact determination, see the effects assessment discussion under Alternative 1A.

14 While greater water demands under the Alternative 8 would alter the magnitude and timing of
15 reservoir releases north, south and east of the Delta, these activities would have no substantial effect
16 on the various watershed sources of trace metals. Moreover, long-term average flow and trace
17 metals at Sacramento River at Hood and San Joaquin River at Vernalis are poorly correlated;
18 therefore, changes in river flows would not be expected to cause a substantial long-term change in
19 trace metal concentrations upstream of the Delta.

20 Average and 95th percentile trace metal concentrations are very similar across the primary source
21 waters to the Delta. Given this similarity, very large changes in source water fraction would be
22 necessary to effect a relatively small change in trace metal concentration at a particular Delta
23 location. Moreover, average and 95th percentile trace metal concentrations for these primary source
24 waters are all below their respective water quality criteria, including those that are hardness-based
25 without a WER adjustment. No mixing of these three source waters could result in a metal
26 concentration greater than the highest source water concentration, and given that trace metals do
27 not already exceed water quality criteria, more frequent exceedances of criteria in the Delta would
28 not be expected to occur under the Alternative 8.

29 The assessment of the Alternative 8 effects on trace metals in the SWP/CVP Export Service Areas is
30 based on assessment of changes in trace metal concentrations at Banks and Jones pumping plants.
31 As just discussed regarding similarities in Delta source water trace metal concentrations, the
32 Alternative 8 is not expected to result in substantial changes in trace metal concentrations in Delta
33 waters, including Banks and Jones pumping plants, therefore effects on trace metal concentrations
34 in the SWP/CVP Export Service Area are expected to be negligible.

35 There would be no substantial long-term increase in trace metal concentrations in the rivers and
36 reservoirs upstream of the Delta, in the Delta Region, or the SWP/CVP export service area waters
37 under Alternative 8 relative to Existing Conditions. As such, this alternative is not expected to cause
38 additional exceedance of applicable water quality objectives by frequency, magnitude, and
39 geographic extent that would cause adverse effects on any beneficial uses of waters in the affected
40 environment. Because trace metal concentrations are not expected to increase substantially, no
41 long-term water quality degradation for trace metals is expected to occur and, thus, no adverse
42 effects to beneficial uses would occur. Furthermore, any negligible changes in long-term trace metal
43 concentrations that may occur in water bodies of the affected environment would not be expected to
44 make any existing beneficial use impairments measurably worse. The trace metals discussed in this

1 assessment are not considered bioaccumulative, and thus would not directly cause bioaccumulative
2 problems in aquatic life or humans. This impact is considered to be less than significant. No
3 mitigation is required.

4 **Impact WQ-28: Effects on Trace Metal Concentrations Resulting from Implementation of** 5 **CM2–CM22**

6 *NEPA Effects:* Conservation Measures 2–22 under Alternative 8 would be similar to those under
7 Alternative 1A. Effects on trace metals resulting from the implementation of CM2–CM22 would be
8 similar to that previously discussed for Alternative 1A. As they pertain to trace metals,
9 implementation of CM2–CM22 would not be expected to adversely affect beneficial uses of the
10 affected environment or substantially degrade water quality with respect to trace metals.

11 In summary, implementation of CM2–CM22 under Alternative 8, relative to the No Action
12 Alternative, would have negligible, if any, effect on trace metals concentrations. The effect on trace
13 metals from implementing CM2–CM22 is determined not to be adverse.

14 *CEQA Conclusion:* Implementation of CM2–CM22 under Alternative 8 would not cause substantial
15 long-term increase in trace metal concentrations in the rivers and reservoirs upstream of the Delta,
16 in the Delta Region, or the SWP/CVP export service area. As such, this alternative is not expected to
17 cause additional exceedance of applicable water quality objectives by frequency, magnitude, and
18 geographic extent that would cause adverse effects on any beneficial uses of waters in the affected
19 environment. Because trace metal concentrations are not expected to increase substantially, no
20 long-term water quality degradation for trace metals is expected to occur and, thus, no adverse
21 effects to beneficial uses would occur. Furthermore, any negligible changes in long-term trace metal
22 concentrations that may occur throughout the affected environment would not be expected to make
23 any existing beneficial use impairments measurably worse. The trace metals discussed in this
24 assessment are not considered bioaccumulative, and thus would not directly cause bioaccumulative
25 problems in aquatic life or humans. This impact is considered to be less than significant. No
26 mitigation is required.

27 **Impact WQ-29: Effects on TSS and Turbidity Resulting from Facilities Operations and** 28 **Maintenance (CM1)**

29 *NEPA Effects:* Effects of CM1 on TSS and turbidity under Alternative 8 are the same as those
30 discussed for Alternative 1A and are considered to not be adverse.

31 *CEQA Conclusion:* Effects of CM1 on TSS and turbidity under Alternative 8 would be similar to those
32 discussed for Alternative 1A, and are summarized here, then compared to the CEQA thresholds of
33 significance (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for
34 this constituent. For additional details on the effects assessment findings that support this CEQA
35 impact determination, see the effects assessment discussion under Alternative 1A.

36 Changes river flow rate and reservoir storage that would occur under Alternative 8, relative to
37 Existing Conditions, would not be expected to result in a substantial adverse change in TSS
38 concentrations and turbidity levels in the reservoirs and rivers upstream of the Delta, given that
39 suspended sediment concentrations are more affected by season than flow. Site-specific and
40 temporal exceptions may occur due to localized temporary construction activities, dredging
41 activities, development, or other land use changes would be site-specific and temporal, which would

1 be regulated to limit both their short-term and long-term effects on TSS and turbidity levels to less
2 than substantial levels.

3 Within the Delta, geomorphic changes associated with sediment transport and deposition are
4 usually gradual, occurring over years, and high storm event inflows would not be substantially
5 affected. Thus, it is expected that the TSS concentrations and turbidity levels in the affected channels
6 would not be substantially different from the levels under Existing Conditions. Consequently, this
7 alternative is expected to have minimal effect on TSS concentrations and turbidity levels in the Delta
8 region, relative to Existing Conditions.

9 There is not expected to be substantial, if even measurable, changes in TSS concentrations and
10 turbidity levels in the SWP/CVP Export Service Areas waters under Alternative 8, relative to Existing
11 Conditions, because as stated above, this alternative is not expected to result in substantial changes
12 in TSS concentrations and turbidity levels at the south Delta export pumps, relative to Existing
13 Conditions.

14 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
15 objectives where such objectives are not exceeded under Existing Conditions. Because TSS
16 concentrations and turbidity levels are not expected to be substantially different, long-term water
17 quality degradation is not expected, and, thus, beneficial uses are not expected to be adversely
18 affected. Finally, TSS and turbidity are neither bioaccumulative nor Clean Water Act section 303(d)
19 listed constituents. This impact is considered to be less than significant. No mitigation is required.

20 **Impact WQ-30: Effects on TSS and Turbidity Resulting from Implementation of CM2–CM22**

21 **NEPA Effects:** Effects of CM2–CM22 on TSS and turbidity under Alternative 8 are the same as those
22 discussed for Alternative 1A and are considered to not be adverse.

23 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 8 would be similar to
24 those proposed under Alternative 1A. As such, effects on TSS and turbidity resulting from the
25 implementation of CM2–CM22 would be similar to that previously discussed for Alternative 1A. This
26 impact is considered to be less than significant. No mitigation is required.

27 **Impact WQ-31: Water Quality Effects Resulting from Construction-Related Activities (CM1–** 28 **CM22)**

29 The conveyance features for CM1 under Alternative 8 would be very similar to those discussed for
30 Alternative 1A. The primary difference between Alternative 8 and Alternative 1A is that under
31 Alternative 8, there would be two fewer intakes and two fewer pumping plant locations, which
32 would result in a reduced level of construction activity. Additional construction activity also would
33 occur to restore channel margin and seasonally inundated floodplain habitats. However,
34 construction techniques and locations of major features of the conveyance system within the Delta
35 would be similar. The remainder of the facilities constructed under Alternative 8, including CM2–
36 CM22, would be very similar to, or the same as, those to be constructed for Alternative 1A. However,
37 under Alternative 8, there would be up to 20,000 acres of inundated floodplain habitat restored (as
38 opposed to 10,000 acres under the majority of the other alternatives), thus resulting in increased
39 construction-related disturbances.

40 **NEPA Effects:** The types and magnitude of potential construction-related water quality effects
41 associated with implementation of CM1–CM22 under Alternative 8 would be very similar to the
42 effects discussed for Alternative 1A, and the effects anticipated with implementation of CM2–CM22

1 would be essentially identical. Nevertheless, the construction of CM1, and any individual
 2 components necessitated by CM2, and CM4–CM10, with the implementation of the BMPs specified in
 3 Appendix 3B, *Environmental Commitments*, and other agency permitted construction requirements
 4 would result in the potential water quality effects being largely avoided and minimized. The specific
 5 environmental commitments that would be implemented under Alternative 8 would be similar to
 6 those described for Alternative 1A. Consequently, relative to Existing Conditions, Alternative 8
 7 would not be expected to cause exceedance of applicable water quality objectives/criteria or
 8 substantial water quality degradation with respect to constituents of concern, and thus would not
 9 adversely affect any beneficial uses upstream of the Delta, in the Delta, or in the SWP and CVP
 10 service area.

11 In summary, with implementation of environmental commitments in Appendix 3B, the potential
 12 construction-related water quality effects are considered to be not adverse.

13 **CEQA Conclusion:** Because environmental commitments would be implemented under Alternative 8
 14 for construction-related activities along with agency-issued permits that also contain construction
 15 requirements to protect water quality, the construction-related effects, relative to Existing
 16 Conditions, would not be expected to cause or contribute to substantial alteration of existing
 17 drainage patterns which would result in substantial erosion or siltation on- or off-site, substantial
 18 increased frequency of exceedances of water quality objectives/criteria, or substantially degrade
 19 water quality with respect to the constituents of concern on a long-term average basis, and thus
 20 would not adversely affect any beneficial uses in water bodies upstream of the Delta, within the
 21 Delta, or in the SWP and CVP service area. Moreover, because the construction-related activities
 22 would be temporary and intermittent in nature, the construction would involve negligible
 23 discharges, if any, of bioaccumulative or 303(d) listed constituents to water bodies of the affected
 24 environment. As such, construction activities would not contribute measurably to bioaccumulation
 25 of contaminants in organisms or humans or cause 303(d) impairments to be discernibly worse.
 26 Based on these findings, this impact is determined to be less than significant. No mitigation is
 27 required.

28 **8.4.3.16 Alternative 9—Through Delta/Separate Corridors (15,000 cfs; 29 Operational Scenario G)**

30 Under Alternative 9, two fish-screened intakes would be constructed—one at the Delta Cross Channel
 31 and the other at Georgiana Slough. Water would be conveyed through a flow-collection channel and
 32 radial gates, eventually reaching the existing channel. Once in the channel, water would flow south
 33 through the Mokelumne River and San Joaquin River to Middle River and Victoria Canal, which
 34 would be dredged to accommodate increased flows. Along the way, diverted water would be guided
 35 by operable barriers. Water flowing through Victoria Canal would lead into two new canal segments
 36 and pass under two existing watercourses through culvert siphons, eventually reaching Clifton
 37 Court Forebay. From there, water would flow through existing SWP facilities, and a new canal would
 38 be constructed to connect the forebay to CVP facilities. Water supply and conveyance operational
 39 criteria under Alternative 9 would be guided by criteria identified in Scenario G. Conservation
 40 Measures 2–22 (CM2–22) would be implemented under this alternative, and would be the same as
 41 those under Alternative 1A. See Chapter 3, *Description of Alternatives*, Section 3.5.16, for additional
 42 details on Alternative 9.

1 **Effects of the Alternative on Delta Hydrodynamics**

2 Under the No Action Alternative and Alternatives 1–9, the following two primary factors can
3 substantially affect water quality within the Delta:

- 4 • Within the south, west, and interior Delta, a decrease in the percentage of Sacramento River-
5 sourced water and a concurrent increase in San Joaquin River-sourced water can increase the
6 concentrations of numerous constituents (e.g., boron, bromide, chloride, electrical conductivity,
7 nitrate, organic carbon, some pesticides, selenium). This source water replacement is caused by
8 decreased exports of San Joaquin River water (due to increased Sacramento River water
9 exports), or effects of climate change on timing of flows in the rivers. Changes in channel flows
10 also can affect water residence time and many related physical, chemical, and biological
11 variables.
- 12 • Particularly in the west Delta, sea water intrusion as a result of sea level rise or decreased Delta
13 outflow can increase the concentration of salts (bromide, chloride) and levels of electrical
14 conductivity. Conversely, increased Delta outflow (e.g., as a result of Fall X2 operations in wet
15 and above normal water years) will decrease levels of these constituents, particularly in the
16 west Delta.

17 Under Alternative 9, over the long term, average annual delta exports are anticipated to decrease by
18 766 TAF relative to Existing Conditions, and by 63 TAF relative to the No Action Alternative.
19 Although all of the diversions are from the existing south Delta intakes, the operable barriers
20 included under this alternative would result in the exported water containing a higher proportion of
21 Sacramento River water as opposed to San Joaquin River water (see Chapter 5, *Water Supply*, for
22 more information). The result of this is greatly increased San Joaquin River water influence
23 throughout the south, west, and interior Delta, and a corresponding decrease in Sacramento River
24 water influence. This can be seen, for example, in Appendix 8D, ALT 9–Old River at Rock Slough for
25 ALL years (1976–1991), which shows increased San Joaquin River (SJR) percentage and decreased
26 Sacramento River (SAC) percentage under the alternative, relative to Existing Conditions and the No
27 Action Alternative.

28 Under Alternative 9, long-term average annual Delta outflow is anticipated to increase 807 TAF
29 relative to Existing Conditions, due to both changes in operations (including use of operable barriers
30 and numerous other operational components of Scenario G) and climate change/sea level rise (see
31 Chapter 5, *Water Supply*, for more information). The result of this is decreased sea water intrusion in
32 the west Delta. The decrease of sea water intrusion in the west Delta under Alternative 9 is greater
33 relative to the Existing Conditions because it does not include operations to meet Fall X2, whereas
34 the No Action alternative and Alternative 9 do. Long-term average annual Delta outflow is
35 anticipated to increase under Alternative 9 by 57 TAF relative to the No Action Alternative, due only
36 to changes in operations. The decreases in sea water intrusion (represented by an decrease in San
37 Francisco Bay (BAY) percentage) can be seen, for example, in Appendix 8D, ALT 9–Sacramento River
38 at Mallard Island for ALL years (1976–1991).

39 **Impact WQ-1: Effects on Ammonia Concentrations Resulting from Facilities Operations and** 40 **Maintenance (CM1)**

41 ***Upstream of the Delta***

42 For the same reasons stated for the No Action Alternative, Alternative 9 would have negligible, if
43 any, effect on ammonia concentrations in the rivers and reservoirs upstream of the Delta relative to

Existing Conditions and the No Action Alternative. Any negligible increases in ammonia-N concentrations that could occur in the water bodies of the affected environment located upstream of the Delta would not be of frequency, magnitude and geographic extent that would adversely affect any beneficial uses or substantially degrade the quality of these water bodies, with regard to ammonia.

Delta

Assessment of effects of ammonia under Alternative 9 is the same as discussed under Alternative 1A, except that because flows in the Sacramento River at Freeport are different between the two alternatives, estimated monthly average and long term annual average predicted ammonia-N concentrations in the Sacramento River downstream of Freeport are different.

As Table 8-72 shows, estimated ammonia-N concentrations in the Sacramento River downstream of Freeport (upon full mixing of the SRWTP discharge with river water) under Alternative 9 and the No Action Alternative are expected to be similar. Minor increases in ammonia-N concentrations would occur during January through March, July, October, and December, and remaining months would be unchanged or have a minor decrease. A minor increase in the annual average concentration would occur under Alternative 9, compared to the No Action Alternative. Moreover, the estimated concentrations downstream of Freeport under Alternative 9 would be similar to existing source water concentrations for the San Francisco Bay and San Joaquin River. Consequently, changes in source water fraction anticipated under Alternative 9, relative to the No Action Alternative, are not expected to substantially increase ammonia concentrations at any Delta locations.

Table 8-72. Estimated Ammonia-N (mg-L as N) Concentrations in the Sacramento River Downstream of the Sacramento Regional Wastewater Treatment Plant for the No Action Alternative and Alternative 9

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual Average
No Action Alternative	0.074	0.084	0.069	0.060	0.057	0.060	0.058	0.064	0.067	0.060	0.067	0.064	0.065
Alternative 9	0.076	0.084	0.070	0.061	0.058	0.061	0.058	0.063	0.067	0.061	0.067	0.064	0.066

Any negligible increases in ammonia-N concentrations that could occur at certain locations in the Delta would not be of frequency, magnitude, and geographic extent that would adversely affect any beneficial uses or substantially degrade the water quality at these locations, with regards to ammonia.

SWP/CVP Export Service Areas

The assessment of effects on ammonia in the SWP/CVP Export Service Area is based on assessment of ammonia-N concentrations at Banks and Jones pumping plants. Similar to the discussion for Alternative 1A, under Alternative 9 for areas of the Delta that are influenced by Sacramento River water, including Banks and Jones pumping plants, ammonia-N concentrations are expected to decrease, relative to Existing Conditions (in association with less diversion of water influenced by the SRWTP). This decrease in ammonia-N concentrations for water exported via the south Delta pumps is not expected to result in adverse effects on beneficial uses or substantially degrade water quality of exported water, with regards to ammonia.

1 Furthermore, as discussed above for the Plan Area, for all areas of the Delta, including Banks and
2 Jones pumping plants, ammonia-N concentrations are not expected to be substantially different
3 under Alternative 9, relative to No Action Alternative. Any negligible increases in ammonia-N
4 concentrations that could occur at Banks and Jones pumping plants would not be of frequency,
5 magnitude and geographic extent that would adversely affect any beneficial uses or substantially
6 degrade the water quality at these locations, with regards to ammonia.

7 **NEPA Effects:** In summary, based on the discussion above, effects on ammonia from implementation
8 of CM1 are considered to be not adverse.

9 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
10 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
11 purpose of making the CEQA impact determination for this constituent. For additional details on the
12 effects assessment findings that support this CEQA impact determination, see the effects assessment
13 discussion that immediately precedes this conclusion.

14 Ammonia-N concentrations are generally low in the reservoirs and rivers of the watersheds, owing
15 to the lack of substantial point and nonpoint sources of ammonia-N upstream of the SRWTP in the
16 Sacramento River watershed, in the watersheds of the eastern tributaries (Cosumnes, Mokelumne,
17 and Calaveras Rivers), or upstream of the Delta in the San Joaquin River watershed. Consequently,
18 any modified reservoir operations and subsequent changes in river flows under Alternative 9,
19 relative to Existing Conditions, are expected to have negligible, if any, effects on reservoir and river
20 ammonia-N concentrations upstream of Freeport in the Sacramento River watershed and upstream
21 of the Delta in the San Joaquin River watershed.

22 Ammonia-N concentrations in the Sacramento River downstream of the SRWTP would be
23 substantially lower under Alternative 9, relative to Existing Conditions, due to upgrades to the
24 SRWTP that are assumed to be in place, and thus, ammonia concentrations for all areas of the Delta
25 that are influenced by Sacramento River water are expected to decrease. At locations which are not
26 influenced notably by Sacramento River water, concentrations are expected to remain relatively
27 unchanged, due to the similarity in SJR and BAY concentrations and the lack of expected changes in
28 either of these concentrations.

29 The assessment of effects on ammonia in the SWP/CVP Export Service Areas is based on assessment
30 of ammonia-N concentrations at Banks and Jones pumping plants. As discussed above for the Plan
31 Area, for areas of the Delta that are influenced by Sacramento River water, including Banks and
32 Jones pumping plants, ammonia-N concentrations are expected to decrease under Alternative 9,
33 relative to Existing Conditions.

34 Based on the above, there would be no substantial, long-term increase in ammonia-N concentrations
35 in the rivers and reservoirs upstream of the Delta, in the Plan Area, or the waters exported to the
36 CVP and SWP service areas under Alternative 9 relative to Existing Conditions. As such, this
37 alternative is not expected to cause additional exceedance of applicable water quality
38 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
39 on any beneficial uses of waters in the affected environment. Because ammonia concentrations are
40 not expected to increase substantially, no long-term water quality degradation is expected to occur
41 and, thus, no adverse effects on beneficial uses would occur. Ammonia is not 303(d) listed within the
42 affected environment and thus any minor increases that could occur in some areas would not make
43 any existing ammonia-related impairment measurably worse because no such impairments
44 currently exist. Because ammonia-N is not bioaccumulative, minor increases that could occur in

1 some areas would not bioaccumulate to greater levels in aquatic organisms that would, in turn, pose
2 substantial health risks to fish, wildlife, or humans. This impact is considered to be less than
3 significant. No mitigation is required.

4 **Impact WQ-2: Effects on Ammonia Concentrations Resulting from Implementation of CM2–** 5 **CM22**

6 **NEPA Effects:** Effects of CM2–CM22 on ammonia under Alternative 9 are the same as those
7 discussed for Alternative 1A and are considered to be not adverse.

8 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 9 would be similar to
9 those proposed under Alternative 1A. As such, effects on ammonia resulting from the
10 implementation of CM2–CM22 would be similar to that previously discussed for Alternative 1A. This
11 impact is considered to be less than significant. No mitigation is required.

12 **Impact WQ-3: Effects on Boron Concentrations Resulting from Facilities Operations and** 13 **Maintenance (CM1)**

14 ***Upstream of the Delta***

15 Effects of CM1 on boron under Alternative 9 in areas upstream of the Delta would be very similar to
16 the effects discussed for Alternative 1A. There would be no expected change to the sources of boron
17 in the Sacramento and east-side tributary watersheds, and resultant changes in flows from altered
18 system-wide operations would have negligible, if any, effects on the concentration of boron in the
19 rivers and reservoirs of these watersheds. The modeled long-term annual average lower San Joaquin
20 River flow at Vernalis would decrease slightly compared to Existing Conditions (in association with
21 changed operations, climate change, and increased water demands) and the No Action Alternative
22 considering only changes due to Alternative 9 operations. The reduced flow would result in possible
23 increases in long-term average boron concentrations of up to about 3% relative to the Existing
24 Conditions (Appendix 8F, Table 24). The increased boron concentrations would not increase the
25 frequency of exceedances of any applicable objectives or criteria and would not be expected to cause
26 further degradation at measurable levels in the lower San Joaquin River, and thus would not cause
27 the existing impairment there to be discernibly worse. Consequently, Alternative 9 would not be
28 expected to cause exceedance of boron objectives/criteria or substantially degrade water quality
29 with respect to boron, and thus would not adversely affect any beneficial uses of the Sacramento
30 River, the east-side tributaries, associated reservoirs upstream of the Delta, or the San Joaquin River.

31 ***Delta***

32 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
33 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
34 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
35 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
36 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
37 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

38 Relative to the Existing Conditions and No Action Alternative, Alternative 9 would result in similar
39 or reduced long-term average boron concentrations for the 16-year period modeled at northern and
40 eastern Delta locations, with a substantial reduction in boron concentrations in the San Joaquin
41 River at Buckley Cove. Long-term average boron concentrations would increase at interior and

1 western Delta locations (by as much as 66% at Franks Tract, 80% at Old River at Rock Slough, and
2 9% at the Sacramento River at Emmaton) (Appendix 8F, Table Bo-22). The comparison to Existing
3 Conditions reflects changes due to both Alternative 9 operations (including use of operable barriers
4 and numerous other operational components of Scenario G) and climate change/sea level rise. The
5 comparison to the No Action Alternative reflects changes due only to operations.

6 Implementation of tidal habitat restoration under CM4 also may contribute to increased boron
7 concentrations at western Delta assessment locations (more discussion of this phenomenon is
8 included in Section 8.3.1.3), and thus would not be anticipated to substantially affect agricultural
9 diversions which occur primarily at interior Delta locations. The long-term annual average and
10 monthly average boron concentrations, for either the 16-year period or drought period modeled,
11 would never exceed the 2,000 µg/L human health advisory objective (i.e., for children) or 500 µg/L
12 agricultural objective at any of the eleven Delta assessment locations, which represents no change
13 from the Existing Conditions and No Action Alternative (Appendix 8F, Table Bo-3A). The increased
14 concentrations at interior Delta locations would result in moderate reductions in the long-term
15 average assimilative capacity of up to 33% at Franks Tract and up to 46% at Old River at Rock
16 Slough locations (Appendix 8F, Table Bo-23). However, because the absolute boron concentrations
17 would still be well below the lowest 500 µg/L objective for the protection of the agricultural
18 beneficial use under Alternative 9, the levels of boron degradation would not be of sufficient
19 magnitude to substantially increase the risk of exceeding objectives or cause adverse effects to
20 municipal and agricultural water supply beneficial uses, or any other beneficial uses, in the Delta
21 (Appendix 8F, Figure Bo-5).

22 ***SWP/CVP Export Service Areas***

23 Effects of CM1 on boron under Alternative 9 in the Delta would be similar to the effects discussed for
24 Alternative 1A. Under Alternative 9, long-term average boron concentrations would decrease by as
25 much as 18% at the Banks Pumping Plant and by as much as 31% at Jones Pumping Plant relative to
26 Existing Conditions and No Action Alternative (Appendix 8F, Table Bo-22) as a result of export of a
27 greater proportion of low-boron Sacramento River water. Commensurate with the decrease in
28 exported boron concentrations, boron concentrations in the lower San Joaquin River may be
29 reduced and would likely alleviate or lessen any expected increase in boron concentrations at
30 Vernalis associated with flow reductions (see discussion of Upstream of the Delta), as well as
31 locations in the Delta receiving a large fraction of San Joaquin River water. Reduced export boron
32 concentrations also may contribute to reducing the existing 303(d) impairment in the lower San
33 Joaquin River and associated TMDL actions for reducing boron loading.

34 Maintenance of SWP and CVP facilities under Alternative 9 would not be expected to create new
35 sources of boron or contribute towards a substantial change in existing sources of boron in the
36 affected environment. Maintenance activities would not be expected to cause any substantial
37 increases in boron concentrations or degradation with respect to boron such that objectives would
38 be exceeded more frequently, or any beneficial uses would be adversely affected anywhere in the
39 affected environment.

40 ***NEPA Effects:*** In summary, relative to the No Action Alternative conditions, Alternative 9 would
41 result in moderate increases in long-term average boron concentrations in the Delta and not
42 appreciably change boron levels in the lower San Joaquin River. However, the predicted changes in
43 the Delta would not be expected to result in exceedances of applicable objectives or further water

1 quality degradation such that objectives would likely be exceeded or there would be substantially
2 increased risk of adverse effect on water quality.

3 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
4 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
5 purpose of making the CEQA impact determination for this constituent. For additional details on the
6 effects assessment findings that support this CEQA impact determination, see the effects assessment
7 discussion that immediately precedes this conclusion.

8 Boron is not a constituent of concern in the Sacramento River watershed upstream of the Delta, thus
9 river flow rate and reservoir storage reductions that would occur under the Alternative 9, relative to
10 Existing Conditions, would not be expected to result in a substantial adverse change in boron levels.
11 Additionally, relative to Existing Conditions, Alternative 9 would not result in reductions in river
12 flow rates (i.e., less dilution) or increased boron loading such that there would be any substantial
13 increases in boron concentration upstream of the Delta in the San Joaquin River watershed.

14 Moderate increased boron levels (i.e., up to 82% increased concentration) and degradation
15 predicted for interior and western Delta locations in response to a shift in the Delta source water
16 percentages and tidal habitat restoration under this alternative would not be expected to cause
17 exceedances of objectives. Alternative 9 maintenance also would not result in any substantial
18 increases in boron concentrations in the affected environment. Boron concentrations would be
19 reduced in water exported from the Delta to the CVP/SWP Export Service Areas, thus reflecting a
20 potential improvement to boron loading in the lower San Joaquin River.

21 Boron is not a bioaccumulative constituent, thus any increased concentrations under Alternative 9
22 would not result in adverse boron bioaccumulation effects to aquatic life or humans. Relative to
23 Existing Conditions, Alternative 9 would not result in substantially increased boron concentrations
24 such that frequency of exceedances of municipal and agricultural water supply objectives would
25 increase. The levels of boron degradation that may occur under Alternative 9, while widespread in
26 particular at interior Delta locations, would not be of sufficient magnitude to cause substantially
27 increased risk for adverse effects to municipal or agricultural beneficial uses within the affected
28 environment. Long-term average boron concentrations would decrease in Delta water exports to the
29 SWP and CVP service area, which may contribute to reducing the existing 303(d) impairment of
30 agricultural beneficial uses in the lower San Joaquin River. Consequently, Alternative 9 would not be
31 expected to cause any substantial increases in boron concentrations or degradation with respect to
32 boron such that objectives would be exceeded more frequently, or any beneficial uses would be
33 adversely affected anywhere in the affected environment. Based on these findings, this impact is
34 determined to be less than significant. No mitigation is required.

35 **Impact WQ-4: Effects on Boron Concentrations Resulting from Implementation of CM2–CM22**

36 **NEPA Effects:** Effects of CM2–CM22 on boron under Alternative 9 are the same as those discussed
37 for Alternative 1A and are determined to be not adverse.

38 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 9 would be similar to
39 those proposed under Alternative 1A. As such, effects on boron resulting from the implementation
40 of CM2–CM22 would be similar to that previously discussed for Alternative 1A. This impact is
41 considered to be less than significant. No mitigation is required.

1 **Impact WQ-5: Effects on Bromide Concentrations Resulting from Facilities Operations and**
2 **Maintenance (CM1)**

3 ***Upstream of the Delta***

4 Under Alternative 9 there would be no expected change to the sources of bromide in the Sacramento
5 and eastside tributary watersheds. Bromide loading in these watersheds would remain unchanged
6 and resultant changes in flows from altered system-wide operations under Alternative 9 would have
7 negligible, if any, effects on the concentration of bromide in the rivers and reservoirs of these
8 watersheds. Consequently, Alternative 9 would not be expected to adversely affect the MUN
9 beneficial use, or any other beneficial uses, of the Sacramento River, the eastside tributaries, or their
10 associated reservoirs upstream of the Delta.

11 Under Alternative 9, modeling indicates that long-term annual average flows on the San Joaquin
12 River would decrease by 6%, relative to Existing Conditions and would remain virtually the same
13 relative to the No Action Alternative (Appendix 5A). These decreases in flow would result in
14 possible increases in long-term average bromide concentrations of about 3% relative to Existing
15 Conditions and less than <1% relative to the No Action Alternative (Appendix 8E, Bromide Table
16 22). The small increases in lower San Joaquin River bromide levels that could occur under
17 Alternative 9, relative to existing and No Action Alternative conditions would not be expected to
18 adversely affect the MUN beneficial use, or any other beneficial uses, of the lower San Joaquin River.

19 ***Delta***

20 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
21 and CM4) would affect Delta hydrodynamics. To the extent that restoration actions alter
22 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
23 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
24 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
25 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

26 Using the mass-balance modeling approach for bromide (see Section 8.3.1.3), relative to Existing
27 Conditions, Alternative 9 would result in increases in long-term average bromide concentrations at
28 Buckley Cove (for the modeled drought period only), Emmaton, and Barker Slough, while long-term
29 average concentrations would decrease at the other assessment locations (Appendix 8E, *Bromide*,
30 Table 20). With regard to bromide, Emmaton is a suitable source of raw drinking water on a
31 seasonal basis. While the relative change in long-term average bromide concentration at Emmaton is
32 considerable ($\leq 32\%$), the increase in the average would be due to more frequent seasonal peak
33 concentrations in excess of 1,000 $\mu\text{g/L}$ relative to Existing Conditions (Appendix 8E, *Bromide*, Figure
34 2). At Emmaton the predicted 50 $\mu\text{g/L}$ exceedance frequency would increase only slightly from 82%
35 under Existing Conditions to 86% under Alternative 9 (98% to 100% for the modeled drought
36 period), and the predicted 100 $\mu\text{g/L}$ exceedance frequency would increase from 72% under Existing
37 Conditions to 81% under Alternative 9 (93% to 97% for the modeled drought period), indicative of
38 very small changes during seasonally suitable periods of potential use. At Barker Slough, predicted
39 long-term average bromide concentrations would increase from 51 $\mu\text{g/L}$ to 61 $\mu\text{g/L}$ (19% relative
40 increase) for the modeled 16-year hydrologic period and 54 $\mu\text{g/L}$ to 100 $\mu\text{g/L}$ (88% relative
41 increase) for the modeled drought period. At Barker Slough, the predicted 50 $\mu\text{g/L}$ exceedance
42 frequency would decrease from 49% under Existing Conditions to 41% under Alternative 9, but
43 would increase from 55% to 80% during the drought period. At Barker Slough, the predicted 100
44 $\mu\text{g/L}$ exceedance frequency would increase from 0% under Existing Conditions to 16% under

1 Alternative 9, and would increase from 0% to 42% during the drought period. At Buckley Cove,
2 predicted long-term average bromide concentrations would remain the same (i.e., 259 µg/L), but
3 would increase from 272 µg/L to 330 µg/L (21% relative increase) for the modeled drought period.
4 At Buckley Cove, the predicted 50 µg/L exceedance frequency would not change (i.e., 100%
5 exceedance), but the modeled 100 µg/L exceedance frequency would decrease from 100% under
6 Existing Conditions to 90% under Alternative 9 (100% to 87% for the modeled drought period).
7 This comparison to Existing Conditions reflects changes in bromide due to both Alternative 9
8 operations (including use of operable barriers and numerous other operational components of
9 Scenario G) and climate change/sea level rise.

10 Due to the relatively small differences between modeled Existing Conditions and No Action
11 baselines, changes in long-term average bromide concentrations and changes in exceedance
12 frequencies relative to the No Action Alternative are generally of similar magnitude to those
13 previously described for the existing condition comparison (Appendix 8E, *Bromide*, Table 20).
14 Modeled long-term average bromide concentration at Emmaton would increase by as much as 36%,
15 but change in 50 and 100 µg/L exceedance thresholds would be smaller than that described for the
16 existing condition comparison, indicative of very small changes during seasonally suitable periods of
17 potential use. Modeled long-term average bromide concentration at Barker Slough is predicted to
18 increase by 23% (87% for the modeled drought period) relative to the No Action Alternative.
19 Modeled long-term average bromide concentration increases at Buckley Cove are predicted to
20 increase by 7% (36% for the modeled drought period) relative to the No Action Alternative. Unlike
21 the comparison to Existing Conditions, this comparison to the No Action Alternative reflects changes
22 in bromide due only to Alternative 9 operations.

23 At Barker Slough, modeled long-term average bromide concentrations for the various baseline
24 conditions are very similar ($\leq 4\%$) (Appendix 8E, *Bromide*, Table 20). Such similarity demonstrates
25 that the modeled Alternative 9 change in bromide is almost entirely due to Alternative 9 operations,
26 and not climate change/sea level rise. Therefore, operations are the primary driver of effects on
27 bromide at Barker Slough, regardless whether Alternative 9 is compared to Existing Conditions, or
28 compared to the No Action Alternative.

29 Results of the modeling approach which used relationships between EC and chloride and between
30 chloride and bromide (see Section 8.3.1.3) differed somewhat from what is presented above for the
31 mass-balance approach (see Appendix 8E, Table 21). For most locations, the frequency of
32 exceedance of the 50 µg/L and 100 µg/L were similar. The greatest difference between the methods
33 was predicted for Barker Slough. The increases in frequency of exceedance of the 100 µg/L
34 threshold, relative to Existing Conditions and the No Action Alternative, were not as great using this
35 alternative EC to chloride and chloride to bromide relationship modeling approach as compared to
36 that presented above from the mass-balance modeling approach. However, there were still
37 substantial increases, resulting in 9% exceedance over the modeled period under Alternative 9, as
38 compared to 1% under Existing Conditions and 2% under the No Action Alternative. For the drought
39 period, exceedance frequency increased from 0% under Existing Conditions and the No Action
40 Alternative, to 23% under Alternative 9. Furthermore, concentrations predicted at Buckley Cove
41 also differed. The EC to chloride and chloride to bromide relationship modeling approach predicted
42 that concentrations at Buckley cove would decrease under Alternative 9 on both a long term basis
43 and under the modeled drought period, relative to Existing Conditions and the No Action
44 Alternative. This is in contrast to the mass-balance approach presented above, which predicted an
45 increase in concentrations under the drought period. Because the mass-balance approach predicts a

1 greater level of impact at Barker Slough, determination of impacts was based on the mass-balance
2 results.

3 While the increase in long-term average bromide concentrations at Buckley Cove are relatively
4 small when modeled over a representative 16-year hydrologic period, increases during the modeled
5 drought period, principally the long-term average bromide concentration greater than 300 µg/L,
6 would represent a substantial change in source water quality to the City of Stockton during a season
7 of drought. Additionally, the increase in long-term average bromide concentrations predicted at
8 Barker Slough, principally the relative increase in 100 µg/L exceedance frequency, would result in a
9 substantial change in source water quality for existing drinking water treatment plants drawing
10 water from the North Bay Aqueduct. While the implications of such modeled changes in bromide
11 concentrations at Buckley Cove and Barker Slough is difficult to predict, the substantial modeled
12 increases could lead to adverse changes in the formation of disinfection byproducts such that
13 considerable treatment plant upgrades may be necessary in order to achieve equivalent levels of
14 health protection. Because many of the other modeled locations already frequently exceed the 100
15 µg/L threshold under Existing Conditions and the No Action Alternative, these locations likely
16 already require treatment plant technologies to achieve equivalent levels of health protection, and
17 thus no additional treatment technologies would be triggered by the small increases in the
18 frequency of exceeding the 100 µg/L threshold. Hence, no further impact on the drinking water
19 beneficial use would be expected at these locations.

20 The seasonal intakes at Mallard Slough and City of Antioch are infrequently used due to water
21 quality constraints related to sea water intrusion. On a long-term average basis, bromide at these
22 locations is in excess of 3,000 µg/L, but during seasonal periods of high Delta outflow can be <300
23 µg/L. Based on modeling using the mass-balance approach, use of the seasonal intakes at Mallard
24 Slough and City of Antioch under Alternative 9 would experience a period average increase in
25 bromide during the months when these intakes would most likely be utilized. For those wet and
26 above normal water year types where mass balance modeling would predict water quality typically
27 suitable for diversion, predicted long-term average bromide would increase from 103 µg/L to 140
28 µg/L (37% increase) at City of Antioch and would decrease from 150 µg/L to 146 µg/L (3%
29 decrease) at Mallard Slough relative to Existing Conditions (Appendix 8E, *Bromide*, Table 23).
30 Changes would be similar for the No Action Alternative comparison. Modeling results using the EC to
31 chloride and chloride to bromide relationships show increases during these months, but the relative
32 magnitude of the increases is much lower (Appendix 8E, *Bromide* Table 24). Regardless of the
33 differences in the data between the two modeling approaches, the decisions surrounding the use of
34 these seasonal intakes is largely driven by acceptable water quality, and thus have historically been
35 opportunistic. Opportunity to use these intakes would remain, and the predicted increases in
36 bromide concentrations at the City of Antioch and Mallard Slough intake would not be expected to
37 adversely affect MUN beneficial uses, or any other beneficial use, at these locations.

38 Based on modeling using the mass-balance approach, relative to existing and No Action Alternative
39 conditions, Alternative 9 would lead to predicted improvements in long-term average bromide
40 concentrations at Staten Island, Franks Tract, Rock Slough, and Contra Costa PP No. 1, in addition to
41 Banks and Jones (discussed below). At Staten Island and Franks Tract, long-term average bromide
42 concentrations would be predicted to decrease by 4–21% depending on baseline comparison, while
43 at Rock Slough and Contra Costa PP No. 1, long-term average bromide concentrations would be
44 predicted to decrease by 40–45%, depending on baseline comparison. Modeling results using the EC
45 to chloride and chloride to bromide relationships generally do not show similar decreases for Rock

1 Slough and Contra Costa PP No. 1, but rather, predict small increases. Based on the small magnitude
2 of increases predicted, these increases would not adversely affect beneficial uses at those locations.

3 **SWP/CVP Export Service Areas**

4 Under Alternative 9, improvement in long-term average bromide concentrations would occur at the
5 Banks and Jones pumping plants, with exception to the modeled drought period when compared the
6 No Action Alternative. Long-term average bromide concentrations for the modeled 16-year
7 hydrologic period at these locations would decrease by as much as 21% relative to Existing
8 Conditions and 9% relative to the No Action Alternative (Appendix 8E, *Bromide*, Table 20). However,
9 during the modeled drought period, long-term average bromide concentrations would increase by
10 as much as 12% relative to the No Action Alternative. Exceedances of the 50 µg/L assessment
11 threshold would remain virtually the same for both Banks and Jones, but exceedance of the 100
12 µg/L assessment threshold would decrease, from 100% to 81% at Banks and from 100% to 80% at
13 Jones (100% to 77% for the modeled drought period at both Banks and Jones). Lower long-term
14 average bromide concentrations at Banks and Jones would result in overall improvement in Export
15 Service Areas water quality respective to bromide. Commensurate with the decrease in exported
16 bromide, an improvement in lower San Joaquin River bromide would also be observed since
17 bromide in the lower San Joaquin River is principally related to irrigation water deliveries from the
18 Delta. While the magnitude of this expected lower San Joaquin River improvement in bromide is
19 difficult to predict, the relative decrease in overall loading of bromide to the Export Service Areas
20 would likely alleviate or lessen any expected increase in bromide concentrations at Vernalis (see
21 discussion of Upstream of the Delta) as well as locations in the Delta receiving a large fraction of San
22 Joaquin River water, such as much of the south Delta.

23 The discussion above is based on results of the mass-balance modeling approach. Results of the
24 modeling approach which used relationships between EC and chloride and between chloride and
25 bromide (see Section 8.3.1.3) were consistent with the discussion above, and assessment of bromide
26 using these data results in the same conclusions as are presented above for the mass-balance
27 approach (see Appendix 8E, *Bromide*, Table 21).

28 Similar to the discussion pertaining to the No Action Alternative, maintenance of SWP and CVP
29 facilities under Alternative 9 would not be expected to create new sources of bromide or contribute
30 towards a substantial change in existing sources of bromide in the affected environment.
31 Maintenance activities would not be expected to cause any substantial change in bromide such that
32 MUN beneficial uses, or any other beneficial use, would be adversely affected anywhere in the
33 affected environment.

34 **NEPA Effects:** In summary, Alternative 9 operations and maintenance, relative to the No Action
35 Alternative, would result in small increases (i.e., <1%) in long-term average bromide concentrations
36 at Vernalis related to relatively small declines in long-term average flow on the San Joaquin River.
37 However, Alternative 9 operation and maintenance activities would cause substantial degradation
38 to water quality with respect to bromide at Barker Slough, source of the North Bay Aqueduct.
39 Resultant substantial change in long-term average bromide at Barker Slough could necessitate
40 changes in water treatment plant operations or require treatment plant upgrades in order to
41 maintain DBP compliance, and thus would constitute an adverse effect on water quality. Mitigation
42 Measure WQ-5 is available to reduce these effects (implementation of this measure along with a
43 separate, non-environmental commitment as set forth in EIR/EIS Appendix 3B, *Environmental*

1 *Commitments*, relating to the potential increased treatment costs associated with bromide-related
2 changes would reduce these effects).

3 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
4 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
5 purpose of making the CEQA impact determination for this constituent. For additional details on the
6 effects assessment findings that support this CEQA impact determination, see the effects assessment
7 discussion that immediately precedes this conclusion.

8 Under Alternative 9 there would be no expected change to the sources of bromide in the Sacramento
9 and eastside tributary watersheds. Bromide loading in these watersheds would remain unchanged
10 and resultant changes in flows from altered system-wide operations under Alternative 9 would have
11 negligible, if any, effects on the concentration of bromide in the rivers and reservoirs of these
12 watersheds. However, south of the Delta, the San Joaquin River is a substantial source of bromide,
13 primarily due to the use of irrigation water imported from the southern Delta. Concentrations of
14 bromide at Vernalis are inversely correlated to net river flow. Under Alternative 9, long-term
15 average flows at Vernalis would decrease only slightly, resulting in less than substantial predicted
16 increases in long-term average bromide of about 3% relative to Existing Conditions.

17 Relative to Existing Conditions, Alternative 9 would result in modeled increases in long-term
18 average bromide concentration at Buckley Cove (for the drought period only), Barker Slough, and
19 Emmaton. While the relative change in long-term average bromide concentration at Emmaton is
20 considerable ($\leq 32\%$), the increase in the average would be due to more frequent seasonal peak
21 concentrations in excess of 1,000 $\mu\text{g}/\text{L}$ relative to Existing Conditions, rather than substantial
22 increases during seasonally suitable periods of potential use. However, substantial increases in long-
23 term average bromide at Barker Slough and Buckley Cove (i.e., vicinity of the City of Stockton's
24 drinking water intake) during a season of drought could lead to adverse changes in the formation of
25 disinfection byproducts at drinking water treatment plants such that considerable water treatment
26 plant upgrades would be necessary in order to achieve equivalent levels of drinking water health
27 protection.

28 The assessment of effects on bromide in the SWP/CVP Export Service Areas is based on assessment
29 of changes in bromide concentrations at Banks and Jones pumping plants. Under Alternative 9,
30 substantial improvement would occur at the Banks and Jones pumping plants, where predicted
31 long-term average bromide concentrations are predicted to decrease by as much as 21% relative to
32 Existing Conditions. An overall improvement in bromide-related water quality would be predicted
33 in the SWP/CVP Export Service Areas.

34 Based on the above, Alternative 9 operation and maintenance would not result in any substantial
35 change in long-term average bromide concentration upstream of the Delta. Furthermore, under
36 Alternative 9, water exported from the Delta to the SWP/CVP service area would be substantially
37 improved relative to bromide. Bromide is not bioaccumulative, therefore change in long-term
38 average bromide concentrations would not directly cause bioaccumulative problems in aquatic life
39 or humans. Additionally, bromide is not a constituent related to any 303(d) listings. Alternative 9
40 operation and maintenance activities would not cause substantial long-term degradation to water
41 quality respective to bromide with the exception of water quality at Buckley Cove (drought period
42 only) and Barker Slough. At Buckley Cove, modeled long-term annual average concentrations of
43 bromide would increase from 272 $\mu\text{g}/\text{L}$ to 330 $\mu\text{g}/\text{L}$ (21% relative increase) during the modeled
44 drought period. At Barker Slough, modeled long-term annual average concentrations of bromide

1 would increase from 54 µg/L to 100 µg/L (88% relative increase) for the modeled drought period.
2 Furthermore, for Barker Slough the frequency of predicted bromide concentrations exceeding 100
3 µg/L would increase from 0% under Existing Conditions to 16% under Alternative 9 (0% to 42% for
4 the modeled drought period). Substantial changes in long-term average bromide at these locations
5 could necessitate changes in treatment plant operation or require treatment plant upgrades in order
6 to maintain DBP compliance. The model predicted change at Buckley Cove during the drought
7 period and at Barker Slough is substantial and, therefore, would represent a substantially increased
8 risk for adverse effects on existing MUN beneficial uses should treatment upgrades not be
9 undertaken. The impact is considered significant. However, there is no feasible mitigation available
10 for identified impacts at Buckley Cove, which would remain significant and unavoidable during
11 drought periods.

12 Implementation of Mitigation Measure WQ-5 along with a separate, non-environmental
13 commitment relating to the potential increased treatment costs associated with bromide-related
14 changes would reduce these effects. While mitigation measures to reduce these water quality effects
15 in affected water bodies to less than significant levels are not available, implementation of
16 Mitigation Measure WQ-5 is recommended to attempt to reduce the effect that increased bromide
17 concentrations may have on Delta beneficial uses. However, because the effectiveness of this
18 mitigation measure to result in feasible measures for reducing water quality effects is uncertain, this
19 impact is considered to remain significant and unavoidable. Please see Mitigation Measure WQ-5
20 under Impact WQ-5 in the discussion of Alternative 1A.

21 In addition to and to supplement Mitigation Measure WQ-5, the BDCP proponents have incorporated
22 into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*, a separate, non-
23 environmental commitment to address the potential increased water treatment costs that could
24 result from bromide-related concentration effects on municipal water purveyor operations.
25 Potential options for making use of this financial commitment include funding or providing other
26 assistance towards implementation of the North Bay Aqueduct AIP, acquiring alternative water
27 supplies, or other actions to indirectly reduce the effects of elevated bromide and DOC in existing
28 water supply diversion facilities. Please refer to Appendix 3B, *Environmental Commitments*, for the
29 full list of potential actions that could be taken pursuant to this commitment in order to reduce the
30 water quality treatment costs associated with water quality effects relating to chloride, electrical
31 conductivity, and bromide.

32 **Mitigation Measure WQ-5: Avoid, Minimize, or Offset, as Feasible, Adverse Water Quality** 33 **Conditions**

34 Please see Mitigation Measure WQ-5 under Impact WQ-5 in the discussion of Alternative 1A.

35 **Impact WQ-6: Effects on Bromide Concentrations Resulting from Implementation of CM2- 36 CM22**

37 **NEPA Effects:** Conservation Measures 2–22 under Alternative 9 would be similar to those under
38 Alternative 1A, but with changes in the south Delta to accommodate the modified corridors. As
39 discussed for Alternative 1A, implementation of CM2–CM22 would not present new or substantially
40 changed sources of bromide to the study area. Some conservation measures may replace or
41 substitute for existing irrigated agriculture in the Delta. This replacement or substitution is not
42 expected to substantially increase or present new sources of bromide. CM2–CM22 would not be

1 expected to cause any substantial change in bromide such that MUN beneficial uses, or any other
2 beneficial use, would be adversely affected anywhere in the affected environment.

3 In summary, implementation of CM2–CM22 under Alternative 9, relative to the No Action
4 Alternative, would have negligible, if any, effects on bromide concentrations. The effects on bromide
5 from implementing CM2–CM22 are determined to not be adverse.

6 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 9 would be similar to
7 those proposed under Alternative 1A. As discussed for Alternative 1A, implementation of CM2–
8 CM22 would not present new or substantially changed sources of bromide to the study area. As
9 such, effects on bromide resulting from the implementation of CM2–CM22 would be similar to that
10 previously discussed for Alternative 1A. This impact is considered to be less than significant. No
11 mitigation is required.

12 **Impact WQ-7: Effects on Chloride Concentrations Resulting from Facilities Operations and** 13 **Maintenance (CM1)**

14 ***Upstream of the Delta***

15 Under Alternative 9 there would be no expected change to the sources of chloride in the Sacramento
16 and eastside tributary watersheds. Chloride loading in these watersheds would remain unchanged
17 and resultant changes in flows from altered system-wide operations would have negligible, if any,
18 effects on the concentration of chloride in the rivers and reservoirs of these watersheds. The
19 modeled long-term annual average flows on the lower San Joaquin River at Vernalis would decrease
20 slightly compared to Existing Conditions and be similar compared to the No Action Alternative (as a
21 result of climate change). The reduced flow would result in possible increases in long-term average
22 chloride concentrations of about 2%, relative to the Existing Conditions and no change relative to No
23 Action Alternative (Appendix 8G, Table Cl-62). Consequently, Alternative 9 would not be expected to
24 cause exceedance of chloride objectives/criteria or substantially degrade water quality with respect
25 to chloride, and thus would not adversely affect any beneficial uses of the Sacramento River, the
26 eastside tributaries, associated reservoirs upstream of the Delta, or the San Joaquin River.

27 ***Delta***

28 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
29 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
30 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
31 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
32 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
33 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

34 Relative to the Existing Conditions and No Action Alternative, Alternative 9 would result in similar
35 or reduced long-term average chloride concentrations for the 16-year period modeled at some of
36 the assessment locations, and, depending on the modeling approach (see Section 8.3.1.3), increased
37 concentrations at the North Bay Aqueduct at Barker Slough (i.e., up to 20% compared to No Action
38 Alternative), Contra Costa Canal at Pumping Plant #1 (i.e., up to 23% compared to No Action
39 Alternative), Rock Slough (i.e., up to 20% compared to No Action Alternative), Franks Tract (i.e., up
40 to 29% compared to No Action Alternative), Sacramento River at Emmaton (i.e., up to 25%
41 compared to No Action Alternative), Sacramento River at Mallard Island (i.e., up to 6% compared to
42 No Action Alternative), and North Bay Aqueduct at Barker Slough (i.e., up to 18% compared to No

1 Action Alternative) (Appendix 8G, *Chloride*, Table Cl-55 and Table Cl-56). Moreover, the direction
2 and magnitude of predicted changes for Alternative 9 are similar between the alternatives, thus, the
3 effects relative to Existing Conditions and the No Action Alternative are discussed together.
4 Additionally, implementation of tidal habitat restoration under CM4 would increase the tidal
5 exchange volume in the Delta, and thus may contribute to increased chloride concentrations in the
6 Bay source water as a result of increased salinity intrusion. More discussion of this phenomenon is
7 included in Section 8.3.1.3. Consequently, while uncertain, the magnitude of chloride increases may
8 be greater than indicated herein and would affect the western Delta assessment locations the most
9 which are influenced to the greatest extent by the Bay source water. The comparison to Existing
10 Conditions reflects changes in chloride due to both Alternative 9 operations (including use of
11 operable barriers and numerous other operational components of Scenario G) and climate
12 change/sea level rise. The comparison to the No Action Alternative reflects changes in chloride due
13 only to operations. The following outlines the modeled chloride changes relative to the applicable
14 objectives and beneficial uses of Delta waters.

15 *Municipal Beneficial Uses*

16 Estimates of chloride concentrations generated using EC-chloride relationships and DSM2 EC output
17 (see Section 8.3.1.3) were used to evaluate the 150 mg/L Bay-Delta WQCP objective for municipal
18 and industrial beneficial uses on a basis of the percent of years the chloride objective is exceeded for
19 the modeled 16-year period. The objective is exceeded if chloride concentrations exceed 150 mg/L
20 for a specified number of days in a given water year at both the Antioch and Contra Costa Pumping
21 Plant #1 locations. For Alternative 9, the modeled frequency of objective exceedance would increase
22 from 6% of years under Existing Conditions and 6% under the No Action Alternative to 19% of years
23 under Alternative 9 (Appendix 8G, Table Cl-64).

24 Similarly, estimates of chloride concentrations generated using EC-chloride relationships and DSM2
25 EC output (see Section 8.3.1.3) were also used to evaluate the 250 mg/L Bay-Delta WQCP objective
26 for chloride at Contra Costa Pumping Plant #1 where daily average objectives apply. The basis for
27 the evaluation was the predicted number of days the objective was exceeded for the modeled 16-
28 year period. For Alternative 9, the modeled frequency of objective exceedance would decrease, from
29 6% of modeled days under Existing Conditions and 5% under the No Action Alternative to 1% of
30 modeled days under Alternative 9 (Appendix 8G, Table Cl-63).

31 Given the limitations inherent to estimating future chloride concentrations (see Section 8.3.1.3),
32 estimation of chloride concentrations through both a mass balance approach and an EC-chloride
33 relationship approach was used to evaluate the 250 mg/L Bay-Delta WQCP objectives in terms of
34 both frequency of exceedance and use of assimilative capacity. When utilizing the mass balance
35 approach to model monthly average chloride concentrations for the 16-year period, the predicted
36 frequency of exceeding the 250 mg/L objective would be eliminated at the Contra Costa Canal at
37 Pumping Plant #1 (24% for Existing Conditions to 0% under Alternative 9), thus indicating
38 complete compliance with this objective would be achieved (Appendix 8G, Table Cl-57 and Figure
39 Cl-13). Compared to Existing Conditions, the frequency of exceedances would not change
40 substantially at the San Joaquin River at Antioch (i.e., increase of 2% from 66% to 68%) or at
41 Mallard Island (i.e., increase 6% from 77% to 83%) and would be similar, or decrease, compared to
42 the No Action Alternative (Appendix 8G, Table Cl-57), and there would be no substantial long-term
43 degradation (Appendix 8G, Table Cl-59).

1 In comparison, when utilizing the chloride-EC relationship to model monthly average chloride
2 concentrations for the 16-year period, trends in frequency of exceedance generally agreed, but use
3 of assimilative capacity were predicted to be larger at some locations (Appendix 8G, Table Cl-58 and
4 Table Cl-60). Specifically, while the model predicted exceedance frequency would decrease at the
5 Contra Costa Canal at Pumping Plant #1, Rock Slough and Franks Tract locations, use of assimilative
6 capacity would increase substantially for the months of February through July at Rock at the Contra
7 Costa Canal at Pumping Plant #1 (i.e., maximum of 79% in March and April for the modeled drought
8 period) and at the San Joaquin River in March and April (i.e., 13% and 14%, respectively). Due to
9 such seasonal long-term average water quality degradation at these locations, the potential exists
10 for substantial adverse effects on the municipal and industrial beneficial uses through reduced
11 opportunity for diversion of water with acceptable chloride levels. Moreover, due to the increased
12 frequency of exceeding the 150 mg/L Bay-Delta WQCP objective, the potential exists for adverse
13 effects on the municipal and industrial beneficial uses at Contra Costa Pumping Plant #1 and
14 Antioch.

15 *303(d) Listed Water Bodies*

16 With respect to the 303(d) listing for chloride in Tom Paine Slough, the monthly average chloride
17 concentrations for the 16-year period modeled at Old River at Tracy Road would generally be
18 similar compared to Existing Conditions, and thus, would not be further degraded on a long-term
19 basis (Appendix 8G, Figure Cl-14). With respect to Suisun Marsh, the monthly average chloride
20 concentrations for the 16-year period modeled would generally increase compared to Existing
21 Conditions and No Action Alternative in some months during October through May at the
22 Sacramento River at Collinsville (Appendix 8G, Figure Cl-15), Mallard Island (Appendix 8G, Figure
23 Cl-13), and increase substantially at Montezuma Slough at Beldon's Landing (i.e., over a doubling of
24 concentration in December through February) (Appendix 8G, Figure Cl-16), thereby contributing to
25 additional, measureable long-term degradation that potentially would adversely affect the necessary
26 actions to reduce chloride loading for any TMDL that is developed.

27 *SWP/CVP Export Service Areas*

28 Under Alternative 9, long-term average chloride concentrations based on the mass balance analysis
29 of modeling results for the 16-year period modeled at the Banks and Jones pumping plants would
30 decrease by as much as 21% relative to Existing Conditions and 10% compared to No Action
31 Alternative (Appendix 8G, *Chloride*, Table Cl-55). The modeled frequency of exceedances of
32 applicable water quality objectives/criteria would decrease relative to Existing Conditions and No
33 Action Alternative, for both the 16-year period and the drought period modeled (Appendix 8G,
34 *Chloride*, Table Cl-57). Consequently, water exported into the SWP/CVP service area would
35 generally be of similar or better quality with regards to chloride relative to Existing Conditions and
36 the No Action Alternative conditions.

37 Results of the modeling approach which used relationships between EC and chloride (see Section
38 8.3.1.3) were consistent with the discussion above, and assessment of chloride using these data
39 results in the same conclusions as are presented above for the mass-balance approach (Appendix
40 8G, Table Cl-56 and Table Cl-58).

41 Commensurate with the reduced chloride concentrations in water exported to the service area,
42 reduced chloride loading in the lower San Joaquin River would be anticipated which would likely
43 alleviate or lessen any expected increase in chloride at Vernalis related to decreased annual average
44 San Joaquin River flows (see discussion of Upstream of the Delta).

1 Maintenance of SWP and CVP facilities would not be expected to create new sources of chloride or
2 contribute towards a substantial change in existing sources of chloride in the affected environment.
3 Maintenance activities would not be expected to cause any substantial change in chloride such that
4 any long-term water quality degradation would occur, thus, beneficial uses would not be adversely
5 affected anywhere in the affected environment.

6 **NEPA Effects:** In summary, relative to the No Action Alternative conditions, Alternative 9 would
7 result in 150 mg/L Bay-Delta WCCP objective at Contra Costa Pumping Plant #1 and Antioch,
8 substantial seasonal use of assimilative capacity at Contra Costa Pumping Plant #1, Rock Slough and
9 Franks Tract, measureable water quality degradation relative to the 303(d) impairment in Suisun
10 Marsh. The predicted chloride increases constitute an adverse effect on water quality (see
11 Mitigation Measure WQ-7 below; implementation of this measure along with a separate, non-
12 environmental commitment relating to the potential increased chloride treatment costs would
13 reduce these effects). Additionally, the predicted changes relative to the No Action Alternative
14 conditions indicate that in addition to the effects of climate change/sea level rise, implementation of
15 CM1 and CM4 under Alternative 9 would contribute substantially to the adverse water quality
16 effects.

17 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
18 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
19 purpose of making the CEQA impact determination for this constituent. For additional details on the
20 effects assessment findings that support this CEQA impact determination, see the effects assessment
21 discussion that immediately precedes this conclusion.

22 Chloride is not a constituent of concern in the Sacramento River watershed upstream of the Delta,
23 thus river flow rate and reservoir storage reductions that would occur under the Alternative 9,
24 relative to Existing Conditions, would not be expected to result in a substantial adverse change in
25 chloride levels. Additionally, relative to Existing Conditions, the Alternative 9 would not result in
26 reductions in river flow rates (i.e., less dilution) or increased chloride loading such that there would
27 be any substantial increase in chloride concentrations upstream of the Delta in the San Joaquin River
28 watershed.

29 Relative to Existing Conditions, Alternative 9 operations would result in substantially reduced
30 chloride concentrations in the Delta such that exceedances of the 250 mg/L Bay-Delta WQCP
31 objective at the San Joaquin River at Antioch and Mallard Slough would be reduced. Nevertheless,
32 due to the predicted increased frequency of exceeding the 150 mg/L Bay-Delta WQCP objective at
33 Contra Costa Pumping Plant #1 and Antioch as well as substantial seasonal use of assimilative
34 capacity at Contra Costa Pumping Plant #1 and Antioch, the potential exists for adverse effects on
35 the municipal and industrial beneficial uses (see Mitigation Measure WQ-7 below; implementation
36 of this measure along with a separate, non-environmental commitment relating to the potential
37 increased chloride treatment costs would reduce these effects). Moreover, the modeled increased
38 chloride concentrations and degradation in the western Delta could further contribute, at
39 measurable levels (i.e., over a doubling of concentration), to the existing 303(d) listed impairment
40 due to chloride in Suisun Marsh for the protection of fish and wildlife.

41 Chloride concentrations would be reduced in water exported from the Delta to the CVP/SWP Export
42 Service Areas, thus reflecting a potential improvement to chloride loading in the lower San Joaquin
43 River.

1 Chloride is not a bioaccumulative constituent, thus any increased concentrations under Alternative
2 9 would not result in substantial chloride bioaccumulation impacts on aquatic life or humans.
3 Alternative 9 maintenance would not result in any substantial changes in chloride concentration
4 upstream of the Delta or in the SWP/CVP Export Service Areas. However, based on these findings,
5 this impact is determined to be significant due to increased chloride concentrations and frequency
6 of objective exceedance in the western Delta, as well as potential adverse effects on fish and wildlife
7 beneficial uses in Suisun Marsh.

8 While mitigation measures to reduce these water quality effects in affected water bodies to less than
9 significant levels are not available, implementation of Mitigation Measure WQ-7 is recommended to
10 attempt to reduce the effect that increased chloride concentrations may have on Delta beneficial
11 uses. However, because the effectiveness of this mitigation measure to result in feasible measures
12 for reducing water quality effects is uncertain, this impact is considered to remain significant and
13 unavoidable. Please see Mitigation Measure WQ-7 under Impact WQ-7 in the discussion of
14 Alternative 1A.

15 In addition to and to supplement Mitigation Measure WQ-7, the BDCP proponents have incorporated
16 into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*, a separate, non-
17 environmental commitment to address the potential increased water treatment costs that could
18 result from chloride concentration effects on municipal, industrial and agricultural water purveyor
19 operations. Potential options for making use of this financial commitment include funding or
20 providing other assistance towards acquiring alternative water supplies or towards modifying
21 existing operations when chloride concentrations at a particular location reduce opportunities to
22 operate existing water supply diversion facilities. Please refer to Appendix 3B, *Environmental*
23 *Commitments*, for the full list of potential actions that could be taken pursuant to this commitment in
24 order to reduce the water quality treatment costs associated with water quality effects relating to
25 chloride, electrical conductivity, and bromide.

26 **Mitigation Measure WQ-7: Conduct Additional Evaluation and Modeling of Increased** 27 **Chloride Levels and Develop and Implement Phased Mitigation Actions**

28 Please see Mitigation Measure WQ-7 under Impact WQ-7 in the discussion of Alternative 1A.

29 **Impact WQ-8: Effects on Chloride Concentrations Resulting from Implementation of CM2-** 30 **CM22**

31 **NEPA Effects:** Under Alternative 9, the types and geographic extent of effects on chloride
32 concentrations in the Delta as a result of implementation of the other conservation measures (i.e.,
33 CM2-22) would be similar to, and undistinguishable from, those effects previously described for
34 Alternative 1A. The conservation measures would present no new direct sources of chloride to the
35 affected environment. Moreover, some habitat restoration conservation measures (CM4-10) would
36 occur on lands within the Delta currently used for irrigated agriculture, thus replacing agricultural
37 land uses with restored tidal wetlands, floodplain, and related channel margin and off-channel
38 habitats. The potential reduction in irrigated lands within the Delta may result in reduced
39 discharges of agricultural field drainage with elevated chloride concentrations, which would be
40 considered an improvement compared to Existing Conditions and No Action Alternative conditions.

41 In summary, based on the discussion above, the effects on chloride from implementing CM2-CM22
42 are considered to be not adverse.

1 **CEQA Conclusion:** Implementation of the CM2–CM22 for Alternative 9 would not present new or
2 substantially changed sources of chloride to the affected environment upstream of the Delta, within
3 Delta, or in the SWP/CVP service area. Replacement of irrigated agricultural land uses in the Delta
4 with habitat restoration conservation measures may result in some reduction in discharge of
5 agricultural field drainage with elevated chloride concentrations, thus resulting in improved water
6 quality conditions. Based on these findings, this impact is considered to be less than significant. No
7 mitigation is required.

8 **Impact WQ-9: Effects on Dissolved Oxygen Resulting from Facilities Operations and** 9 **Maintenance (CM1)**

10 **NEPA Effects:** Effects of CM1 on dissolved oxygen under Alternative 9 are the same as those
11 discussed for Alternative 1A and are determined to be not adverse.

12 **CEQA Conclusion:** Effects of CM1 on DO under Alternative 9 would be similar to those discussed for
13 Alternative 1A, and are summarized here, then compared to the CEQA thresholds of significance
14 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this
15 constituent. For additional details on the effects assessment findings that support this CEQA impact
16 determination, see the effects assessment discussion under Alternative 1A.

17 River flow rate and reservoir storage reductions that would occur under Alternative 9, relative to
18 Existing Conditions, would not be expected to result in a substantial adverse change in DO levels in
19 the reservoirs and rivers upstream of the Delta, given that mean monthly flows would remain within
20 the ranges historically seen under Existing Conditions and the affected river are large and turbulent.
21 Any reduced DO saturation level that may be caused by increased water temperature would not be
22 expected to cause DO levels to be outside of the range seen historically. Finally, amounts of oxygen
23 demanding substances and salinity would not be expected to change sufficiently to affect DO levels.

24 It is expected there would be no substantial change in Delta DO levels in response to a shift in the
25 Delta source water percentages under this alternative or substantial degradation of these water
26 bodies, with regard to DO. DO levels would be affected by nutrient loading, which the state has
27 begun to aggressively regulate the discharges of, and this loading would not be expected to lower DO
28 levels relative to Existing Conditions based on historical DO levels. Further, the anticipated changes
29 in salinity would have relatively minor effects on DO levels, and tidal exchange, which contribute to
30 the reaeration of Delta waters would not be expected to change substantially.

31 There is not expected to be substantial, if even measurable, changes in DO levels in the SWP/CVP
32 Export Service Areas waters under Alternative 9, relative to Existing Conditions, because the
33 biochemical oxygen demand of the exported water would not be expected to substantially differ
34 from that under Existing Conditions (due to ever increasing water quality regulations), canal
35 turbulence and exposure of the water to the atmosphere and the algal communities that exist within
36 the canals would establish an equilibrium for DO levels within the canals. The same would occur in
37 downstream reservoirs.

38 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
39 objectives by frequency, magnitude, and geographic extent that would result in significant impacts
40 on any beneficial uses within affected water bodies. Because no substantial changes in DO levels are
41 expected, long-term water quality degradation would not be expected to occur, and, thus, beneficial
42 uses would not be adversely affected. Various Delta waterways are 303(d)-listed for low DO, but
43 because no substantial decreases in DO levels would be expected, greater degradation and DO-

1 related impairment of these areas would not be expected. This impact would be less than significant.
2 No mitigation is required.

3 **Impact WQ-10: Effects on Dissolved Oxygen Resulting from Implementation of CM2–CM22**

4 **NEPA Effects:** Effects of CM2–CM22 on DO under Alternative 9 are the same as those discussed for
5 Alternative 1A and are determined to be not adverse.

6 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 9 would be similar to
7 those proposed under Alternative 1A. As such, effects on DO resulting from the implementation of
8 CM2–CM22 would be similar to that previously discussed for Alternative 1A. This impact is
9 considered to be less than significant. No mitigation is required.

10 **Impact WQ-11: Effects on Electrical Conductivity Concentrations Resulting from Facilities** 11 **Operations and Maintenance (CM1)**

12 ***Upstream of the Delta***

13 For the same reasons stated for the No Action Alternative, EC levels (highs, lows, typical conditions)
14 in the Sacramento River and its tributaries, the eastside tributaries, their associated reservoirs, and
15 the San Joaquin River upstream of the Delta under Alternative 9 are not expected to be outside the
16 ranges occurring under Existing Conditions or would occur under the No Action Alternative. Any
17 minor changes in EC levels that could occur under Alternative 9 in water bodies upstream of the
18 Delta would not be of sufficient magnitude, frequency and geographic extent that would cause
19 adverse effects on beneficial uses or substantially degrade water quality with regard to EC.

20 ***Delta***

21 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
22 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
23 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
24 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
25 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
26 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

27 Relative to Existing Conditions, Alternative 9 would result in an increase in the number of days the
28 Bay-Delta WQCP EC objectives would be exceeded in the Sacramento River at Emmaton and the San
29 Joaquin River at San Andreas Landing (Appendix 8H, Table EC-9). The percent of days the Emmaton
30 EC objective would be exceeded for the entire period modeled (1976–1991) would increase from
31 6% under Existing Conditions to 17% under Alternative 9, and the percent of days out of compliance
32 would increase from 11% under Existing Conditions to 28% under Alternative 9. The percent of
33 days the San Andreas Landing EC objective would be exceeded would be 1% under Existing
34 Conditions and Alternative 9, and the percent of days out of compliance with the EC objective would
35 increase from 1% under Existing Conditions to 2% under Alternative 9. Average EC levels at the
36 western and southern Delta compliance locations, except at Emmaton in the western Delta, and S.
37 Fork Mokelumne River at Terminous (an interior Delta location) would decrease from 1–33% for
38 the entire period modeled and 2–33% during the drought period modeled (1987–1991) (Appendix
39 8H, Table EC-20). In the Sacramento River at Emmaton, average EC would increase 22% for the
40 entire period modeled and 36% during the drought period modeled. In the San Joaquin River at San
41 Andreas Landing, average EC would increase 16% for the entire period modeled and 33% during the

1 drought period modeled. Average EC in the Sacramento River at Emmaton and San Joaquin River at
2 San Andreas Landing would increase during all months (Appendix 8H, Table EC-20). In the San
3 Joaquin River at Prisoners Point, average EC would increase 2% for the entire period modeled and
4 16% during the drought period modeled. Average EC at Prisoners Point would increase in
5 September through December (Appendix 8H, Table EC-20). The western portion of the Delta—which
6 is Clean Water Act section 303(d) listed as impaired due to elevated EC—would have an increased
7 frequency of exceedance of the Bay-Delta WQCP objectives (Appendix 8H, Table EC-9) and long-
8 term average EC levels at compliance locations in this region would increase relative to Existing
9 Conditions (Appendix 8H, Table EC-20). Thus, Alternative 9 could contribute to additional
10 impairment and potentially adversely affect beneficial uses for section 303(d) listed Delta
11 waterways, relative to Existing Conditions. The comparison to Existing Conditions reflects changes
12 in EC due to both Alternative 9 operations (including use of operable barriers and numerous other
13 operational components of Scenario G) and climate change/sea level rise.

14 Relative to the No Action Alternative, the change in percent compliance with Bay-Delta WQCP EC
15 objectives under Alternative 9 would be similar to that described above relative to Existing
16 Conditions. For the entire period modeled, average EC levels would increase in the Sacramento
17 River at Emmaton, and San Joaquin River at San Andreas Landing and Prisoners Point. The greatest
18 average EC increase would occur in the San Joaquin River at San Andreas Landing (22%); the
19 increase at Emmaton would be 21% and at Prisoners Point would be 12% (Appendix 8H, Table EC-
20 20). Similarly, during the drought period modeled, average EC would increase at these locations. The
21 greatest average EC increase during the drought period modeled also would occur in the San
22 Joaquin River at San Andreas Landing (33%); the average EC increase at Emmaton would be 24%
23 and at Prisoners Point would be 25% (Appendix 8H, Table EC-20). The western portion of the Delta—
24 which is Clean Water Act section 303(d) listed as impaired due to elevated EC—would have an
25 increased frequency of exceedance of the Bay-Delta WQCP objectives (Appendix 8H, Table EC-9) and
26 long-term average EC levels at this compliance location would increase relative to the No Action
27 Alternative (Appendix 8H, Table EC-20). Thus, Alternative 9 could contribute to additional
28 impairment and potentially adversely affect beneficial uses for section 303(d) listed Delta
29 waterways, relative to the No Action Alternative. The comparison to the No Action Alternative
30 reflects changes in EC due only to Alternative 9 operations (including use of operable barriers and
31 numerous other operational components of Scenario G).

32 For Suisun Marsh, October–May is the period when Bay-Delta WQCP EC objectives for protection of
33 fish and wildlife apply. Long-term average EC would increase under Alternative 9, relative to
34 Existing Conditions, during the months of December through May by 0.2–0.4 mS/cm in the
35 Sacramento River at Collinsville (Appendix 8H, Table EC-21). In Montezuma Slough at National Steel
36 during January and February, long-term average EC would increase 0.1–0.2 mS/cm (Appendix 8H,
37 Table EC-22). The most substantial increase would occur near Beldon Landing, with long-term
38 average EC levels increasing by 1.5–6.3 mS/cm, depending on the month, nearly doubling and
39 tripling during some months the long-term average EC relative to Existing Conditions (Appendix 8H,
40 Table EC-23). Sunrise Duck Club and Volanti Slough also would have long-term average EC increases
41 during February–May of 1.5–3.9 mS/cm (Appendix 8H, Tables EC-24 and EC-25). The degree to
42 which the long-term average EC increases would cause exceedance of Bay-Delta WQCP objectives is
43 unknown, because objectives are expressed as a monthly average of daily high tide EC, which does
44 not have to be met if it can be demonstrated “equivalent or better protection will be provided at the
45 location” (State Water Resources Control Board 2006:14). The described long-term average EC
46 increase may, or may not, contribute to adverse effects on beneficial uses, depending on how and

1 when wetlands are flooded, soil leaching cycles, and how agricultural use of water is managed, and
 2 future actions taken with respect to the marsh. However, the EC increases at certain locations would
 3 be substantial and it is uncertain the degree to which current management plans for the Suisun
 4 Marsh would be able to address these substantially higher EC levels and protect beneficial uses.
 5 Thus, these increased EC levels in Suisun Marsh are considered to have a potentially adverse effect
 6 on marsh beneficial uses. Long-term average EC increases in Suisun Marsh under Alternative 9
 7 relative to the No Action Alternative would be similar to the increases relative to Existing
 8 Conditions. Suisun Marsh is section 303(d) listed as impaired due to elevated EC, and the potential
 9 increases in long-term average EC concentrations could contribute to additional impairment,
 10 because the increases would be double or triple that relative to Existing Conditions and the No
 11 Action Alternative.

12 ***SWP/CVP Export Service Areas***

13 At the Banks and Jones pumping plants, Alternative 9 would result in no exceedances of the Bay-
 14 Delta WQCP's 1,000 $\mu\text{mhos/cm}$ EC objective for the entire period modeled (Appendix 8H, Table EC-
 15 10). Thus, there would be no adverse effect on the beneficial uses in the SWP/CVP Export Service
 16 Areas using water pumped at this location under the Alternative 9.

17 At the Banks pumping plant, relative to Existing Conditions, average EC levels under Alternative 9
 18 would decrease substantially on average: 56% for the entire period modeled and 62% during the
 19 drought period modeled. Relative to the No Action Alternative, average EC levels would decrease by
 20 53% for the entire period modeled and 60% during the drought period modeled (Appendix 8H,
 21 Table EC-20).

22 At the Jones pumping plant, relative to Existing Conditions, average EC levels under Alternative 9
 23 would also decrease on average, but to a lesser degree: 22% for the entire period modeled and 18%
 24 during the drought period modeled. Relative to the No Action Alternative, average EC levels would
 25 decrease by 18% for the entire period modeled and 14% during the drought period modeled
 26 (Appendix 8H, Table EC-20).

27 Based on the decreases in long-term average EC levels that would occur at the Banks and Jones
 28 pumping plants, Alternative 9 would not cause degradation of water quality with respect to EC in
 29 the SWP/CVP Export Service Areas; rather, Alternative 9 would improve long-term average EC
 30 conditions in the SWP/CVP Export Service Areas.

31 Commensurate with the EC decrease in exported waters, an improvement in lower San Joaquin
 32 River average EC levels would be expected since EC in the lower San Joaquin River is, in part, related
 33 to irrigation water deliveries from the Delta. While the magnitude of this expected lower San
 34 Joaquin River improvement in EC is difficult to predict, the relative decrease in overall loading of EC-
 35 elevating constituents to the Export Service Areas would likely alleviate or lessen any expected
 36 increase in EC at Vernalis related to decreased annual average San Joaquin River flows (see EC
 37 impact discussion under the No Action Alternative).

38 The export area of the Delta is listed on the state's CWA Section 303(d) list as impaired due to
 39 elevated EC. Alternative 9 would result in lower long-term average EC levels relative to Existing
 40 Conditions and the No Action Alternative and, thus, would not contribute to additional beneficial use
 41 impairment related to elevated EC in the SWP/CVP Export Service Areas waters.

42 ***NEPA Effects:*** In summary, the increased frequency of exceedance of EC objectives and increased
 43 long-term and drought period average EC levels that would occur in the San Joaquin River at San

1 Andreas Landing (interior Delta), and the increased frequency of exceedance of EC objectives in the
2 Sacramento River at Emmaton under Alternative 9, relative to the No Action Alternative, would
3 contribute to adverse effects on the agricultural beneficial uses. Given that the western Delta is
4 Clean Water Act section 303(d) listed as impaired due to elevated EC, the increased frequency of
5 exceedance of the Bay-Delta WQCP objectives and long-term average EC levels at this compliance
6 location could contribute to additional impairment and potentially adversely affect beneficial uses
7 for section 303(d) listed Delta waterways, relative to the No Action Alternative. The increases in
8 long-term average EC levels that would occur in Suisun Marsh would further degrade existing EC
9 levels and could contribute additional to adverse effects on the fish and wildlife beneficial uses.
10 Suisun Marsh is section 303(d) listed as impaired due to elevated EC, and the potential increases in
11 long-term average EC levels could contribute to additional beneficial use impairment. These
12 increases in EC constitute an adverse effect on water quality. Mitigation Measure WQ-11 would be
13 available to reduce these effects (implementation of this measure along with a separate, non-
14 environmental commitment as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*,
15 relating to the potential EC-related changes would reduce these effects).

16 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
17 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
18 purpose of making the CEQA impact determination for this constituent. For additional details on the
19 effects assessment findings that support this CEQA impact determination, see the effects assessment
20 discussion that immediately precedes this conclusion.

21 River flow rate and reservoir storage reductions that would occur under Alternative 9, relative to
22 Existing Conditions, would not be expected to result in a substantial adverse change in EC levels in
23 the reservoirs and rivers upstream of the Delta, given that: changes in the quality of watershed
24 runoff and reservoir inflows would not be expected to occur in the future; the state's aggressive
25 regulation of point-source discharge effects on Delta salinity-elevating parameters and the expected
26 further regulation as salt management plans are developed; the salt-related TMDLs adopted and
27 being developed for the San Joaquin River; and the expected improvement in lower San Joaquin
28 River average EC levels commensurate with the lower EC of the irrigation water deliveries from the
29 Delta.

30 Relative to Existing Conditions, Alternative 9 would not result in any substantial increases in long-
31 term average EC levels in the SWP/CVP Export Service Areas. There would be no exceedance of the
32 EC objective at the Jones and Banks pumping plants. Average EC levels for the entire period modeled
33 would decrease at both plants and, thus, this alternative would not contribute to additional
34 beneficial use impairment related to elevated EC in the SWP/CVP Export Service Areas waters.
35 Rather, this alternative would improve long-term EC levels in the SWP/CVP Export Service Areas,
36 relative to Existing Conditions.

37 In the Plan Area, Alternative 9 would result in an 11% increase in the frequency with which the Bay-
38 Delta WQCP EC objectives are exceeded at Emmaton (western Delta) and a <1% increase in the
39 frequency with which EC objectives are exceeded in the San Joaquin River at San Andreas Landing
40 (interior Delta) for the entire period modeled (1976–1991). Further, average EC levels at Emmaton
41 would increase by 22% for the entire period modeled and 36% during the drought period modeled,
42 and EC levels at San Andreas Landing would increase by 16% for the entire period modeled and
43 33% during the drought period modeled. Because EC is not bioaccumulative, the increases in long-
44 term average EC levels would not directly cause bioaccumulative problems in aquatic life or
45 humans. The interior Delta is not Clean Water Act section 303(d) listed for elevated EC, however, the

1 western Delta is. The increases in long-term and drought period average EC levels and increased
 2 frequency of exceedance of EC objectives that would occur in the Sacramento River at Emmaton and
 3 San Joaquin River at San Andreas would potentially contribute to adverse effects on the agricultural
 4 beneficial uses in the interior Delta. This impact is considered to be significant.

5 Further, relative to Existing Conditions, Alternative 9 would result in substantial increases in long-
 6 term average EC during the months of October through May in Suisun Marsh, such that EC levels
 7 would be double or triple that occurring under Existing Conditions. The increases in long-term
 8 average EC levels that would occur in Suisun Marsh could further degrade existing EC levels and
 9 thus contribute additionally to adverse effects on the fish and wildlife beneficial uses. Because EC is
 10 not bioaccumulative, the increases in long-term average EC levels would not directly cause
 11 bioaccumulative problems in wildlife. Suisun Marsh is Clean Water Act section 303(d) listed for
 12 elevated EC and the increases in long-term average EC that would occur in the marsh could make
 13 beneficial use impairment measurably worse. This impact is considered to be significant.

14 Implementation of Mitigation Measure WQ-11 along with a separate, non-environmental
 15 commitment relating to the potential increased costs associated with EC-related changes would
 16 reduce these effects. While mitigation measures to reduce these water quality effects in affected
 17 water bodies to less than significant levels are not available, implementation of Mitigation Measure
 18 WQ-11 is recommended to attempt to reduce the effect that increased EC concentrations may have
 19 on Delta beneficial uses. However, because the effectiveness of this mitigation measure to result in
 20 feasible measures for reducing water quality effects is uncertain, this impact is considered to remain
 21 significant and unavoidable. Please see Mitigation Measure WQ-11 under Impact WQ-11 in the
 22 discussion of Alternative 1A.

23 In addition to and to supplement Mitigation Measure WQ-11, the BDCP proponents have
 24 incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*, a
 25 separate, non-environmental commitment to address the potential increased water treatment costs
 26 that could result from EC concentration effects on municipal, industrial and agricultural water
 27 purveyor operations. Potential options for making use of this financial commitment include funding
 28 or providing other assistance towards acquiring alternative water supplies or towards modifying
 29 existing operations when EC concentrations at a particular location reduce opportunities to operate
 30 existing water supply diversion facilities. Please refer to Appendix 3B, *Environmental Commitments*,
 31 for the full list of potential actions that could be taken pursuant to this commitment in order to
 32 reduce the water quality treatment costs associated with water quality effects relating to chloride,
 33 electrical conductivity, and bromide.

34 **Mitigation Measure WQ-11: Avoid, Minimize, or Offset, as Feasible, Reduced Water**
 35 **Quality Conditions**

36 Please see Mitigation Measure WQ-11 under Impact WQ-11 in the discussion of Alternative 1A.

37 **Impact WQ-12: Effects on Electrical Conductivity Resulting from Implementation of CM2–**
 38 **CM22**

39 **NEPA Effects:** Effects of CM2–CM22 on EC under Alternative 9 are the same as those discussed for
 40 Alternative 1A and are considered not to be adverse.

41 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 9 would be similar to
 42 those proposed under Alternative 1A. As such, effects on EC resulting from the implementation of

1 CM2–CM22 would be similar to that previously discussed for Alternative 1A. This impact is
2 considered to be less than significant. No mitigation is required.

3 **Impact WQ-13: Effects on Mercury Concentrations Resulting from Facilities Operations and** 4 **Maintenance (CM1)**

5 *Upstream of the Delta*

6 Under Alternative 9, the magnitude and timing of reservoir releases and river flows upstream of the
7 Delta in the Sacramento River watershed and east-side tributaries would be altered, relative to
8 Existing Conditions and the No Action Alternative.

9 The Sacramento River at Freeport and San Joaquin River at Vernalis (as summarized for water
10 quality average concentrations in Tables 8-48 and 8-49) were examined for flow/concentration
11 relationships for mercury and methylmercury. No significant, predictive regression relationships
12 were discovered for mercury or methylmercury, except for total mercury with flow at Freeport
13 (monthly or annual)(Figures 8I-10 through 8I-13, Appendix 8I). Such a positive relationship
14 between total mercury and flow is to be expected based on the association of mercury with
15 suspended sediment and the mobilization of sediments during storm flows. However, the changes in
16 flow in the Sacramento River under Alternative 9 relative to Existing Conditions and the No Action
17 Alternative are not of the magnitude of storm flows, in which substantial sediment-associated
18 mercury is mobilized. Therefore mercury loading should not be substantially different due to
19 changes in flow. In addition, even though it may be flow-affected, total mercury concentrations
20 remain well below criteria at upstream locations. Any negligible changes in mercury concentrations
21 that may occur in the water bodies of the affected environment located upstream of the Delta would
22 not be of frequency, magnitude, and geographic extent that would adversely affect any beneficial
23 uses or substantially degrade the quality of these water bodies as related to mercury. Both
24 waterborne methylmercury concentrations and largemouth bass fillet mercury concentrations are
25 expected to remain above guidance levels at upstream of Delta locations, but will not change
26 substantially relative to Existing Conditions or the No Action Alternative due to changes in flows
27 under Alternative 9.

28 The upstream of Delta areas in the north will benefit from the implementation of the Cache Creek,
29 Sulfur Creek, Harley Gulch, and Clear Lake Mercury TMDLs and the American River methylmercury
30 TMDL. These projects will target specific sources of mercury and methylation upstream of the Delta
31 and could result in net improvement to Delta mercury loading in the future. The implementation of
32 these projects could help to ensure that upstream of Delta environments will not be substantially
33 degraded for water quality with respect to mercury or methylmercury.

34 *Delta*

35 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
36 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
37 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
38 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
39 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
40 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

41 The water quality impacts of waterborne concentrations of mercury and methylmercury and fish
42 tissue mercury concentrations were evaluated for 9 Delta locations. The analysis of percentage

1 change in assimilative capacity of waterborne total mercury of Alternative 9 relative to the 25 ng/L
2 ecological risk benchmark as compared to Existing Conditions showed the greatest decrease of
3 10.2% at Old River at Rock Slough, and a 10.1% reduction relative to the No Action Alternative at
4 that location (Figures 8-53 and 8-54). Similarly, increases in long term annual average
5 methylmercury concentration are expected to be greatest (approximately 30%) at the Contra Costa
6 Pumping Plant as compared to Existing Conditions and the No Action Alternative (Appendix 8I,
7 Figure 8I-9, Table I-6). The concentration of methylmercury is estimated to be 0.163 ng/L at that
8 location, which is greater than Existing Conditions (0.121 ng/L) and the No Action Alternative
9 (0.122 ng/L). All modeled input concentrations exceeded the methylmercury TMDL guidance
10 objective of 0.06 ng/L, therefore percentage change in assimilative capacity was not evaluated for
11 methylmercury.

12 Fish tissue estimates show some substantial percentage increases in concentration and exceedance
13 quotients for mercury at some Delta locations. The greatest change in exceedance quotients are
14 expected for Old River at Rock Slough with changes of 66% over Existing Conditions, and 59% over
15 the No Action Alternative (Figure 8-55, Appendix 8I, Table I-16b). The Contra Costa Pumping Plant
16 values shows a 62% increase in fish tissue concentrations over Existing Conditions, and 59% over
17 the No Action Alternative (Appendix 8I, Table I-16b).

18 ***SWP/CVP Export Service Areas***

19 The analysis of mercury and methylmercury in the SWP/CVP Export Service Areas was based on
20 concentrations estimated at the Banks and Jones pumping plants. Both waterborne total and
21 methylmercury concentrations for Alternative 9 are projected to be lower than Existing Conditions
22 and the No Action Alternative at the Jones and Banks pumping plants (Appendix 8I, Figures 8I-7 and
23 8I-9). Therefore, mercury shows an increased assimilative capacity at these locations (Figures 8-53
24 and 8-54). Bass tissue mercury concentrations are also improved under Alternative 9, relative to
25 Existing Conditions and the No Action Alternative (Figure 8-55; Appendix 8I, Table I-16a,b).

26 ***NEPA Effects:*** Based on the above discussion, the effects of mercury and methylmercury in
27 comparison of Alternative 9 to the No Action Alternative (as waterborne and bioaccumulated forms)
28 are considered to be adverse for the case of fish tissue bioaccumulation at some locations.

29 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
30 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
31 purpose of making the CEQA impact determination for this constituent. For additional details on the
32 effects assessment findings that support this CEQA impact determination, see the effects assessment
33 discussion that immediately precedes this conclusion.

34 Under Alternative 9, greater water demands and climate change would alter the magnitude and
35 timing of reservoir releases and river flows upstream of the Delta in the Sacramento River
36 watershed and east-side tributaries, relative to Existing Conditions. Concentrations of mercury and
37 methylmercury upstream of the Delta will not be substantially different relative to Existing
38 Conditions due to the lack of important relationships between mercury/methylmercury
39 concentrations and flow for the major rivers.

40 Methylmercury concentrations exceed criteria at all locations in the Delta and no assimilative
41 capacity exists. However, monthly average waterborne concentrations of total and methylmercury,
42 over the period of record, are very similar to Existing Conditions. Similarly, estimates of fish tissue

1 mercury concentrations show almost no differences would occur among sites for Alternative 9 as
2 compared to Existing Conditions for Delta sites.

3 Assessment of effects of mercury in the SWP and CVP Export Service Areas were based on effects on
4 mercury concentrations and fish tissue mercury concentrations at the Banks and Jones pumping
5 plants. The Banks and Jones pumping plants are expected to show increased assimilative capacity
6 for waterborne mercury and decreased fish tissue concentrations of mercury for Alternative 9 as
7 compared to Existing Conditions.

8 As such, this alternative is not expected to cause additional exceedance of applicable water quality
9 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
10 on any beneficial uses of waters in the affected environment. However, increases in fish tissue
11 mercury concentrations are substantial, and changes in fish tissue mercury concentrations would
12 make existing mercury-related impairment in the Delta measurably worse. In comparison to
13 Existing Conditions, Alternative 9 would increase levels of mercury by frequency, magnitude, and
14 geographic extent such that the affected environment would be expected to have measurably higher
15 body burdens of mercury in aquatic organisms, thereby substantially increasing the health risks to
16 wildlife (including fish) or humans consuming those organisms. This impact is considered to be
17 significant. Feasible or effective actions to reduce the effects on mercury resulting from CM1 are
18 unknown. General mercury management measures through CM12, or actions taken by other entities
19 or programs such as TMDL implementation, may minimize or reduce sources and inputs of mercury
20 to the Delta and methylmercury formation. However, it is uncertain whether this impact would be
21 reduced to a level that would be less than significant as a result of CM12 or other future actions.
22 Therefore, the impact would be significant and unavoidable.

23 **Impact WQ-14: Effects on Mercury Concentrations Resulting from Implementation of CM2-** 24 **CM22**

25 **NEPA Effects:** Some habitat restoration activities under Alternative 9 would occur on lands in the
26 Delta formerly used for irrigated agriculture. Tidal and other restoration proposed under
27 Alternative 9 have the potential to increase water residence times and increase accumulation of
28 organic sediments that are known to enhance methylmercury bioaccumulation in biota in the
29 restored habitat. Therefore, increases in mercury methylation in the habitat restoration areas is
30 possible but uncertain depending on the specific restoration design implemented at a particular
31 Delta location. Models to estimate the potential for methylmercury formation in restored areas are
32 not currently available. However, DSM2 modeling for Alternative 9 operations does incorporate
33 assumptions for certain habitat restoration activities proposed under CM2 and CM4 (see Section
34 8.3.1.3) that result in changes to Delta hydrodynamics compared to the No Action Alternative. These
35 modeled restoration assumptions provide some insight into potential hydrodynamic changes that
36 could be expected related to implementing CM2 and CM4 and are considered in the evaluation of the
37 potential for increased mercury and methylmercury concentrations under Alternative 9.

38 BDCP Conservation Measure 12 (CM12) addresses the potential for methylmercury bioaccumulation
39 associated with restoration activities and acknowledges the uncertainties associated with mitigating
40 or minimizing this potential effect. CM12 proposes project-specific mercury management plans for
41 restoration actions that will incorporate relevant approaches recommended in Phase 1
42 Methylmercury TMDL control studies. Specific approaches recommended under CM12 that are
43 intended to minimize or mitigate for potential increases in methylmercury bioaccumulation at
44 future restoration sites include:

- 1 • Characterizing mercury, methylmercury, organic carbon, iron, and sulfate concentrations to
2 better inform restoration design,
- 3 • Sequestering methylmercury at restoration sites using low intensity chemical dosing
4 techniques,
- 5 • Minimizing microbial methylation associated with anoxic conditions by reducing the amount of
6 organic material at a restoration site,
- 7 • Designing restoration sites to enhance photo degeneration that converts methylmercury into a
8 biologically unavailable, inorganic form of mercury,
- 9 • Remediating restoration site soils with iron to reduce methylation in sulfide rich soils, and
- 10 • Considering capping mercury laden sediments, where possible to reduce methylation potential
11 at a site.

12 Because of the uncertainties associated with site-specific estimates of methylmercury
13 concentrations and the uncertainties in source modeling and tissue modeling, the effectiveness of
14 methylmercury management proposed under CM12 to reduce methylmercury concentrations would
15 need to be evaluated separately for each restoration effort, as part of design and implementation.
16 Because of this uncertainty and the known potential for methylmercury creation in the Delta this
17 potential effect of implementing CM2-CM22 is considered adverse.

18 **CEQA Conclusion:** There would be no substantial, long-term increase in mercury or methylmercury
19 concentrations or loads in the rivers and reservoirs upstream of the Delta or the waters exported to
20 the CVP and SWP service areas due to implementation of CM2–CM22 relative to Existing Conditions.
21 However, uptake of mercury from water and/or methylation of inorganic mercury may increase to
22 an unquantified degree as part of the creation of new, marshy, shallow, or organic-rich restoration
23 areas. Methylmercury is 303(d)-listed within the affected environment, and therefore any potential
24 measurable increase in methylmercury concentrations would make existing mercury-related
25 impairment measurably worse. Because mercury is bioaccumulative, increases in water-borne
26 mercury or methylmercury that could occur in some areas could bioaccumulate to somewhat
27 greater levels in aquatic organisms and would, in turn, pose health risks to fish, wildlife, or humans.
28 Design of restoration sites under Alternative 9 would be guided by CM12 which requires
29 development of site specific mercury management plans as restoration actions are implemented.
30 The effectiveness of minimization and mitigation actions implemented according to the mercury
31 management plans is not known at this time although the potential to reduce methylmercury
32 concentrations exists based on current research. Although the BDCP will implement CM12 with the
33 goal to reduce this potential effect the uncertainties related to site specific restoration conditions
34 and the potential for increases in methylmercury concentrations in the Delta result in this potential
35 impact being considered significant. No mitigation measures would be available until specific
36 restoration actions are proposed. Therefore this programmatic impact is considered significant and
37 unavoidable.

1 **Impact WQ-15: Effects on Nitrate Concentrations Resulting from Facilities Operations and**
2 **Maintenance (CM1)**

3 ***Upstream of the Delta***

4 For the same reasons stated for the No Action Alternative, Alternative 9 would have negligible, if
5 any, impact on nitrate concentrations in the rivers and reservoirs upstream of the Delta in the
6 Sacramento River watershed relative to Existing Conditions and the No Action Alternative.

7 Under Alternative 9, modeling indicates that long-term annual average flows on the San Joaquin
8 River would decrease by an estimated 6% relative to Existing Conditions, and would remain
9 virtually the same relative to the No Action Alternative (Appendix 5A). Given these relatively small
10 decreases in flows and the weak correlation between nitrate and flows in the San Joaquin River (see
11 Nitrate Appendix 8J, Figure 2), it is expected that nitrate concentrations in the San Joaquin River
12 would be minimally affected, if at all, by changes in flow rates under Alternative 9.

13 Any negligible changes in nitrate-N concentrations that may occur in the water bodies of the affected
14 environment located upstream of the Delta would not be of frequency, magnitude and geographic
15 extent that would adversely affect any beneficial uses or substantially degrade the quality of these
16 water bodies, with regards to nitrate.

17 ***Delta***

18 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
19 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
20 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
21 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
22 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
23 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

24 Results of the mixing calculations indicate that under Alternative 9, relative to Existing Conditions,
25 and the No Action Alternative, nitrate concentrations throughout the Delta are anticipated to remain
26 low (<1.4 mg/L-N) relative to adopted objectives (Nitrate Appendix 8J, Table 31 and 32). Long-term
27 average nitrate concentrations are anticipated to increase at most locations in the Delta. The
28 increase would be greatest at Franks Tract, Old River at Rock Slough, and Contra Costa Pumping
29 Plant #1 (all >100% increase). Long-term average concentrations were estimated to increase to
30 0.96, 1.32, and 1.38 mg/L-N for Franks Tract, Old River at Rock Slough, and Contra Costa Pumping
31 Plant #1, respectively, due primarily to increased San Joaquin River water percentage at these
32 locations (see Fingerprinting Appendix 8D). Although changes at specific Delta locations and for
33 specific months may be substantial on a relative basis, the absolute concentration of nitrate in Delta
34 waters would remain low (<1.4 mg/L-N) in relation to the drinking water MCL of 10 mg/L-N, as well
35 as all other thresholds identified in Table 8-50. No additional exceedances of the MCL are
36 anticipated at any location (Nitrate Appendix 8J, Table 31). On a monthly average basis and on a
37 long term annual average basis, for all modeled years and for the drought period (1987–1991) only,
38 use of assimilative capacity available under Existing Conditions and the No Action Alternative,
39 relative to the drinking water MCL of 10 mg/L-N, was up to approximately 13% at Old River at Rock
40 Slough and Contra Costa Pumping Plant #1, and averaged approximately 9% on a long-term average
41 basis (Nitrate Appendix 8J, Table 33). Similarly, the use of available assimilative capacity at Franks
42 Tract was up to approximately 10%, and averaged approximately 6% over the long term. The
43 concentrations estimated for these locations would not increase the likelihood of exceeding the 10

1 mg/L-N MCL, nor would they increase the risk for adverse effects to beneficial uses. At all other
2 locations, use of assimilative capacity was negligible (<5%) (Nitrate Appendix 8J, Table 33).

3 Nitrate concentrations will likely be higher than the modeling results indicate in certain locations.
4 This includes in the Sacramento River between Freeport and Mallard Island and other areas in the
5 Delta downstream of Freeport that are influenced by Sacramento River water. These increases are
6 associated with ammonia and nitrate that are discharged from the SRWTP, which are not included in
7 the modeling.

- 8 • Under Existing Conditions, most of the ammonia discharged from the SRWTP is converted to
9 nitrate downstream of the facility's discharge at Freeport, and thus, nitrate concentrations
10 under Existing Conditions in these areas are expected to be higher than the modeling
11 predicts, the increase becoming greater with increasing distance downstream. However, the
12 increase in nitrate concentrations downstream of the SRWTP is expected to be small—the
13 existing increase appears to be from approximately 0.1 mg/L-N to approximately 0.4–0.5
14 mg/L-N over this reach, due to approximately a 1:1 conversion of ammonia-N to nitrate-N
15 (Central Valley Water Board 2010a:32).
- 16 • Under Alternative 9, the planned upgrades to the SRWTP, which include nitrification/partial
17 denitrification, would substantially decrease ammonia concentrations in the discharge, but
18 would increase nitrate concentrations in the discharge up to 10 mg/L-N, which is
19 substantially higher than under Existing Conditions.
- 20 • Overall, under Alternative 9, the nitrogen load from the SRWTP discharge is expected to
21 decrease (by up to 50%), relative to Existing Conditions, due to nitrification/partial
22 denitrification upgrades at the SRWTP facility. Thus, while concentrations of nitrate
23 downstream of the facility are expected to be higher than modeling results indicate for both
24 Existing Conditions and Alternative 9, the increase is expected to be greater under Existing
25 Conditions than for Alternative 9 due to the upgrades that are assumed under Alternative 9.

26 The other areas in which nitrate concentrations will be higher than the modeling results indicate are
27 immediately downstream of other wastewater treatment plants that practice nitrification, but not
28 denitrification (e.g., City of Rio Vista Beach WWTF, Town of Discovery Bay WWTF, City of Stockton
29 RWCF). For all such facilities in the Delta, the Regional Water Boards have issued NPDES permits
30 that allow discharge of wastewater containing nitrate into the Delta, and under these permits, the
31 State has determined that no beneficial uses are adversely affected by the discharge, and that the
32 discharger's use of available assimilative capacity of the water body is acceptable. When dilution is
33 necessary in order for the discharge to be in compliance with the Basin Plans (which incorporate the
34 10 mg/L-N MCL by reference), not all of the assimilative capacity of the receiving water is granted to
35 the discharger. Thus, limited decreases in flows are not anticipated to result in systemic
36 exceedances of the MCLs by these POTWs. Furthermore, NPDES permits are renewed on a 5-year
37 basis, and thus, if under changes in flows, dilution was no longer sufficient to maintain nitrate below
38 the MCL in the receiving water, the NPDES permit renewal process would address such cases.

39 Therefore, any increases in nitrate-N concentrations that may occur at certain locations within the
40 Delta would not be of frequency, magnitude and geographic extent that would adversely affect any
41 beneficial uses or substantially degrade the water quality at these locations, with regards to nitrate.

1 **SWP/CVP Export Service Areas**

2 Assessment of effects of nitrate in the SWP and CVP Export Service Areas is based on effects on
3 nitrate-N at the Banks and Jones pumping plants.

4 Results of the mixing calculations indicate that under Alternative 9, relative to Existing Conditions
5 and the No Action Alternative, nitrate concentrations at Banks and Jones pumping plants are
6 anticipated to decrease on a long-term average annual basis (Nitrate Appendix 8J, Table 31 and 32).
7 No additional exceedances of the MCL are anticipated (Nitrate Appendix 8J, Table 31). On a monthly
8 average basis and on a long term annual average basis, for all modeled years and for the drought
9 period (1987–1991) only, use of assimilative capacity available under Existing Conditions and the
10 No Action Alternative, relative to the 10 mg/L-N MCL, was negligible for both Banks and Jones
11 pumping plants (Nitrate Appendix 8J, Table 33).

12 Therefore, implementation of this alternative is not expected to result in adverse effects to beneficial
13 uses or substantially degrade the quality of exported water, with regards to nitrate.

14 **NEPA Effects:** In summary, based on the discussion above, the effects on nitrate from implementing
15 CM1 are considered to be not adverse.

16 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
17 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
18 purpose of making the CEQA impact determination for this constituent. For additional details on the
19 effects assessment findings that support this CEQA impact determination, see the effects assessment
20 discussion that immediately precedes this conclusion.

21 Nitrate-N concentrations are generally low in the reservoirs and rivers of the watersheds, owing to
22 substantial dilution available for point sources and the lack of substantial nonpoint sources of
23 nitrate-N upstream of the SRWTP in the Sacramento River watershed, and in the watersheds of the
24 eastern tributaries (Cosumnes, Mokelumne, and Calaveras Rivers). Although higher in the San
25 Joaquin River watershed, nitrate-N concentrations are not well-correlated with flow rates.
26 Consequently, any modified reservoir operations and subsequent changes in river flows under
27 Alternative 9, relative to Existing Conditions, are expected to have negligible, if any, effects on
28 reservoir and river nitrate-N concentrations upstream of Freeport in the Sacramento River
29 watershed and upstream of the Delta in the San Joaquin River watershed.

30 In the Delta, results of the mixing calculations indicate that under Alternative 9, relative to Existing
31 Conditions, long-term average nitrate concentrations are anticipated to increase at most locations.
32 The increase would be greatest at Franks Tract, Old River at Rock Slough, and Contra Costa Pumping
33 Plant #1 (all >100% increase), due primarily to increased San Joaquin River water percentage at
34 these locations. However, nitrate concentrations throughout the Delta are anticipated to remain low
35 (<1.4 mg/L-N) relative to adopted objectives, and no additional exceedances of the MCL are
36 anticipated at any location. Use of assimilative capacity at locations throughout the Delta (up to
37 13%) did not result in concentrations that would increase the likelihood of exceeding the 10 mg/L-N
38 MCL, nor would they increase the risk for adverse effects to beneficial uses.

39 Assessment of effects of nitrate in the SWP and CVP Export Service Areas is based on effects on
40 nitrate-N concentrations at the Banks and Jones pumping plants. Results of the mixing calculations
41 indicate that under Alternative 9, relative to Existing Conditions, long-term average nitrate
42 concentrations at Banks and Jones pumping plants are anticipated to decrease. No additional
43 exceedances of the MCL are anticipated, and use of assimilative capacity available under Existing

1 Conditions, relative to the MCL, for both Banks and Jones pumping plants was negligible for all
2 months.

3 Based on the above, this alternative is not expected to cause additional exceedance of applicable
4 water quality objectives/criteria by frequency, magnitude, and geographic extent that would cause
5 adverse effects on any beneficial uses of waters in the affected environment. No long-term water
6 quality degradation is expected to occur such that exceedance of criteria is more likely or such that
7 there is an increased risk of adverse impacts to beneficial uses. Nitrate is not 303(d) listed within
8 the affected environment and thus any increases that may occur in some areas and months would
9 not make any existing nitrate-related impairment measurably worse because no such impairments
10 currently exist. Because nitrate is not bioaccumulative, increases that may occur in some areas and
11 months would not bioaccumulate to greater levels in aquatic organisms that would, in turn, pose
12 substantial health risks to fish, wildlife, or humans. This impact is considered to be less than
13 significant. No mitigation is required.

14 **Impact WQ-16: Effects on Nitrate Concentrations Resulting from Implementation of CM2-
15 CM22**

16 **NEPA Effects:** Effects of CM2–CM22 on nitrate under Alternative 9 are the same as those discussed
17 for Alternative 1A and are considered not to be adverse.

18 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 9 would be similar to
19 those proposed under Alternative 1A. As such, effects on nitrate resulting from the implementation
20 of CM2–CM22 would be similar to that previously discussed for Alternative 1A. This impact is
21 considered to be less than significant. No mitigation is required.

22 **Impact WQ-17: Effects on Dissolved Organic Carbon Concentrations Resulting from Facilities
23 Operations and Maintenance (CM1)**

24 ***Upstream of the Delta***

25 Under Alternative 9, there would be no substantial change to the sources of DOC within the
26 watersheds upstream of the Delta. Moreover, long-term average flow and DOC levels in the
27 Sacramento River at Hood and San Joaquin River at Vernalis are poorly correlated. Thus changes in
28 system operations and resulting reservoir storage levels and river flows would not be expected to
29 cause a substantial long-term change in DOC concentrations in the water bodies upstream of the
30 Delta. Any negligible changes in DOC levels in water bodies upstream of the Delta under Alternative
31 9, relative to Existing Conditions and the No Action Alternative, would not be of sufficient frequency,
32 magnitude and geographic extent that would adversely affect any beneficial uses or substantially
33 degrade the quality of these water bodies, with regards to DOC.

34 ***Delta***

35 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
36 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
37 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
38 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
39 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
40 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

1 Under Alternative 9, the geographic extent of effects pertaining to long-term average DOC
2 concentrations in the Delta would be similar to that previously described for Alternative 1A,
3 although the magnitude of predicted long-term increase and relative frequency of concentration
4 threshold exceedances would be substantially greater. Modeled effects would be greatest at Franks
5 Tract, Rock Slough, and Contra Costa PP No. 1., where for the 16-year hydrologic period and the
6 modeled drought period, long-term average concentration increases ranging from 0.6–1.0 mg/L
7 would be predicted ($\leq 28\%$ net increase), resulting in long-term average DOC concentrations greater
8 than 4 mg/L at Rock Slough and Contra Costa PP No. 1 (Appendix 8K, DOC Table 10). Increases in
9 long-term average concentrations would correspond to more frequent concentration threshold
10 exceedances, with the greatest change occurring at Rock Slough and Contra Costa PP No. 1 locations.
11 For Rock Slough, long-term average DOC concentrations exceeding 3 mg/L would increase from
12 52% under Existing Conditions to 99% under the Alternative 9 (an increase from 47% to 100% for
13 the drought period), and concentrations exceeding 4 mg/L would increase from 30% to 44% (32%
14 to 67% for the drought period). For Contra Costa PP No. 1, long-term average DOC concentrations
15 exceeding 3 mg/L would increase from 52% under Existing Conditions to 100% under Alternative 9
16 (45% to 100% for the drought period), and concentrations exceeding 4 mg/L would increase from
17 32% to 45% (35% to 65% for the drought period). Relative change in frequency of threshold
18 exceedance for other assessment locations would be similar or less. This comparison to Existing
19 Conditions reflects changes in DOC due to both Alternative 9 operations (including use of operable
20 barriers and numerous other operational components of Scenario G) and climate change/sea level
21 rise.

22 In comparison, Alternative 9 relative to the No Action Alternative would generally result in a similar
23 magnitude of change to that discussed for the comparison to Existing Conditions. Maximum
24 increases of 0.6–0.9 mg/L DOC (i.e., $\leq 24\%$) would be predicted at Franks Tract, Rock Slough, and
25 Contra Costa PP No. 1 relative to No Action Alternative (Appendix 8K, DOC Table 10). Threshold
26 concentration exceedance frequency trends would also be similar to that discussed for the existing
27 condition comparison, with exception to the predicted 4 mg/L exceedance frequency at Buckley
28 Cove. In comparison to the No Action Alternative, the frequency which long-term average DOC
29 concentrations exceeded 4 mg/L at Buckley Cove would increase from 27% to 39% (42% to 50% for
30 the modeled drought period). Unlike the comparison to Existing Conditions, this comparison to the
31 No Action Alternative reflects changes in DOC due only to Alternative 9 operations.

32 The increases in long-term average DOC concentrations estimated to occur at Franks Tract, Rock
33 Slough, and Contra Costa PP No. 1 are considered substantial and could potentially trigger
34 significant changes in drinking water treatment plant design or operations. In particular, assessment
35 locations at Rock Slough and Contra Costa PP No. 1 represent municipal intakes servicing existing
36 drinking water treatment plants. Under Alternative 9, drinking water treatment plants obtaining
37 water from these interior Delta locations would likely need to upgrade existing treatment systems in
38 order to achieve EPA Stage 1 Disinfectants and Disinfection Byproduct Rule action thresholds. While
39 treatment technologies sufficient to achieve the necessary DOC removals exist, implementation of
40 such technologies would likely require substantial investment in new or modified infrastructure.

41 Relative to existing and No Action Alternative conditions, Alternative 9 would lead to predicted
42 improvements in long-term average DOC concentrations at Barker Slough and Staten Island, as well
43 Banks and Jones pumping plants (discussed below). Predicted long-term average DOC
44 concentrations at Barker Slough and Staten Island would decrease < 0.1 – 0.2 mg/L, depending on
45 baseline conditions comparison and modeling period.

1 **SWP/CVP Export Service Areas**

2 Under Alternative 9, modeled long-term average DOC concentrations would decrease at Banks and
3 Jones pumping plants for both the modeled 16-year hydrologic period and the modeled drought
4 period. Modeled decreases would generally be similar between Existing Conditions and the No
5 Action Alternative. Relative to Existing Conditions, long-term average DOC concentrations at Banks
6 would be predicted to decrease by 1.5 mg/L (1.8 mg/L during drought period) (Appendix 8K, DOC
7 Table 10 Table). At Jones, long-term average DOC concentrations would be predicted to decrease by
8 1.5 mg/L (1.7 mg/L during drought period). Such substantial improvement in long-term average
9 DOC concentrations would include fewer exceedances of concentration thresholds. At both Banks
10 and Jones, average DOC concentrations exceeding the 2 mg/L concentration threshold would
11 decrease from 100% under Existing Conditions and the No Action Alternative to 39% under
12 Alternative 9 (100% to 32% during the drought period), while concentrations exceeding 4 mg/L
13 would nearly be eliminated (i.e., $\leq 10\%$ exceedance frequency). Such modeled improvement would
14 correspond to substantial improvement in Export Service Areas water quality, respective to DOC.

15 Similar to the discussion pertaining to the No Action Alternative, maintenance of SWP and CVP
16 facilities under Alternative 9 would not be expected to create new sources of DOC or contribute
17 towards a substantial change in existing sources of DOC in the affected area. Maintenance activities
18 would not be expected to cause any substantial change in long-term average DOC concentrations
19 such that MUN beneficial uses, or any other beneficial use, would be adversely affected.

20 **NEPA Effects:** In summary, Alternative 9, relative to the No Action Alternative, would not cause a
21 substantial long-term change in DOC concentrations in the water bodies upstream of the Delta.
22 Long-term average DOC concentrations at Banks and Jones pumping plants are predicted to
23 decrease by as much as 1.9 mg/L, while long-term average DOC concentrations for some Delta
24 interior locations, including Franks Tract, Rock Slough and Contra Costa PP #1, are predicted to
25 increase by as much as 0.9 mg/L. Resultant substantial changes in long-term average DOC at these
26 Delta interior locations could necessitate changes in water treatment plant operations or require
27 treatment plant upgrades in order to maintain DBP compliance, and thus would constitute an
28 adverse effect on water quality and MUN beneficial uses. Mitigation Measure WQ-17 is available to
29 reduce these effects.

30 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
31 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
32 purpose of making the CEQA impact determination for this constituent. For additional details on the
33 effects assessment findings that support this CEQA impact determination, see the effects assessment
34 discussion that immediately precedes this conclusion.

35 While greater water demands under the Alternative 9 would alter the magnitude and timing of
36 reservoir releases north, south and east of the Delta, these activities would have no substantial effect
37 on the various watershed sources of DOC. Moreover, long-term average flow and DOC at Sacramento
38 River at Hood and San Joaquin River at Vernalis are poorly correlated; therefore, changes in river
39 flows would not be expected to cause a substantial long-term change in DOC concentrations
40 upstream of the Delta.

41 Relative to Existing Conditions, Alternative 9 would result in substantial increases (i.e., 0.6–1.0
42 mg/L) in long-term average DOC concentrations at some Delta interior locations, and would be
43 greatest at Franks Tract, Rock Slough, and Contra Costa PP No. 1. At these locations the predicted
44 changes in DOC would substantially increase the frequency with which long-term average

1 concentrations exceeds 2, 3, or 4 mg/L. Drinking water treatment plants obtaining water from these
 2 interior Delta locations would likely need to upgrade existing treatment systems in order to achieve
 3 EPA Stage 1 Disinfectants and Disinfection Byproduct Rule action thresholds. Such predicted
 4 magnitude change in long-term average DOC concentrations would represent a substantially
 5 increased risk for adverse effects on existing MUN beneficial.

6 The assessment of Alternative 9 effects on DOC in the SWP/CVP Export Service Areas is based on
 7 assessment of changes in DOC concentrations at Banks and Jones pumping plants. Relative to the
 8 existing condition, long-term average DOC concentrations would decrease by as much as 1.8 mg/L at
 9 Banks and Jones pumping plants. The frequency with which long-term average DOC concentrations
 10 would exceed 2, 3, or 4 mg/L would be substantially reduced, where predicted exceedances of >4
 11 mg/L would be nearly eliminated (i.e., ≤10% exceedance frequency). As a result, substantial
 12 improvement in DOC-related water quality would be predicted in the SWP/CVP Export Service
 13 Areas.

14 Based on the above, Alternative 9 operation and maintenance would not result in any substantial
 15 change in long-term average DOC concentration upstream of the Delta. Furthermore, under
 16 Alternative 9, water exported from the Delta to the SWP/CVP service area would be substantially
 17 improved relative to DOC. DOC is not bioaccumulative, therefore change in long-term average DOC
 18 concentrations would not directly cause bioaccumulative problems in aquatic life or humans.
 19 Additionally, DOC is not a constituent related to any 303(d) listings. Nevertheless, new and modified
 20 conveyance facilities proposed under Alternative 9 would result in a substantial increase in long-
 21 term average DOC concentrations (i.e., 0.6–1.0 mg/L, equivalent to ≤28% relative increase) at
 22 Franks Tract, Rock Slough, and Contra Costa PP No. 1. In particular, under Alternative 9, model
 23 predicted long-term average DOC concentrations would be greater than 4 mg/L at Rock Slough and
 24 Contra Costa PP No. 1 with commensurate substantial increases in the frequency with which
 25 average DOC concentrations exceed 2, 3, and 4 mg/L levels. Drinking water treatment plants
 26 obtaining water from these interior Delta locations would likely need to upgrade existing treatment
 27 systems in order to achieve EPA Stage 1 Disinfectants and Disinfection Byproduct Rule action
 28 thresholds. Therefore, such a magnitude change in long-term average DOC concentrations would
 29 represent a substantially increased risk for adverse effects on existing MUN beneficial uses at Rock
 30 Slough and Contra Costa PP No. 1 should such treatment upgrades not be undertaken. The impact is
 31 considered significant and mitigation is required. While Mitigation Measure WQ-17 is available to
 32 partially reduce this impact of DOC, the feasibility and effectiveness of this mitigation measure is
 33 uncertain and implementation would not necessarily reduce the identified impact to a level that
 34 would be less than significant, and therefore it is significant and unavoidable.

35 **Mitigation Measure WQ-17: Consult with Delta Water Purveyors to Identify Means to**
 36 **Avoid, Minimize, or Offset Increases in Long-Term Average DOC Concentrations**

37 Please see Mitigation Measure WQ-17 under Impact WQ-17 in the Alternative 6A discussion.

38 **Impact WQ-18: Effects on Dissolved Organic Carbon Concentrations Resulting from**
 39 **Implementation of CM2–CM22**

40 **NEPA Effects:** Conservation Measures 2–22 under Alternative 9 would be similar to those under
 41 Alternative 1A, but with changes in the south Delta to accommodate the modified corridors.
 42 Therefore, effects on DOC resulting from the implementation of CM2–CM22 would be similar to that
 43 previously discussed for Alternative 1A. In summary, CM4–CM7 and CM10 could contribute

1 substantial amounts of DOC to raw drinking water supplies, largely depending on final design and
 2 operational criteria for the related wetland and riparian habitat restoration activities. Substantially
 3 increased long-term average DOC in raw water supplies could lead to a need for treatment plant
 4 upgrades in order to appropriately manage DBP formation in treated drinking water. This potential
 5 for future DOC increases would lead to substantially greater associated risk of long-term adverse
 6 effects on the MUN beneficial use.

7 In summary, the habitat restoration elements of CM4–CM7 and CM10 under Alternative 9 would
 8 present new localized sources of DOC to the study area, and in some circumstances would substitute
 9 for existing sources related to replaced agriculture. Depending on localized hydrodynamics and
 10 proximity to municipal drinking water intakes, such restoration activities could contribute
 11 substantial amounts of DOC to municipal raw water. Substantial increases in municipal raw water
 12 DOC could necessitate changes in water treatment plant operations or require treatment plant
 13 upgrades in order to maintain DBP compliance, and thus would constitute an adverse effect on
 14 water quality. Mitigation Measure WQ-18 is available to reduce these effects.

15 **CEQA Conclusion:** Effects of CM4–CM7 and CM10 on DOC under Alternative 9 are similar to those
 16 discussed for Alternative 1A. Similar to the discussion for Alternative 1A, this impact is considered
 17 to be significant. Mitigation is required. It is uncertain whether implementation of Mitigation
 18 Measure WQ-18 would reduce identified impacts to a less-than-significant level. Hence, this impact
 19 remains significant and unavoidable.

20 In addition to and to supplement Mitigation Measure WQ-18, the BDCP proponents have
 21 incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*, a
 22 separate, non-environmental commitment to address the potential increased water treatment costs
 23 that could result from DOC concentration effects on municipal and industrial water purveyor
 24 operations. Potential options for making use of this financial commitment include funding or
 25 providing other assistance towards implementing treatment for DOC and/or DBPs or DOC source
 26 control strategies. Please refer to Appendix 3B, *Environmental Commitments*, for the full list of
 27 potential actions that could be taken pursuant to this commitment in order to reduce the water
 28 quality treatment costs associated with water quality effects relating to DOC.

29 **Mitigation Measure WQ-18: Design Wetland and Riparian Habitat Features to Minimize**
 30 **Effects on Municipal Intakes**

31 Please see Mitigation Measure WQ-18 under Impact WQ-18 in the discussion of Alternative 1A.

32 **Impact WQ-19: Effects on Pathogens Resulting from Facilities Operations and Maintenance**
 33 **(CM1)**

34 **NEPA Effects:** Effects of CM1 on pathogens under Alternative 9 are the same as those discussed for
 35 Alternative 1A and are considered to not be adverse.

36 **CEQA Conclusion:** Effects of CM1 on pathogens under Alternative 9 are the same as those discussed
 37 for Alternative 1A, and are summarized here, then compared to the CEQA thresholds of significance
 38 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this
 39 constituent. For additional details on the effects assessment findings that support this CEQA impact
 40 determination, see the effects assessment discussion under Alternative 1A.

41 River flow rate and reservoir storage reductions that would occur due to implementation of CM1
 42 (water facilities and operations) under Alternative 9, relative to Existing Conditions, would not be

1 expected to result in a substantial adverse change in pathogen concentrations in the reservoirs and
2 rivers upstream of the Delta, given the small magnitude of urban runoff contributions relative to the
3 magnitude of river flows, that pathogen concentrations in the rivers have a minimal relationship to
4 river flow rate, and the expected reduced pollutant loadings in response to NPDES stormwater-
5 related regulations.

6 It is expected there would be no substantial change in Delta pathogen concentrations in response to
7 a shift in the Delta source water percentages under this alternative or substantial degradation of
8 these water bodies, with regard to pathogens. This conclusion is based on the Pathogens Conceptual
9 Model, which found that pathogen sources in close proximity to a Delta site appear to have the
10 greatest influence on pathogen levels at the site, rather than the primary source(s) of water to the
11 site. In-Delta potential pathogen sources, including water-based recreation, tidal habitat, wildlife,
12 and livestock-related uses, would continue under this alternative.

13 In the SWP/CVP Export Service Areas waters, relative to Existing Conditions, an increased
14 proportion of water coming from the Sacramento River would not adversely affect beneficial uses in
15 the SWP/CVP Export Service Areas. The pathogen levels in the Sacramento River are similar to or
16 lower than the water diverted at the Delta export pumps. Further, it is localized sources of
17 pathogens that appear to have the greatest influence on concentrations. Thus, an increased
18 proportion of Sacramento River water diverted to the SWP/CVP Export Service Areas would result
19 in minimal changes in pathogen levels in the SWP/CVP Export Service Areas waters.

20 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
21 objectives by frequency, magnitude, and geographic extent that would cause adverse effects on any
22 beneficial uses of waters in the affected environment. Because pathogen concentrations are not
23 expected to increase substantially, no long-term water quality degradation for pathogens is
24 expected to occur and, thus, no adverse effects on beneficial uses would occur. The San Joaquin
25 River in the Stockton Deep Water Ship Channel is Clean Water Act section 303(d) listed for
26 pathogens. Because no measurable increase in Deep Water Ship Channel pathogen concentrations
27 are expected to occur on a long-term basis, further degradation and impairment of this area is not
28 expected to occur. Finally, pathogens are not bioaccumulative constituents. This impact is
29 considered to be less than significant. No mitigation is required.

30 **Impact WQ-20: Effects on Pathogens Resulting from Implementation of CM2–CM22**

31 **NEPA Effects:** Effects of CM2–CM22 on pathogens under Alternative 9 are the same as those
32 discussed for Alternative 1A and are considered to not be adverse.

33 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 9 would be similar to
34 those proposed under Alternative 1A. As such, effects on pathogens resulting from the
35 implementation of CM2–CM22 would be similar to that previously discussed for Alternative 1A. This
36 impact is considered to be less than significant. No mitigation is required.

37 **Impact WQ-21: Effects on Pesticide Concentrations Resulting from Facilities Operations and** 38 **Maintenance (CM1)**

39 ***Upstream of the Delta***

40 For the same reasons stated for the No Action Alternative, under Alternative 9 no specific operations
41 or maintenance activity of the SWP or CVP would substantially drive a change in pesticide use, and

1 thus pesticide sources would remain unaffected upstream of the Delta. Nevertheless, changes in the
2 timing and magnitude of reservoir releases could have an effect on available dilution capacity along
3 river segments such as the Sacramento, Feather, American, and San Joaquin Rivers.

4 Under Alternative 9, winter (November–March) and summer (April–October) season average flow
5 rates on the Sacramento River at Freeport, American River at Nimbus, Feather River at Thermalito
6 and the San Joaquin River at Vernalis would change. Relative to existing condition and the No Action
7 Alternative, seasonal average flow rates on the Sacramento would decrease no more than 3% during
8 the summer and winter (Appendix 8L, Seasonal average flows Tables 1-4). On the Feather River,
9 average flow rates would increase by as much as 10% during the summer, but would decrease by as
10 much as 5% in the winter. American River average flow rates would decrease by as much as 17% in
11 the summer but would increase by as much as 7% in the winter. Seasonal average flow rates on the
12 San Joaquin River would decrease by as much as 12% in the summer, but increase by as much as 1%
13 in the winter. For the same reasons stated for the No Action Alternative, decreased seasonal average
14 flow of $\leq 17\%$ is not considered to be of sufficient magnitude to substantially increase pesticide
15 concentrations or alter the long-term risk of pesticide-related toxicity to aquatic life, nor adversely
16 affect other beneficial uses of water bodies upstream of the Delta.

17 ***Delta***

18 Sources of diuron, OP and pyrethroid insecticides to the Plan Area include direct input of surface
19 runoff from in-Delta agriculture and Delta urbanized areas as well as inputs from rivers upstream of
20 the Delta. Similar to Upstream of the Delta, CVP/SWP operations would not affect these sources.

21 Under Alternative 9, the distribution and mixing of Delta source waters would change. Percent
22 change in monthly average source water fraction were evaluated for the modeled 16-year (1976–
23 1991) hydrologic period and a representative drought period (1987–1991), with special attention
24 given to changes in San Joaquin River, Sacramento River and Delta Agriculture sources water
25 fractions. Relative to Existing Conditions, under Alternative 9 modeled San Joaquin River fractions
26 would increase greater than 10% at Franks Tract, Rock Slough, Contra Costa PP No. 1, and the San
27 Joaquin River at Antioch (Appendix 8D, Source Water Fingerprinting). At Antioch, San Joaquin River
28 source water fractions would increase by 12–15% from October through May (11–14% from
29 November through April for the modeled drought period). While this change at Antioch is not
30 considered substantial, changes in San Joaquin River source water fraction in the Delta interior
31 would be considerable. At Franks Tract, San Joaquin River source water fractions would increase
32 between 25–57% for the entire calendar year of January through December (11–52% for October
33 through July of the modeled drought period). Changes at Rock Slough and Contra Costa PP No. 1
34 would be very similar, where modeled San Joaquin River source water fractions would increase
35 from 35–80% (25–78% for the modeled drought period) for the entire calendar year of January
36 through December. In addition, Sacramento River fractions would increase greater than 10% at
37 Staten Island and Buckley Cove (not including Banks and Jones). At Staten Island, Sacramento River
38 fractions would increase by 16% in April and 20% in May (13–15% from February through April of
39 the modeled drought period). These changes at Staten Island are not considered substantial. At
40 Buckley Cove, however, Sacramento source water fraction would increase between 36–72% (46–
41 73% for the drought period) for the entire calendar year of January through December. Although a
42 considerable change, this change in source water fraction at Buckley Cove would balance through a
43 nearly equivalent decrease in San Joaquin River water. Delta agricultural fractions would not
44 increase greater than 8% at any assessment location.

1 Relative to Existing Conditions, increases in San Joaquin River source water fraction at Franks Tract,
2 Rock Slough, and Contra Costa PP NO. 1 would primarily balance through decreases in Sacramento
3 River water, and as a result the San Joaquin River would account for greater than 50% of the total
4 source water volume at Franks Tract between October and June (>50% for November and
5 December during the modeled drought period), and would be greater than 50%, and as much as
6 86% for the entire calendar year at Rock Slough and Contra Costa PP No. 1 (greater than 50% and as
7 high as 80% for October through June of the modeled drought period). While the source water and
8 potential pesticide related toxicity co-occurrence predictions do not mean adverse effects would
9 occur, such considerable modeled increases in winter and early summer source water fraction at
10 Franks Tract and winter and summer source water fractions at Rock Slough and Contra Costa PP No.
11 1 could substantially alter the long-term risk of pesticide-related toxicity to aquatic life, given the
12 apparent greater incidence of pesticides in the San Joaquin River.

13 When compared to the No Action Alternative, changes in source water fractions would be similar in
14 season, geographic extent, and magnitude to those discussed for Existing Conditions (Appendix 8D,
15 Source Water Fingerprinting). Relative to the No Action Alternative the similar magnitude increase
16 in San Joaquin River source water fraction at Franks Tract, Rock Slough, and Contra Costa PP No. 1
17 would be considered substantial and could substantially increase the long-term risk of pesticide-
18 related toxicity to aquatic life.

19 These predicted adverse effects on pesticides relative to Existing Conditions and the No Action
20 Alternative fundamentally assume that the present pattern of pesticide incidence in surface water
21 will occur at similar levels into the future. In reality, however, the makeup and character of the
22 pesticide use market in the late long-term (i.e., the year 2060) will not be exactly as it is today.
23 Current use of chlorpyrifos and diazinon is on the decline with their replacement by pyrethroids on
24 the rise, yet in this assessment it is the apparent greater incidence of diazinon and chlorpyrifos on
25 the San Joaquin River that serves as the basis for concluding that substantially increased San Joaquin
26 River source water fraction would correspond to an increased risk of pesticide-related toxicity to
27 aquatic life. By 2060, however, alternative pesticides, such as neonicotinoids and biologicals, will
28 likely be a more substantial contributing part of the existing mix of pesticides, and perhaps more
29 prominent. The trend in the development of future-use pesticides is towards reduced risk pesticides,
30 including more biopesticides, with greater targeted specificity, fewer residues, and lower overall
31 non-target toxicity. By 2060 existing chlorpyrifos and diazinon TMDLs for the Sacramento and San
32 Joaquin Rivers will have been in effect for more than 50 years. Moreover, it is reasonable to expect
33 that CWA section 303(d) listings and future additional listings will have developed TMDLs by 2060.
34 To the extent these existing and future TMDL's address current and future-use pesticides, a greater
35 degree of pesticide related source control can be anticipated. Nevertheless, forecasting whether
36 these various efforts will ultimately be successful at resolving current pesticide related impairments
37 requires considerable speculation. While the fundamental assumptions that have guided this
38 assessment of pesticides may be somewhat altered by 2060, these assumptions are informed by
39 actual studies and monitoring data collected from the recent past and, therefore, judging project
40 alternative effects in the future remain most accurate through use of these informed assumptions
41 rather than based on assumptions founded upon future speculative conditions.

42 ***SWP/CVP Export Service Areas***

43 Assessment of effects in SWP/CVP Export Service Areas is based on effects seen in the Plan Area at
44 the Banks and Jones pumping plants. Under Alternative 9, Sacramento River source water fractions
45 would increase at both Banks and Jones pumping plants relative to Existing Conditions and the No

1 Action Alternative (Appendix 8D, Source Water Fingerprinting). At Banks pumping plant,
2 Sacramento source water fractions would generally increase from 12–38% for February through
3 June (12–37% for February through June of the modeled drought period) and at Jones pumping
4 plant Sacramento source water fractions would generally increase from 7–54% for the entire
5 calendar year (14–69% for September through June of the modeled drought period). These
6 increases in Sacramento source water fraction would primarily balance through equivalent
7 decreases in San Joaquin River water. Based on the general observation that San Joaquin River, in
8 comparison to the Sacramento River, is a greater contributor of OP insecticides in terms of greater
9 frequency of incidence and presence at concentrations exceeding water quality benchmarks,
10 modeled increases in Sacramento River fraction at Banks and Jones would generally represent an
11 improvement in export water quality respective to pesticides.

12 **NEPA Effects:** In summary, the changes in long-term average flows on the Sacramento, Feather,
13 American, and San Joaquin Rivers, under Alternative 9 relative to the No Action Alternative, are of
14 insufficient magnitude to substantially increase the long-term risk of pesticide-related water quality
15 degradation and related toxicity to aquatic life in these water bodies upstream of the Delta.
16 However, modeled increases in San Joaquin River fraction at Franks Tract, Rock Slough, and Contra
17 Costa PP No. 1 are of sufficient magnitude to substantially alter the long-term risk of pesticide-
18 related water quality degradation and related toxicity to aquatic life in the Delta. The effects on
19 pesticides from operations and maintenance (CM1) are determined to be adverse and unavoidable.

20 **CEQA Conclusion:** Key findings discussed in the effects assessment relative to Existing Conditions is
21 provided above are summarized here, and are then compared to the CEQA thresholds of significance
22 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this
23 constituent. For additional details on the effects assessment findings that support this CEQA impact
24 determination, see the effects assessment discussion that immediately precedes this conclusion.

25 Sources of pesticides upstream of the Delta include direct input of pesticide containing surface
26 runoff from agriculture and urbanized areas. Flows in rivers receiving these discharges dilute these
27 pesticide inputs. Relative to Existing Conditions, however, modeled changes in long-term average
28 flows on the Sacramento, Feather, American, and San Joaquin Rivers are of insufficient magnitude to
29 substantially increase the long-term risk of pesticide-related water quality degradation and related
30 toxicity to aquatic life in these water bodies upstream of the Delta.

31 In the Delta, sources of pesticides include direct input of surface runoff from Delta agriculture and
32 Delta urbanized areas as well as inputs from rivers upstream of the Delta. While facilities operations
33 and maintenance activities would not affect these sources, changes in Delta source water fraction
34 could change the relative risk associated with pesticide related toxicity to aquatic life. Under
35 Alternative 9, modeled long-term average San Joaquin River source water fractions at Franks Tract,
36 Rock Slough and Contra Costa PP No. 1 locations would increase considerably for some months such
37 that the long-term risk of pesticide-related toxicity to aquatic life could substantially increase.

38 The assessment of Alternative 9 effects on pesticides in the SWP/CVP Export Service Areas is based
39 on assessment of changes predicted at Banks and Jones pumping plants. Sacramento River source
40 water fractions would increase substantially at both Banks and Jones pumping plants and would
41 generally represent an improvement in export water quality respective to pesticides.

42 Based on the above, Alternative 9 would not result in any substantial change in long-term average
43 pesticide concentration or result in substantial increase in the anticipated frequency with which
44 long-term average pesticide concentrations would exceed aquatic life toxicity thresholds or other

1 beneficial use effect thresholds upstream of the Delta or the SWP/CVP service area. Numerous
2 pesticides are currently used throughout the affected environment, and while some of these
3 pesticides may be bioaccumulative, those present-use pesticides for which there is sufficient
4 evidence for their presence in waters affected by SWP and CVP operations (i.e., diazinon,
5 chlorpyrifos, diuron, and pyrethroids) are not considered bioaccumulative, and thus changes in their
6 concentrations would not directly cause bioaccumulative problems in aquatic life or humans.
7 Furthermore, while there are numerous 303(d) listings throughout the affected environment that
8 name pesticides as the cause for beneficial use impairment, the modeled changes in upstream river
9 flows and Delta source water fractions would not be expected to make any of these beneficial use
10 impairments measurably worse, with principal exception to locations in the Delta that would receive
11 a substantially greater fraction San Joaquin River water under Alternative 9. Long-term average San
12 Joaquin River source water fractions at Franks Tract, Rock Slough and Contra Costa PP No. 1
13 locations would change considerably for the calendar year such that the long-term risk of pesticide-
14 related toxicity to aquatic life could substantially increase. Additionally, the potential for increased
15 incidence of pesticide related toxicity could include pesticides such as chlorpyrifos and diazinon for
16 which existing 303(d) listings exist for the Delta, and thus existing beneficial use impairment could
17 be made discernibly worse. The impact is considered to be significant and unavoidable. There is no
18 feasible mitigation available to reduce the effect of this significant impact.

19 **Impact WQ-22: Effects on Pesticide Concentrations Resulting from Implementation of CM2- 20 CM22**

21 **NEPA Effects:** Conservation Measures 2-22 under Alternative 9 would be similar to those under
22 Alternative 1A, but with changes in the south Delta to accommodate the modified corridors. Effects
23 on pesticides resulting from the implementation of CM2-CM22 would be similar to that previously
24 discussed for Alternative 1A. In summary, CM13 proposes the use of herbicides to control invasive
25 aquatic vegetation around habitat restoration sites. Herbicides directly applied to water could
26 include adverse effects on non-target aquatic life, such as aquatic invertebrates and beneficial
27 aquatic plants. As such, aquatic life toxicity objectives could be exceeded with sufficient frequency
28 and magnitude such that beneficial uses would be impacted, thus constituting an adverse effect on
29 water quality.

30 In summary, based on the discussion above, the effects on pesticides from implementing CM2-CM22
31 are considered to be adverse. Mitigation Measure WQ-22 would be available to reduce this adverse
32 effect.

33 **CEQA Conclusion:** Effects of CM2-CM22 on pesticides under Alternative 9 are similar to those
34 discussed for Alternative 1A. Potential environmental effects related only to CM13 are considered to
35 be significant. Mitigation is required. While Mitigation Measure WQ-22 is available to partially
36 reduce this impact of pesticides, no feasible mitigation is available that would reduce it to a level
37 that would be less than significant.

38 **Mitigation Measure WQ-22: Implement Least Toxic Integrated Pest Management 39 Strategies**

40 Please see Mitigation Measure WQ-22 under Impact WQ-22 in the discussion of Alternative 1A.

1 **Impact WQ-23: Effects on Phosphorus Concentrations Resulting from Facilities Operations**
2 **and Maintenance (CM1)**

3 **NEPA Effects:** Effects of water facilities and operations (CM1) on phosphorus levels in water bodies
4 of the affected environment under Alternative 9 would be very similar (i.e., nearly the same) to
5 those discussed for Alternative 1A. Consequently, the environmental consequences to phosphorus
6 levels discussed in detail for Alternative 1A also adequately represent the effects under Alternative
7 9, which are considered to be not adverse.

8 **CEQA Conclusion:** Key findings discussed in the effects assessment relative to Existing Conditions is
9 provided above are summarized here, and are then compared to the CEQA thresholds of significance
10 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this
11 constituent. For additional details on the effects assessment findings that support this CEQA impact
12 determination, see the effects assessment discussion that immediately precedes this conclusion.

13 Because phosphorus loading to waters upstream of the Delta is not anticipated to change, and
14 because changes in flows do not necessarily result in changes in concentrations or loading of
15 phosphorus to these water bodies, substantial changes in phosphorus concentration upstream of the
16 Delta are not anticipated for Alternative 9, relative to Existing Conditions.

17 Because phosphorus concentrations in the major source waters to the Delta are similar for much of
18 the year, phosphorus concentrations in the Delta are not anticipated to change substantially on a
19 long term-average basis under Alternative 9, relative to Existing Conditions. Algal growth rates are
20 limited by availability of light in the Delta, and therefore any minor increases in phosphorus levels
21 that may occur at some locations and times within the Delta would be expected to have little effect
22 on primary productivity in the Delta.

23 The assessment of effects of phosphorus under Alternative 9 in the SWP and CVP Export Service
24 Areas is based on effects on phosphorus at the Banks and Jones pumping plants. As noted above,
25 phosphorus concentrations in the Delta (including Banks and Jones pumping plants) are not
26 anticipated to change substantially on a long term-average basis.

27 Based on the above, there would be no substantial, long-term increase in phosphorus concentrations
28 in the rivers and reservoirs upstream of the Delta, in the Delta Region, or the waters exported to the
29 CVP and SWP service areas under Alternative 9 relative to Existing Conditions. As such, this
30 alternative is not expected to cause additional exceedance of applicable water quality objectives/
31 criteria by frequency, magnitude, and geographic extent that would cause adverse effects on any
32 beneficial uses of waters in the affected environment. Because phosphorus concentrations are not
33 expected to increase substantially, no long-term water quality degradation is expected to occur and,
34 thus, no adverse effects to beneficial uses would occur. Phosphorus is not 303(d) listed within the
35 affected environment and thus any minor increases that may occur in some areas would not make
36 any existing phosphorus-related impairment measurably worse because no such impairments
37 currently exist. Because phosphorus is not bioaccumulative, minor increases that may occur in some
38 areas would not bioaccumulate to greater levels in aquatic organisms that would, in turn, pose
39 substantial health risks to fish, wildlife, or humans. This impact is considered to be less than
40 significant. No mitigation is required.

1 **Impact WQ-24: Effects on Phosphorus Concentrations Resulting from Implementation of**
 2 **CM2–CM22**

3 **NEPA Effects:** Effects of CM2–CM22 on phosphorus levels in water bodies of the affected
 4 environment under Alternative 9 would be very similar (i.e., nearly the same) to those discussed for
 5 Alternative 1A. Consequently, the environmental consequences to phosphorus levels from
 6 implementing CM2–CM22 discussed in detail for Alternative 1A also adequately represent the
 7 effects of these same actions under Alternative 9, which are considered to be not adverse.

8 **CEQA Conclusion:** Conservation Measures 2–22 proposed under Alternative 9 would be similar to
 9 those proposed under Alternative 1A. As such, effects on phosphorus resulting from the
 10 implementation of CM2–CM22 would be similar to that previously discussed for Alternative 1A. This
 11 impact is considered to be less than significant. No mitigation is required.

12 **Impact WQ-25: Effects on Selenium Concentrations Resulting from Facilities Operations and**
 13 **Maintenance (CM1)**

14 ***Upstream of the Delta***

15 For the same reasons stated for the No Action Alternative, Alternative 9 would have negligible, if
 16 any, effect on selenium concentrations in the rivers and reservoirs upstream of the Delta relative to
 17 Existing Conditions and the No Action Alternative. Any negligible increases in selenium
 18 concentrations that could occur in the water bodies of the affected environment located upstream of
 19 the Delta would not be of frequency, magnitude and geographic extent that would adversely affect
 20 any beneficial uses or substantially degrade the quality of these water bodies, with regard to
 21 selenium.

22 ***Delta***

23 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 24 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 25 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 26 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 27 CM2-22 not attributable to hydrodynamics, for example, additional loading of a constituent to the
 28 Delta, are discussed within the impact header for CM2-22. See section 8.3.1.3 for more information.

29 Alternative 9 would result in small to moderate changes in average selenium concentrations in
 30 water at modeled Delta assessment locations relative to Existing Conditions and the No Action
 31 Alternative (Appendix 8M, Table M-10A). The various changes in selenium concentrations in water
 32 are reflected in small (10% or less) to moderate (between 11% and 50%) changes in available
 33 assimilative capacity for selenium (based on 2 µg/L ecological risk benchmark) for all years. Relative
 34 to Existing Conditions, Alternative 9 would result in the largest modeled increase in assimilative
 35 capacity at Buckley Cove (32%) and the three largest decreases would be at Franks Tract (13%),
 36 Rock Slough (19%), and Contra Costa PP (18%) (Figure 8-59). Relative to the No Action Alternative,
 37 the largest modeled increase in assimilative capacity would be at Buckley Cove (26%) and the three
 38 largest decreases would be at Franks Tract (13%), Rock Slough (19%), and Contra Costa PP (18%)
 39 (Figure 8-60). Although there would be moderate (greater than 10%) negative changes in
 40 assimilative capacity at three locations (Franks Tract, Rock Slough, and Contra Costa PP), the
 41 changes would be minimal (10% or less decrease) at the other locations and the available
 42 assimilative capacity at all locations would remain substantial; overall, the effect of Alternative 9

1 would be generally moderate for portions of the Delta represented by Franks Tract, Rock Slough,
2 and Contra Costa PP. However, the ranges of modeled selenium concentrations in water (Appendix
3 8M, Table M-10A) for Alternative 9 (range 0.23–0.70 µg/L), Existing Conditions (range 0.21–0.76
4 µg/L), and the No Action Alternative (range 0.21–0.69 µg/L) are similar, and all would be below the
5 ecological risk benchmark (2 µg/L).

6 Relative to Existing Conditions and the No Action Alternative, Alternative 9 would generally result in
7 minimal to moderate changes in estimated selenium concentrations in biota (whole-body fish, bird
8 eggs [invertebrate diet], bird eggs [fish diet], and fish fillets) (Appendix 8M, Table M20 and
9 Addendum M.A to Appendix 8M, Table M.A-2). Relative to Existing Conditions and the No Action
10 Alternative, the largest increase of selenium concentrations in biota would be at Rock Slough and
11 Contra Costa PP for drought years and in sturgeon at the two western Delta locations in all as well as
12 drought years, and the largest decrease would be at Buckley Cove for drought years. Except for
13 sturgeon in the western Delta, concentrations of selenium in whole-body fish and in bird eggs
14 (invertebrate and fish diets) would exceed the lower benchmarks (4 and 6 mg/kg dry weight,
15 respectively, indicating a low potential for effects), under drought conditions, at Buckley Cove for
16 Existing Conditions and the No Action Alternative, and at Rock Slough and Contra Costa PP for
17 Alternative 9 (Figures 8-61 through 8-63). Exceedance Quotients for these comparisons to the lower
18 benchmarks are between 1.0 and 1.5, indicating a low risk to biota in the Delta, but modeled
19 selenium concentrations in whole-body fish and in bird eggs (invertebrate and fish diets) exceed
20 those benchmarks at two locations where they do not exceed under Existing Conditions and the No
21 Action Alternative. Selenium concentrations in fish fillets would not exceed the screening value for
22 protection of human health (Figure 8-64). For sturgeon in the western Delta, whole-body selenium
23 concentrations would increase from 12.3 mg/kg under Existing Conditions and the No Action
24 Alternative to 15.1 mg/kg under Alternative 9, a 23% increase (Table M.A-2). All of these values
25 exceed both the low and high toxicity benchmarks. The predicted increases are high enough that
26 they may represent a measurable increase in body burdens of sturgeon, which would constitute an
27 adverse impact (see also the discussion of results provided in Addendum M.A to Appendix 8M).

28 Under Alternative 9, the most notable effect on selenium concentrations in water would be the
29 increase at Rock Slough, Franks Tract, and Contra Costa PP, decreasing the available assimilative
30 capacity and increasing the selenium concentrations in biota at those locations. Alternative 9 is the
31 only action alternative that would exceed benchmarks for biota that are not exceeded under Existing
32 Conditions and the No Action Alternative (and only at Rock Slough and Contra Costa PP); this level
33 of bioaccumulation is predicted despite the conclusion that selenium concentrations in water would
34 not exceed ecological benchmarks at any location and the assimilative capacity would remain
35 substantial. The foremost difference between Alternative 9 and the other alternatives is the
36 exceedances of risk-based benchmarks for biota at Rock Slough and Contra Costa PP (and a large
37 increase in tissue concentrations predicted at Franks Tract, although the tissue benchmarks would
38 not be exceeded) compared to the exceedances at Buckley Cove for Existing Conditions and the No
39 Action Alternative and the other alternatives. In essence, the location where selenium
40 bioaccumulation is highest would be displaced from Buckley Cove to Rock Slough, Franks Tract, and
41 Contra Costa PP. Therefore, selenium concentrations in water and biota within the Delta would also
42 differ spatially for Alternative 9 compared to Existing Conditions and the No Action Alternative and
43 the other action alternatives, and under Alternative 9 could increase the frequency with which
44 applicable benchmarks would be exceeded in some regions of the Delta or substantially degrade the
45 quality of water with respect to beneficial uses in the Delta.

1 **SWP/CVP Export Service Areas**

2 Alternative 9 would result in small to moderate changes in average selenium concentrations in
3 water relative to Existing Conditions and the No Action Alternative (Appendix 8M, Table M-10A).
4 These changes are reflected in the small (10% or less) to moderate (between 11% and 50%)
5 changes in available assimilative capacity for selenium for all years. Relative to Existing Conditions
6 and the No Action Alternative, Alternative 9 would result in increases in assimilative capacity at
7 Jones PP (12% and 13%, respectively) and at Banks PP (5%) (Figures 8-59 and 8-60), so it would
8 have a positive effect at the Export Service Area locations. The ranges of modeled selenium
9 concentrations in water (Appendix 8M, Table M-10A) for Alternative 9 (range 0.32–0.40 µg/L),
10 Existing Conditions (range 0.37–0.58 µg/L), and the No Action Alternative (range 0.37–0.59 µg/L)
11 are similar, and all would be well below the ecological risk benchmark (2 µg/L).

12 Relative to Existing Conditions and the No Action Alternative, Alternative 9 would result in minimal
13 changes in estimated selenium concentrations in biota (Appendix 8M, Table M-20). Relative to
14 Existing Conditions and the No Action Alternative, the largest increase of selenium concentrations in
15 biota would be at Banks PP for all years. Relative to all Existing Conditions and the No Action
16 Alternative, the largest decrease of selenium concentrations in biota would be at Jones PP for
17 drought years. Selenium concentrations in biota would not exceed any benchmarks for Alternative 9
18 (Figures 8-61 through 8-64).

19 Thus, relative to Existing Conditions and the No Action Alternative, Alternative 9 would result in
20 small to moderate changes in selenium concentrations in water and minimal changes in selenium
21 concentrations in biota at the Export Service Area locations. Selenium concentrations in water and
22 biota generally would decrease under Alternative 9 and would not exceed ecological benchmarks at
23 either location, whereas the lower benchmark for bird eggs (fish diet) would be exceeded under
24 Existing Conditions and the No Action Alternative at Jones PP under drought conditions. This small
25 positive change in selenium concentrations under Alternative 9 would be expected to slightly
26 decrease the frequency with which applicable benchmarks would be exceeded or slightly improve
27 the quality of water at the Export Service Area locations, with regard to selenium.

28 **NEPA Effects:** Based on the discussion above, the effects on selenium from Alternative 9 are
29 considered to be adverse. This determination is reached because 1) modeled selenium
30 concentrations in water would increase at Rock Slough, Franks Tract, and Contra Costa PP,
31 decreasing the available assimilative capacity by more than 10 percent at each of those locations; 2)
32 selenium concentrations in whole-body fish and in bird eggs (invertebrate and fish diets) at those
33 locations would increase so that Level of Concern benchmarks for biota that are not exceeded under
34 the No Action Alternative would be exceeded at Rock Slough and Contra Costa PP (and approach
35 exceedance at Franks Tract); and selenium concentrations in whole-body sturgeon modeled at two
36 western Delta locations would increase by an estimated 23%, which may represent a measurable
37 increase in the environment. Because both low and high toxicity benchmarks are already exceeded
38 under the No Action Alternative, these potentially measurable increases represent an adverse
39 impact.

40 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
41 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
42 purpose of making the CEQA impact determination for selenium. For additional details on the effects
43 assessment findings that support this CEQA impact determination, see the effects assessment
44 discussion that immediately precedes this conclusion.

1 There are no substantial point sources of selenium in watersheds upstream of the Delta, and no
2 substantial nonpoint sources of selenium in the watersheds of the Sacramento River and the eastern
3 tributaries. Nonpoint sources in the San Joaquin Valley that contribute selenium to the Delta will be
4 controlled through a TMDL developed by the Central Valley Water Board (2001) for the lower San
5 Joaquin River, established limits for the Grassland Bypass Project, and Basin Plan objectives (Central
6 Valley Water Board 2010c) and State Water Board (2010d, 2010e) that are expected to result in
7 decreasing discharges of selenium from the San Joaquin River to the Delta. Consequently, any
8 modified reservoir operations and subsequent changes in river flows under Alternative 9, relative to
9 Existing Conditions, are expected to cause negligible changes in selenium concentrations in water.
10 Any negligible changes in selenium concentrations that may occur in the water bodies of the affected
11 environment located upstream of the Delta would not be of frequency, magnitude, and geographic
12 extent that would adversely affect any beneficial uses or substantially degrade the quality of these
13 water bodies as related to selenium.

14 Relative to Existing Conditions, modeling estimates indicate that selenium concentrations in water
15 and biota within the Delta would differ spatially for Alternative 9 compared to Existing Conditions,
16 and the differences would be substantial. Under Alternative 9, modeled selenium concentrations in
17 water would increase at Rock Slough, Franks Tract, and Contra Costa PP, decreasing the available
18 assimilative capacity by more than 10 percent at each of those locations; consequently, selenium
19 concentrations in whole-body fish and in bird eggs (invertebrate and fish diets) at those locations
20 would increase so that Level of Concern benchmarks for biota that are not exceeded under Existing
21 Conditions would be exceeded at Rock Slough and Contra Costa PP (and approach exceedance at
22 Franks Tract). Additionally, relative to Existing Conditions, modeling estimates indicate that
23 Alternative 9 would increase selenium concentrations in whole-body sturgeon modeled at two
24 western Delta locations by an estimated 23%, which may represent a measurable increase in the
25 environment. Because both low and high toxicity benchmarks are already exceeded under Existing
26 Conditions, these potentially measurable increases represent a potential impact to aquatic life
27 beneficial uses.

28 Assessment of effects of selenium in the SWP and CVP Export Service Areas is based on effects on
29 selenium concentrations at the Banks and Jones pumping plants. Relative to Existing Conditions,
30 Alternative 9 would slightly decrease the frequency with which applicable benchmarks would be
31 exceeded or slightly improve the quality of water in selenium concentrations at the Banks and Jones
32 pumping plants locations.

33 Based on the above, although waterborne selenium concentrations would not exceed applicable
34 water quality objectives/criteria, significant impacts on some beneficial uses of waters in the Delta
35 could occur because uptake of selenium from water to biota would be expected to increase above
36 potential effects levels at some locations, and in the western Delta where concentrations in sturgeon
37 exceed both low and high toxicity benchmarks under Existing Conditions, uptake of selenium from
38 water to sturgeon may measurably increase. In comparison to Existing Conditions, water quality
39 conditions under this alternative would increase levels of selenium (a bioaccumulative pollutant) by
40 frequency, magnitude, and geographic extent such that the affected environment would be expected
41 to have measurably higher body burdens of selenium in aquatic organisms, thereby substantially
42 increasing the health risks to wildlife (including fish); however, impacts to humans consuming those
43 organisms are not expected to occur. Water quality conditions under this alternative with respect to
44 selenium would cause long-term degradation of water quality in the western Delta, and conditions
45 at Rock Slough and Contra Costa PP (and the regions of the Delta they represent) are expected to
46 result in exceedance of selenium thresholds in some biota, indicating a level of risk greater than

1 under Existing Conditions. Except in the vicinity of the western Delta, Rock Slough, and Contra Costa
2 PP (and the region of the Delta they represent), water quality conditions under this alternative
3 would not increase levels of selenium by frequency, magnitude, and geographic extent such that the
4 affected environment would be expected to have measurably higher body burdens of selenium in
5 aquatic organisms. The greater level of selenium bioaccumulation in the vicinities of the western
6 Delta, Rock Slough, and Contra Costa PP would further degrade water quality by measurable levels,
7 on a long-term basis, for selenium and, thus, cause the 303(d)-listed impairment of beneficial use to
8 be made discernibly worse. This impact is considered significant.

9 The need for, and the feasibility and effectiveness of, post-operation mitigation for the predicted
10 level of selenium bioaccumulation is uncertain. The first step shall be to determine the reliability of
11 the model in predicting biota selenium concentrations in the affected environment where effects are
12 predicted but selenium data are lacking. For that reason, the model shall be validated with site-
13 specific sampling before extensive mitigation measures relative to CM1 operations are developed
14 and evaluated for feasibility, as the measures and their evaluation for feasibility are likely to be
15 complex. Specifically, it remains to be determined whether the available existing data for transfer of
16 selenium from water to particulates and through different trophic levels of the food chain are
17 representative of conditions that may occur from implementation of Alternative 9. Therefore, the
18 proposed mitigation measure requires that sampling be conducted to characterize each step of data
19 inputs needed for the model, and then the refined model be validated for local conditions. This
20 impact is considered significant and unavoidable.

21 **Impact WQ-26: Effects on Selenium Concentrations Resulting from Implementation of CM2–** 22 **CM22**

23 *NEPA Effects:* In general, with the possible exception of changes in Delta hydrodynamics resulting
24 from habitat restoration, CM2–CM11 would not substantially increase selenium concentrations in
25 the water bodies of the affected environment. Modeling scenarios included assumptions regarding
26 how certain habitat restoration activities (CM2 and CM4) would affect Delta hydrodynamics, and
27 thus such effects of these restoration measures were included in the assessment of CM1 facilities
28 operations and maintenance (see Impact WQ-25).

29 However, implementation of these conservation measures may increase water residence time
30 within the restoration areas. Increased restoration area water residence times could potentially
31 increase the bioaccumulation of selenium in biota, thereby potentially increasing fish tissue and bird
32 egg concentrations of selenium, but models are not available to quantitatively estimate the level of
33 changes in residence time and the associated selenium bioavailability. If increases in fish tissue or
34 bird egg selenium were to occur, the increases would likely be of concern only where fish tissues or
35 bird eggs are already elevated in selenium to near or above thresholds of concern. That is, where
36 biota concentrations are currently low and not approaching thresholds of concern, changes in
37 residence time alone would not be expected to cause them to then approach or exceed thresholds of
38 concern. In consideration of this factor, although the Delta as a whole is a 303(d)-listed water body
39 for selenium, and although monitoring data of fish tissue or bird eggs in the Delta are sparse, the
40 most likely areas in which biota tissues would be at levels high enough that additional
41 bioaccumulation due to increased residence time from restoration areas would be a concern are the
42 western Delta and Suisun Bay, and the South Delta in areas that receive San Joaquin River water.

43 The western Delta and Suisun Bay receive elevated selenium loads from North San Francisco Bay
44 (including San Pablo Bay, Carquinez Strait, and Suisun Bay) and from the San Joaquin River. Point

1 sources of selenium in North San Francisco Bay (i.e., refineries) that contribute selenium to Suisun
2 Bay are expected to be reduced through a TMDL under development by the San Francisco Bay Water
3 Board (San Francisco Bay Water Board 2012) that is expected to result in decreasing discharges of
4 selenium. Nonpoint sources of selenium in the San Joaquin Valley that contribute selenium to the
5 San Joaquin River, and thus the Delta and Suisun Bay, will be controlled through a TMDL developed
6 by the Central Valley Water Board (2001) for the lower San Joaquin River, established limits for the
7 Grassland Bypass Project, and Basin Plan objectives (Central Valley Water Board 2010c, d) that are
8 expected to result in decreasing discharges of selenium from the San Joaquin River to the Delta. If
9 selenium levels are not sufficiently reduced via these efforts, it is expected that the State Water
10 Board and the San Francisco Bay and Central Valley Water Boards would initiate additional actions
11 to further control sources of selenium.

12 The South Delta receives elevated selenium loads from the San Joaquin River. In contrast to Suisun
13 Bay and possibly the western Delta in the future, the South Delta lacks the overbite clam (*Corbula*
14 [*Potamocorbula*] *amurensis*), which is considered a key driver of selenium bioaccumulation in
15 Suisun Bay, due to its high bioaccumulation of selenium and its role in the benthic food web that
16 includes long-lived sturgeon. The South Delta does have *Corbicula fluminea*, another bivalve that
17 bioaccumulates selenium, but it is not as invasive as the overbite clam and thus likely makes up a
18 smaller fraction of sturgeon diet. Also, as mentioned above, nonpoint sources of selenium in the San
19 Joaquin Valley that contribute selenium to the Delta will be controlled through a TMDL developed by
20 the Central Valley Water Board (2001) for the lower San Joaquin River, established limits for the
21 Grassland Bypass Project, and Basin Plan objectives (Central Valley Water Board 2010c, d) that are
22 expected to result in decreasing discharges of selenium from the San Joaquin River to the Delta.
23 Further, if selenium levels in the San Joaquin River are not sufficiently reduced via these efforts, it is
24 expected that the State Water Board and Central Valley Water Board would initiate additional
25 TMDLs to further control nonpoint sources of selenium.

26 Wetland restoration areas will not be designed such that water flows in and does not flow out.
27 Exchange of water between the restoration areas and existing Delta channels is an important design
28 factor, since one goal of the restoration areas is to export food produced in these areas to the rest of
29 the Delta (see BDCP Chapter 3, *Conservation Strategy*, Section 3.3, Biological Goals and Objectives).
30 Thus, these areas can be thought of as “flow-through” systems. Consequently, although water
31 residence times associated with BDCP restoration could increase, they are not expected to increase
32 without bound. and selenium concentrations in the water column would not continue to build up
33 and be recycled in sediments and organisms as may be the case within a closed system.

34 However, because increases in bioavailable selenium in the habitat restoration areas are uncertain,
35 proposed avoidance and minimization measures would require evaluating risks of selenium
36 exposure at a project level for each restoration area, minimizing to the extent practicable potential
37 risk of additional bioaccumulation, and monitoring selenium levels in fish and/or wildlife to
38 establish whether, or to what extent, additional bioaccumulation is occurring. See Appendix 3B,
39 *Environmental Commitments* for a description of the environmental commitment BDCP proponents
40 are making with respect to Selenium Management; and Appendix 3.C. of the BDCP for additional
41 detail on this avoidance and minimization measure (AMM27). Data generated as part of the
42 avoidance and minimization measures will assist the State and Regional Water Boards in
43 determining whether beneficial uses are being impacted by selenium, and thus will provide the data
44 necessary to support regulatory actions (including additional TMDL development), should such
45 actions be warranted.

1 Given the factors discussed in the assessment above, any increases in bioaccumulation rates from
 2 water-borne selenium that could occur in some areas as a result of increased water residence time
 3 would not be of sufficient magnitude and geographic extent that any portion of the Delta would be
 4 expected to have measurably higher body burdens of selenium in aquatic organisms and, therefore,
 5 would not substantially increase risk for adverse effects to beneficial uses. Furthermore, although
 6 the Delta is a 303(d)-listed water body for selenium, given the discussion in the assessment above, it
 7 is unlikely that restoration areas would result in measurable increases in selenium in fish tissues or
 8 bird eggs such that the beneficial use impairment would be made discernibly worse.

9 Because it is unlikely that substantial increases in selenium in fish tissues or bird eggs would occur
 10 such that effects on aquatic life beneficial uses would be anticipated, and because of the avoidance
 11 and minimization measures that are designed to further minimize and evaluate the risk of such
 12 increases, the effects of WQ-26 are considered not adverse.

13 **CEQA Conclusion:** There would be no substantial, long-term increase in selenium concentrations in
 14 water in the rivers and reservoirs upstream of the Delta, water in the Delta, or the waters exported
 15 to the CVP and SWP service areas due to implementation of CM2–CM22 relative to Existing
 16 Conditions. Waterborne selenium concentrations under this alternative would not exceed applicable
 17 water quality objectives/criteria.

18 Given the factors discussed in the assessment above, any increases in bioaccumulation rates from
 19 water-borne selenium that could occur in some areas as a result of increased water residence times
 20 would not be of sufficient magnitude and geographic extent that any portion of the Delta would be
 21 expected to have measurably higher body burdens of selenium in aquatic organisms, and therefore
 22 would not substantially increase risk for adverse effects to beneficial uses. CM2-22 would not cause
 23 long-term degradation of water quality resulting in sufficient use of available assimilative capacity
 24 such that occasionally exceeding water quality objectives/criteria would be likely. Also, CM2-22
 25 would not result in substantially increased risk for adverse effects to any beneficial uses.
 26 Furthermore, although the Delta is a 303(d)-listed water body for selenium, given the discussion in
 27 the assessment above, it is unlikely that restoration areas would result in measurable increases in
 28 selenium in fish tissues or bird eggs such that the beneficial use impairment would be made
 29 discernibly worse.

30 Since it is unlikely that substantial increases in selenium in fish tissues or bird eggs would occur
 31 such that effects on aquatic life beneficial uses would be anticipated, and because of the avoidance
 32 and minimization measures that are designed to further minimize and evaluate the risk of such
 33 increases (see Appendix 3.C. of the BDCP for more detail on AMM27) as well as the Selenium
 34 Management environmental commitment (see Appendix 3B, *Environmental Commitments*), this
 35 impact is considered less than significant. No mitigation is required.

36 **Impact WQ-27: Effects on Trace Metal Concentrations Resulting from Facilities Operations** 37 **and Maintenance (CM1)**

38 ***Upstream of the Delta***

39 For the same reasons stated for the No Action Alternative, Alternative 9 would result in negligible,
 40 and likely immeasurable, increases in trace metal concentrations in the rivers and reservoirs
 41 upstream of the Delta, relative to Existing Conditions and the No Action Alternative. Effects due to
 42 the operation and maintenance of the conveyance facilities are expected to be immeasurable, on an
 43 annual and long-term average basis. As such, Alternative 9 would not be expected to substantially

1 increase the frequency with which applicable Basin Plan objectives or CTR criteria would be
2 exceeded in water bodies of the affected environment located upstream of the Delta or substantially
3 degrade the quality of these water bodies, with regard to trace metals.

4 ***Delta***

5 For the same reasons stated for the No Action Alternative, Alternative 9 would not result in
6 substantial increases in trace metal concentrations in the Delta relative to Existing Conditions and
7 the No Action Alternative. However, substantial changes in source water fraction would occur in the
8 south Delta (Appendix 8D, Source Water Fingerprinting). Throughout much of the south Delta, San
9 Joaquin River water would replace Sacramento River water, with the future trace metals profile
10 largely reflecting that of the San Joaquin River. As discussed for the No Action Alternative, trace
11 metal concentration profiles between the San Joaquin and Sacramento Rivers are very similar and
12 currently meet Basin Plan objectives and CTR criteria. While the change in trace metal
13 concentrations in the south Delta would likely be measurable, Alternative 9 would not be expected
14 to substantially increase the frequency with which applicable Basin Plan objectives or CTR criteria
15 would be exceeded in the Delta or substantially degrade the quality of Delta waters with regard to
16 trace metals.

17 ***SWP/CVP Export Service Areas***

18 For the same reasons stated for the No Action Alternative, Alternative 9 would not result in
19 substantial increases in trace metal concentrations in the water exported from the Delta or diverted
20 from the Sacramento River through the proposed conveyance facilities. As such, there is not
21 expected to be substantial changes in trace metal concentrations in the SWP/CVP export service
22 area waters under Alternative 9, relative to Existing Conditions and the No Action Alternative. As
23 such, Alternative 9 would not be expected to substantially increase the frequency with which
24 applicable Basin Plan objectives or CTR criteria would be exceeded in the water bodies of the
25 affected environment in the SWP and CVP Service Area or substantially degrade the quality of these
26 water bodies, with regard to trace metals.

27 ***NEPA Effects:*** In summary, Alternative 9, relative to the No Action Alternative, would not cause a
28 substantial increase in long-term average trace metals concentrations within the affected
29 environment, nor would it cause an increased frequency of water quality objective/criteria
30 exceedances within the affected environment. The effect on trace metals is determined not to be
31 adverse.

32 ***CEQA Conclusion:*** Effects of CM1 on trace metals under Alternative 9 would be similar to those
33 discussed for Alternative 1A, and are summarized here, then compared to the CEQA thresholds of
34 significance (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for
35 this constituent. For additional details on the effects assessment findings that support this CEQA
36 impact determination, see the effects assessment discussion under Alternative 1A.

37 While greater water demands under the Alternative 9 would alter the magnitude and timing of
38 reservoir releases north, south and east of the Delta, these activities would have no substantial effect
39 on the various watershed sources of trace metals. Moreover, long-term average flow and trace
40 metals at Sacramento River at Hood and San Joaquin River at Vernalis are poorly correlated;
41 therefore, changes in river flows would not be expected to cause a substantial long-term change in
42 trace metal concentrations upstream of the Delta.

1 Average and 95th percentile trace metal concentrations are very similar across the primary source
 2 waters to the Delta. Given this similarity, very large changes in source water fraction would be
 3 necessary to effect a relatively small change in trace metal concentration at a particular Delta
 4 location. Moreover, average and 95th percentile trace metal concentrations for these primary source
 5 waters are all below their respective water quality criteria, including those that are hardness-based
 6 without a WER adjustment. No mixing of these three source waters could result in a metal
 7 concentration greater than the highest source water concentration, and given that trace metals do
 8 not already exceed water quality criteria, more frequent exceedances of criteria in the Delta would
 9 not be expected to occur under the Alternative 9.

10 The assessment of the Alternative 9 effects on trace metals in the SWP/CVP Export Service Areas is
 11 based on assessment of changes in trace metal concentrations at Banks and Jones pumping plants.
 12 As just discussed regarding similarities in Delta source water trace metal concentrations, the
 13 Alternative 9 is not expected to result in substantial changes in trace metal concentrations in Delta
 14 waters, including Banks and Jones pumping plants, therefore effects on trace metal concentrations
 15 in the SWP/CVP Export Service Area are expected to be negligible.

16 Based on the above, there would be no substantial long-term increase in trace metal concentrations
 17 in the rivers and reservoirs upstream of the Delta, in the Delta Region, or the SWP/CVP export
 18 service area waters under Alternative 9 relative to Existing Conditions. As such, this alternative is
 19 not expected to cause additional exceedance of applicable water quality objectives by frequency,
 20 magnitude, and geographic extent that would cause adverse effects on any beneficial uses of waters
 21 in the affected environment. Because trace metal concentrations are not expected to increase
 22 substantially, no long-term water quality degradation for trace metals is expected to occur and, thus,
 23 no adverse effects to beneficial uses would occur. Furthermore, any negligible changes in long-term
 24 trace metal concentrations that may occur in water bodies of the affected environment would not be
 25 expected to make any existing beneficial use impairments measurably worse. The trace metals
 26 discussed in this assessment are not considered bioaccumulative, and thus would not directly cause
 27 bioaccumulative problems in aquatic life or humans. This impact is considered to be less than
 28 significant. No mitigation is required.

29 **Impact WQ-28: Effects on Trace Metal Concentrations Resulting from Implementation of** 30 **CM2–CM22**

31 **NEPA Effects:** Conservation Measures 2–22 under Alternative 9 would be similar to those under
 32 Alternative 1A, but with changes in the south Delta to accommodate the modified corridors. Effects
 33 on trace metals resulting from the implementation of Conservation Measures 2–22 would be similar
 34 to that previously discussed for Alternative 1A. As they pertain to trace metals, implementation of
 35 CM2–CM22 would not be expected to adversely affect beneficial uses of the affected environment or
 36 substantially degrade water quality with respect to trace metals.

37 In summary, implementation of CM2–CM22 under Alternative 9, relative to the No Action
 38 Alternative, would have negligible, if any, effect on trace metals concentrations. The effect on trace
 39 metals from implementing CM2–CM22 is determined not to be adverse.

40 **CEQA Conclusion:** Implementation of CM2–CM22 under Alternative 9 would not cause substantial
 41 long-term increase in trace metal concentrations in the rivers and reservoirs upstream of the Delta,
 42 in the Delta Region, or the SWP/CVP export service area. As such, this alternative is not expected to
 43 cause additional exceedance of applicable water quality objectives by frequency, magnitude, and
 44 geographic extent that would cause adverse effects on any beneficial uses of waters in the affected

1 environment. Because trace metal concentrations are not expected to increase substantially, no
2 long-term water quality degradation for trace metals is expected to occur and, thus, no adverse
3 effects to beneficial uses would occur. Furthermore, any negligible changes in long-term trace metal
4 concentrations that may occur throughout the affected environment would not be expected to make
5 any existing beneficial use impairments measurably worse. The trace metals discussed in this
6 assessment are not considered bioaccumulative, and thus would not directly cause bioaccumulative
7 problems in aquatic life or humans. This impact is considered to be less than significant. No
8 mitigation is required.

9 **Impact WQ-29: Effects on TSS and Turbidity Resulting from Facilities Operations and**
10 **Maintenance (CM1)**

11 **NEPA Effects:** Effects of CM1 on TSS and turbidity under Alternative 9 are the same as those
12 discussed for Alternative 1A. The effects on TSS and turbidity from implementing CM1 is determined
13 to not be adverse.

14 **CEQA Conclusion:** Effects of CM1 on TSS and turbidity under Alternative 9 would be similar to those
15 discussed for Alternative 1A, and are summarized here, then compared to the CEQA thresholds of
16 significance (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for
17 this constituent. For additional details on the effects assessment findings that support this CEQA
18 impact determination, see the effects assessment discussion under Alternative 1A.

19 Changes river flow rate and reservoir storage that would occur under Alternative 9, relative to
20 Existing Conditions, would not be expected to result in a substantial adverse change in TSS
21 concentrations and turbidity levels in the reservoirs and rivers upstream of the Delta, given that
22 suspended sediment concentrations are more affected by season than flow. Site-specific and
23 temporal exceptions may occur due to localized temporary construction activities, dredging
24 activities, development, or other land use changes would be site-specific and temporal, which would
25 be regulated to limit both their short-term and long-term effects on TSS and turbidity levels to less
26 than substantial levels.

27 Within the Delta, geomorphic changes associated with sediment transport and deposition are
28 usually gradual, occurring over years, and high storm event inflows would not be substantially
29 affected. Thus, it is expected that the TSS concentrations and turbidity levels in the affected channels
30 would not be substantially different from the levels under Existing Conditions. Consequently, this
31 alternative is expected to have minimal effect on TSS concentrations and turbidity levels in the Delta
32 region, relative to Existing Conditions.

33 There is not expected to be substantial, if even measurable, changes in TSS concentrations and
34 turbidity levels in the SWP/CVP Export Service Areas waters under Alternative 9, relative to Existing
35 Conditions, because as stated above, this alternative is not expected to result in substantial changes
36 in TSS concentrations and turbidity levels at the south Delta export pumps, relative to Existing
37 Conditions.

38 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
39 objectives where such objectives are not exceeded under Existing Conditions. Because TSS
40 concentrations and turbidity levels are not expected to be substantially different, long-term water
41 quality degradation is not expected, and, thus, beneficial uses are not expected to be adversely
42 affected. Finally, TSS and turbidity are neither bioaccumulative nor Clean Water Act section 303(d)
43 listed constituents. This impact is considered to be less than significant. No mitigation is required.

Impact WQ-30: Effects on TSS and Turbidity Resulting from Implementation of CM2–CM22

NEPA Effects: Effects of CM2–CM22 on TSS and turbidity under Alternative 9 are the same as those discussed for Alternative 1A. The effects on TSS and turbidity from implementing CM2–CM22 is determined to not be adverse.

CEQA Conclusion: Conservation Measures 2–22 proposed under Alternative 9 would be similar to those proposed under Alternative 1A. As such, effects on TSS and turbidity resulting from the implementation of CM2–CM22 would be similar to that previously discussed for Alternative 1A. This impact is considered to be less than significant. No mitigation is required.

Impact WQ-31: Water Quality Effects Resulting from Construction-Related Activities (CM1–CM22)

The construction activities necessary to implement new conveyance features for CM1 under Alternative 9 would involve substantially different locations and types of construction activity to those discussed for Alternative 1A. In particular, the construction of permanent operable gates, locks, new levees, channel improvements and enlargement within Delta channels would involve considerable in-channel dredging and in-water facility construction activity. However, construction techniques for many features of the conveyance system within the Delta would be similar. Landside construction of water conveyance facilities under Alternative 9 would involve an array of intakes, pumping plants, pipelines, culvert siphons, canals, borrow areas, and other facilities. The remainder of the facilities constructed under Alternative 9, including CM2–CM22, would be very similar to, or the same as, those to be constructed for Alternative 1A.

NEPA Effects: The types of potential construction-related materials used, constituent discharges, and related water quality effects associated with implementation of CM1 under Alternative 9 would be similar to the effects discussed for Alternative 1A, and the effects anticipated with implementation of CM2–CM22 would be essentially identical. However, given the substantial differences in the conveyance features under CM1, there could be differences in the location, magnitude, duration, and frequency of construction activities and related water quality effects. In particular, relative to the Existing Conditions and No Action Alternative conditions, the extensive in-water dredging, and construction of channel enlargements, operable barriers, culvert siphons, and canal segments under Alternative 9 would result in potential direct turbidity discharges and sediment resuspension. Nevertheless, the construction of CM1, and any individual components necessitated by CM2, and CM4–CM10, with the implementation of the BMPs specified in Appendix 3B, *Environmental Commitments*, and other agency permitted construction requirements would result in the potential water quality effects being largely avoided and minimized. The specific environmental commitments that would be implemented under Alternative 9 would be similar to those described for Alternative 1A with the exception that Category “B” BMPs for RTM dewatering basin construction and operations, if necessary at all, would be much reduced. Moreover, the in-channel construction activities would result in Consequently, relative to Existing Conditions, Alternative 9 would not be expected to cause exceedance of applicable water quality objectives/criteria or substantial degradation with respect to constituents of concern, and thus would not adversely affect any beneficial uses upstream of the Delta, in the Delta, or in the SWP and CVP service area.

In summary, with implementation of environmental commitments in Appendix 3B, the potential construction-related water quality effects are considered to be not adverse.

1 **CEQA Conclusion:** Because environmental commitments would be implemented under Alternative 9
2 for construction-related activities along with agency-issued permits that also contain construction
3 requirements to protect water quality, the construction-related effects, relative to Existing
4 Conditions, would not be expected to cause or contribute to substantial alteration of existing
5 drainage patterns which would result in substantial erosion or siltation on- or off-site, substantial
6 increased frequency of exceedances of water quality objectives/criteria, or substantially degrade
7 water quality with respect to the constituents of concern on a long-term average basis, and thus
8 would not adversely affect any beneficial uses in water bodies upstream of the Delta, within the
9 Delta, or in the SWP and CVP service area. Moreover, because the construction-related activities
10 would be temporary and intermittent in nature, the construction would involve negligible
11 discharges, if any, of bioaccumulative or 303(d) listed constituents to water bodies of the affected
12 environment. As such, construction activities would not contribute measurably to bioaccumulation
13 of contaminants in organisms or humans or cause 303(d) impairments to be discernibly worse.
14 Based on these findings, this impact is determined to be less than significant. No mitigation is
15 required.

16 **Cumulative Analysis**

17 The cumulative effects analysis for water quality considers past, present, and reasonably
18 foreseeable projects or programs, as well as these in combination with the effects of BDCP
19 implementation. This assessment discusses only water quality constituents which could result, in
20 part, from construction and implementation of the BDCP. Constituents or constituent groups which
21 could not be affected by the BDCP are identified and addressed in the water quality Screening
22 Analysis presented in Appendix 8C. The majority of the constituents assessed in the Screening
23 Analysis have not been detected in the major source waters to the Delta, and others that have been
24 detected have generally not exceeded water quality objectives/criteria or would not be affected by
25 construction and implementation of the BDCP. Consequently, they are not specifically addressed in
26 this cumulative assessment. For a discussion of cumulative effects related to water temperature, see
27 Chapter 11, *Fish and Aquatic Resources*.

28 **No Action Alternative**

29 The cumulative effect of the No Action Alternative is as follows. Water quality conditions upstream
30 of the Delta, in the Delta Region, and in the SWP/CVP export service areas of the affected
31 environment are expected to change as a result of past, present, and reasonably foreseeable future
32 projects, population growth, climate change, and changes in water quality regulations (e.g.,
33 completion of TMDLs, adoption of new or more restrictive criteria/objectives). Many past, present,
34 and reasonably foreseeable future projects are identified and described in Appendix 3D, and specific
35 projects or regulatory programs that are either ongoing or proposed for future implementation, and
36 thus, could affect future cumulative water quality conditions, are listed in Table 8-73. The combined
37 water quality effects of projects considered in the cumulative condition will vary, including potential
38 contribution to the degradation of various water quality parameters, whereas others will function to
39 improve constituent-specific water quality in certain areas. Future population growth may produce
40 increased constituent loadings to the water bodies of the affected environment through increased
41 urban stormwater runoff, increased POTW discharges, and changes in land uses. Climate change is
42 anticipated to cause salinity increases in the western and southern Delta due to sea level rise. This is
43 evidenced by the increase in violations of the D-1641 salinity standard in the Sacramento River at
44 Emmaton under the No Action Alternative, relative to Existing Conditions, as described in section
45 8.3.3.1 above. Conversely, changes in water quality regulations generally are in a direction that

1 results in improvements in water quality (e.g., increased monitoring and restrictions on urban
2 stormwater runoff, completion of TMDLs to lessen or eliminate existing beneficial use impairments
3 through improved water quality, more restrictive regulations on POTW discharges, new and/or
4 more restrictive water quality criteria/objectives in Basin Plans).

5 Some water quality constituents are at levels under Existing Conditions that cause some impact to
6 beneficial uses. These include:

- 7 • Bromide
- 8 • Chloride
- 9 • Electrical Conductivity
- 10 • Mercury
- 11 • Organic Carbon
- 12 • Pesticides and Herbicides
- 13 • Selenium

14 Under the cumulative No Action Alternative, even with consideration of the factors that will affect
15 water quality discussed above, these constituents are expected to remain at levels that cause some
16 impact to beneficial uses. Thus, for the purposes of NEPA, water quality conditions for these
17 constituents under the cumulative No Action Alternative constitute an adverse environmental
18 condition. The cumulative effect of the No Action Alternative for all other water quality constituents
19 is not adverse.

20 Although the constituents listed above are at levels under Existing Conditions that cause some
21 impact to beneficial uses, the only constituent for which the cumulative effects of the No Action
22 Alternative are expected to adversely affect beneficial uses, relative to Existing Conditions, is
23 electrical conductivity, due to the effects of climate change and sea level rise. Thus, for the purposes
24 of CEQA, water quality conditions for electrical conductivity under the cumulative No Action
25 Alternative constitute a significant environmental condition. The cumulative effect of the No Action
26 Alternative for all other water quality constituents is less than significant, relative to Existing
27 Conditions.

1 **Table 8-73. Effects on Water Quality from the Programs, Projects, and Policies Considered for**
 2 **Cumulative Analysis**

Agency	Program/Project	Status	Description of Program/Project	Effects on Water Quality
Regulatory-, Discharge-, and Source Control-related Actions				
Sacramento Regional County Sanitation District	SRWTP Facility Upgrade Project	Proposed	Upgrade existing secondary treatment facilities to advanced unit processes including improved nitrification/denitrification and filtration.	Reduced discharge concentration and mass of many constituents in wastewater to Sacramento River.
Sacramento County, Sacramento, Citrus Heights, Elk Grove, Folsom, Galt, and Rancho Cordova	Sacramento Stormwater Quality Partnership	Ongoing and future actions	Development and implementation of federal stormwater compliance programs	Reduced discharge concentration and mass of many constituents in stormwater to Sacramento River.
San Joaquin County, Stockton, Tracy, and the State Water Resources Control Board	San Joaquin County, Stockton, and Tracy Stormwater Management Programs	Ongoing and future actions	Development and implementation of federal stormwater compliance programs	Reduced discharge concentration and mass of many constituents in stormwater to San Joaquin River.
Yolo County, Public Works Division	Yolo County Stormwater Management Program	Ongoing and future actions	Development and implementation of federal stormwater compliance programs	Reduced discharge concentration and mass of many constituents in stormwater to Yolo Bypass.
Central Valley Water Board	Irrigated Lands Regulatory Program	Ongoing and future actions	Prevent agricultural discharges from impairing the waters that receive runoff.	Reduced discharge concentration and mass of many constituents in agricultural drainage to the Delta and tributaries.
U.S. Bureau of Reclamation and San Luis & Delta Mendota Water Authority	Grassland Bypass Project, 2010-2019	Ongoing and future actions	Agricultural drainage management actions to reduce selenium discharges.	Goal is regulatory compliance for reduced selenium discharges to San Joaquin River.
U.S. Bureau of Reclamation and San Luis & Delta Mendota Water Authority	Agricultural Drainage Selenium Management Program Plan	Ongoing and future actions	Agricultural drainage management actions to reduce selenium discharges.	Goal is regulatory compliance for reduced selenium discharges to San Joaquin River.
California Department of Water Resources and U.S. Bureau of Reclamation	Franks Tract Project	Proposed	Proposed operable gates to control channel flows at key locations to reduce sea water intrusion.	Goal is reduced western Delta salinity.
Central Valley Water Board	Sacramento-San Joaquin Delta Estuary TMDL for Methylmercury	Ongoing and future actions	Regulatory and implementation actions to achieve compliance with water quality objectives.	Goal is reduced source loading of mercury and methylmercury formation.

Agency	Program/Project	Status	Description of Program/Project	Effects on Water Quality
Central Valley Water Board	Total Maximum Daily Load for Selenium in the Lower San Joaquin River	Ongoing and future actions	Regulatory and implementation actions to achieve compliance with water quality objectives.	Goal is reduced source loading of selenium.
Central Valley Water Board	San Joaquin River Selenium TMDL	Ongoing and future actions	Regulatory and implementation actions to achieve compliance with water quality objectives.	Goal is reduced source loading of selenium.
Central Valley Water Board	Central Valley Pesticide TMDL	Ongoing and future actions	Regulatory and implementation actions to achieve compliance with water quality objectives.	Goal is reduced source loading of pesticides.
Central Valley Water Board	Salt and Boron TMDL for the Lower San Joaquin River	Ongoing and future actions	Regulatory and implementation actions to achieve compliance with water quality objectives.	Goal is reduced source loading of salts and boron.
Central Valley Water Board	Cache Creek, Bear Creek, Sulphur Creek, and Harley Gulch TMDL for Mercury	Ongoing and future actions	Regulatory and implementation actions to achieve compliance with water quality objectives.	Goal is reduced source loading of mercury and methylmercury formation.
Central Valley Water Board	Clear Lake Mercury TMDL	Ongoing and future actions	Regulatory and implementation actions to achieve compliance with water quality objectives.	Goal is reduced source loading of mercury and methylmercury formation.
Central Valley Water Board	American River TMDL for Methylmercury	Ongoing and future actions	Regulatory and implementation actions to achieve compliance with water quality objectives.	Goal is reduced source loading of mercury and methylmercury formation.
Central Valley Water Board	Central Valley Organochlorine Pesticide TMDL	Ongoing and future actions	Regulatory and implementation actions to achieve compliance with water quality objectives.	Goal is reduced source loading of legacy organochlorine pesticides.
Central Valley Water Board	Central Valley Diuron TMDL	Ongoing and future actions	Regulatory and implementation actions to achieve compliance with water quality objectives.	Goal is reduced source loading of diuron pesticide.
Central Valley Water Board	Central Valley Pyrethroid Pesticides TMDL	Ongoing and future actions	Regulatory and implementation actions to achieve compliance with water quality objectives.	Goal is reduced source loading of pyrethroid pesticides.
Central Valley Water Board	Stockton Urban Waterbodies Pathogen TMDL	Ongoing and future actions	Regulatory and implementation actions to achieve compliance with water quality objectives.	Goal is reduced source loading of pathogens in urban stormwater runoff.

Agency	Program/Project	Status	Description of Program/Project	Effects on Water Quality
U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, and California Department of Water Resources	Biological Opinion on the Long-Term Operations of the Central Valley Project and State Water Project (Delta smelt)	Ongoing and future actions	Regulatory program and actions for CVP/SWP water supply operations for recovery of Delta smelt population. Actions include habitat, flow, and water quality management.	Actions may affect seasonal and long-term Delta water quality conditions.
U.S. Department of Commerce, National Marine Fisheries Service, U.S. Bureau of Reclamation, and California Department of Water Resources	Biological Opinion and Conference Opinion on the Long-Term Operations of the Central Valley Project and State Water Project	Ongoing and future actions	Regulatory program and actions for CVP/SWP water supply operations for recovery of special-status anadromous fish. Actions include habitat, flow, and water quality management.	Actions may affect seasonal and long-term Delta water quality conditions.
Restoration Actions				
California Department of Fish and Wildlife	Ecosystem Restoration Program Conservation Strategy		Actions to address the critical environmental conditions in the Delta and Suisun Marsh/Bay including Delta flows and habitat restoration.	Changes in tidal prism and salinity patterns; potential incremental increase methylmercury formation and contribution to Delta load.
California Department of Fish and Wildlife, U.S. Fish and Wildlife Service, U.S. Bureau of Reclamation, and Suisun Marsh Charter Group	Suisun Marsh Habitat Management, Preservation, and Restoration Plan	Ongoing	Seasonal wetland and tidal marsh restoration actions in Suisun Marsh.	Changes in tidal prism and salinity patterns; potential incremental increase methylmercury formation and contribution to Delta load.
California Department of Water Resources	Dutch Slough Tidal Marsh Restoration Project	Future	Seasonal wetland and tidal marsh restoration actions in western Delta.	Changes in tidal prism and salinity patterns; potential incremental increase methylmercury formation and contribution to Delta load.
California Department of Water Resources and Department of Fish and Wildlife	Cache Slough Area Restoration	Ongoing and future actions	Enhancement and restoration of existing and potential open water, marsh, floodplain and riparian habitat in northern Delta.	Changes in tidal prism and salinity patterns; potential incremental increase methylmercury formation and contribution to Delta load.
Reclamation District 2093	Liberty Island Conservation Bank	Future	Tidal marsh restoration project in northern Delta.	Changes in tidal prism and salinity patterns; potential incremental increase methylmercury formation and contribution to Delta load.

1 **Alternatives 1A through 9**

2 When the effects of the BDCP alternatives on water quality are considered in connection with the
3 potential effects of projects listed in Appendix 3D, *Ongoing Programs, Projects, and Policies included*
4 *in the Cumulative Impact Assessment for the BDCP EIR/EIS* and Attachment A of Appendix 3A,
5 *Alternatives Development Report*, the potential effects range from beneficial to potentially adverse
6 cumulative effects on water quality, depending upon water quality constituent/parameter and
7 location. This cumulative analysis thus follows the list approach outlined in CEQA guidelines
8 15130(b)(1), the list including the defined past, present, and foreseeable actions in Appendix 3D,
9 and in particular the future potential actions listed in Table 8-73. If the cumulative water quality
10 condition (which includes implementation of the BDCP along with past, present, and reasonably
11 foreseeable future projects, population growth, climate change, and changes in water quality
12 regulations) for a constituent or group of constituents within a defined region of the affected
13 environment is determined not to be adverse for the purposes of NEPA compliance (or significant
14 under CEQA), then no further assessment is conducted. No further assessment is conducted because
15 a cumulative condition that is non-adverse (NEPA terminology), or less than significant (CEQA
16 terminology), demonstrates that the BDCP alternative would not have adverse effects that are
17 individually minor but that would “cumulate” or “be additive” with those of other past, present, and
18 reasonably foreseeable projects to result in an adverse cumulative effect.

19 Conversely, if the cumulative water quality condition for a particular constituent is determined to be
20 adverse for NEPA purposes or significant for CEQA purposes, then further assessment is conducted.

21 For compliance with the CEQA Guidelines (Section 15130), further assessment is provided to
22 determine if implementation of the BDCP alternatives would contribute considerably to that
23 significantly impacted cumulative condition. If a BDCP alternative’s implementation would not
24 contribute considerably to the significantly impacted cumulative water quality condition identified,
25 then no further mitigation is required. However, if a BDCP alternative’s implementation would
26 contribute considerably to the significantly impacted cumulative water quality condition identified,
27 then mitigation for the BDCP alternative’s cumulatively considerable contribution to the identified
28 significantly impacted cumulative water quality condition is proposed (if any is at least potentially
29 feasible).

30 For the purposes of NEPA compliance, the context and intensity of the potential BDCP-related
31 contribution to any adverse cumulative condition is evaluated and mitigation measures are
32 identified that would reduce or minimize the BDCP alternative’s contribution to the cumulative
33 impact.

34 The potential for cumulative impacts on water quality for Alternatives 1A through 9 is assessed for:
35 1) construction-related activities, 2) facilities operations and maintenance (CM1), and 3)
36 implementation of CM2–CM22 for the same geographic scope (Affected Environment) as done for
37 analyses contained within the Effects and Mitigation Approaches section. Each BDCP alternative is
38 assessed under each of these three impact assessment categories. Effects are specifically discussed
39 by region of the affected environment (i.e., Upstream of the Delta, Delta Region, and SWP/CVP
40 Export Service Areas) and by constituent or constituent groups. Individual discussions for specific
41 action alternatives are provided only if the anticipated effects under one or more action alternatives
42 can be meaningfully distinguished from the effects anticipated under other alternatives. If the
43 contributions of the various action alternatives to a cumulative condition cannot be readily
44 distinguished from one another, then a single assessment that addresses all BDCP alternatives is
45 provided.

Cumulative Impact WQ-1: Cumulative Impacts on Water Quality Resulting from Construction-Related Activities Upstream of the Delta

Construction activities upstream of the Delta would be tied to conservation measures. Conservation measures or components of these measures that would be constructed in areas upstream of the Delta would be: 1) the Yolo Bypass Fishery Enhancement (CM2) (i.e., the Fremont Weir component of the action), 2) Conservation Hatcheries (CM18) (i.e., the new hatchery facility), and 3) Urban Stormwater Treatment (CM19). Neither the construction to be undertaken nor the techniques and conservation measures to be employed upstream of the Delta would differ sufficiently among alternatives to warrant separate alternative-specific discussions here. Hence, Alternatives 1A–9 will be discussed collectively in this cumulative assessment. Construction of individual components necessitated by CM2, CM18, and CM19 could involve site preparation and earthwork adjacent to water bodies of the affected environment. If so, their construction also would include water quality protection actions in the form of Environmental Commitments (Appendix 3B) and related water quality protection actions issued in agency permits required for construction and operation of facilities. Such actions would include SWPPPs that would minimize erosion of soils into water bodies and would minimize/eliminate the direct spilling of earthmoving equipment fuels, oils, and other construction materials into water bodies, thus minimizing any effects on water quality in adjacent water bodies. Other water quality protection actions issued in agency permits would include those in the State Water Board’s NPDES Stormwater General Permit for Stormwater Discharges Associated with Construction and Land Disturbance Activities (Order No. 2009-0009-DWQ/NPDES Permit No. CAS000002), project-specific WDRs or CWA Section 401 water quality certification from the appropriate Central Valley Water Board, CDFW Streambed Alteration Agreements, and USACE CWA Section 404 dredge and fill permits. Thus, construction activities associated with Alternatives 1A through 9 would not contribute considerably to any adverse cumulative water quality condition upstream of the Delta, nor would construction-related effects make an otherwise non-adverse cumulative water quality condition adverse in this region.

Delta

For Alternatives 1A through 9, the construction of new conveyance facilities (CM1) and construction associated with implementing CM2–CM22, particularly CM2–CM10, could result in substantial adverse water quality effects associated with turbidity/TSS due to the erosion of disturbed soils and associated sedimentation entering Delta waterways or other construction-related wastes (e.g., concrete, asphalt, cleaning agents, paint, and trash). In addition, the use of heavy earthmoving equipment adjacent to Delta waterways may result in spills and leakage of oils, gasoline, diesel fuel, and related petroleum contaminants used in the fueling and operation of such construction equipment. The extensive construction activities that will be necessary to implement CM 1, and 4-10 would involve a variety of land disturbances in the Delta including vegetation removal; grading and excavation of soils; establishment of roads-bridges, staging, and storage areas; in-water sediment dredging and dredge material storage; and hauling and placement or disposal of excavated soils and dredge materials. Although the number of intakes to be constructed, pipeline alignments and other construction aspects vary among the alternatives, all alternatives involve sufficient construction activities that, if conducted improperly, could adversely affect Delta water quality. Although alternatives having greater number of intakes and greater construction activities pose a greater overall potential to adversely affected water quality, adverse water quality effects for all alternatives will be avoided or reduced to less than substantial levels in the same manner, which is by implementing proper conservation measures and obtaining and abiding by agency-issued permits need for construction activities (e.g., State Water Board’s NPDES Stormwater General Permit for

1 Stormwater Discharges Associated with Construction and Land Disturbance Activities (Order No.
2 2009-0009-DWQ/NPDES Permit No. CAS000002), possibly project-specific WDRs, CWA Section 401
3 water quality certification from the appropriate Central Valley Water Board, CDFW Streambed
4 Alteration Agreements, and USACE CWA Section 404 dredge and fill permits.) Because of this
5 commonality among alternatives regarding potential for construction-related water quality effects,
6 and the common means of avoiding or reducing such effects, Alternatives 1A–9 are assessed
7 collectively rather than individually.

8 As stated in Section 8.3 (*Water Quality Environmental Consequences*), the implementation of
9 construction-related Environmental Commitments (Appendix 3B) and abiding by agency-issued
10 permits need for construction activities would reduce potential construction-related water quality
11 impacts in the Delta to less-than-significant levels. Moreover, the cumulative condition for
12 turbidity/TSS and petroleum contaminants in Delta waters are not expected to be adverse. This is
13 due, in large part, to the implementation (or planned implementation) of construction-related
14 Environmental Commitments (Appendix 3B) and agency permitted construction “best management
15 practices” for construction of not only the selected BDCP alternative (including its CMs), but also
16 other past, present, and reasonably foreseeable future projects. Because construction-related effects
17 on all water quality constituents/parameters would be minimized through BDCP Environmental
18 Commitments (Appendix 3B) and permitted construction “best management practices” in the
19 agency-issued permits discussed above, construction activities associated with Alternatives 1A
20 through 9 would not contribute considerably to any adverse cumulative water quality condition in
21 the Delta, nor would construction-related effects make an otherwise non-adverse cumulative water
22 quality condition adverse.

23 ***SWP/CVP Export Service Areas***

24 Because construction-related activities associated with Alternatives 1A through 9 are not expected
25 to contribute considerably to any adverse cumulative Delta water quality condition, including
26 conditions at the Banks and Jones pumping plants, which are the primary locations of water export
27 to the SWP/CVP Export Service Areas, the construction of these alternatives would not contribute
28 considerably to any adverse cumulative water quality condition in water bodies located in the
29 SWP/CVP Export Service Areas.

30 ***NEPA Effects:*** Alternatives 1A–9 involve minimal construction elements upstream of the Delta and
31 would include implementation of construction-related Environmental Commitments (Appendix 3B)
32 that would mitigate any temporary construction-related effects on water quality. Thus their
33 construction would not adversely affect any cumulative water quality constituent/parameter
34 condition upstream of the Delta. Construction of conveyance facilities and CMs for the selected BDCP
35 alternative could potentially result in temporary water quality effects on Delta turbidity/TSS levels
36 and petroleum contaminants. However, the cumulative condition for Delta turbidity/TSS and
37 petroleum contaminants would not be adverse for several reasons. First, there is currently no
38 adverse conditions for turbidity/TSS levels and petroleum contaminants in the Delta. Second,
39 implementation of construction-related Environmental Commitments (Appendix 3B) for the BDCP
40 alternative to be implemented and use of related construction BMPs for other projects would reduce
41 effects on these and other Delta water quality constituents/parameters. Third, because
42 construction-related effects on water quality are temporary in nature, they tend not to be
43 cumulative over time (i.e., construction effects on water quality are not permanent).

1 **CEQA Conclusion.** The temporary construction-related effects on water quality resulting from
 2 constructing the selected BDCP alternative, including its CMs, would not contribute considerably to
 3 any significant adverse cumulative Delta water quality condition, nor would construction-related
 4 effects make an otherwise non-adverse cumulative Delta water quality condition for any
 5 constituent/parameter potentially significant. Because construction-related activities are not
 6 expected to contribute considerably to any adverse cumulative Delta water quality condition, they
 7 also would not contribute considerably to any adverse cumulative water quality condition in water
 8 bodies located in the SWP/CVP Export Service Areas. No mitigation is required.

9 **Cumulative Impact WQ-2: Cumulative Impacts on Water Quality Upstream of the Delta**
 10 **Resulting from Facilities Operations and Maintenance (CM1) and Implementation of**
 11 **Conservation Measures 2-22**

12 Constituent loading from upstream watersheds and resultant concentrations/levels in the water
 13 bodies upstream of the Delta would remain unchanged, or would be negligibly affected, by
 14 implementation of facilities operations and maintenance (CM1) under Alternatives 1A-9. Changes in
 15 seasonal reservoir storage levels and river flows from altered system-wide operations under
 16 Alternatives 1A-9 would have negligible, if any, effects on water quality in the rivers and reservoirs
 17 upstream of the Delta. Consequently, facilities operations and maintenance (CM1) under any of the
 18 Alternatives 1A-9 would not be expected to contribute considerably to any cumulative water quality
 19 condition within the affected environment, upstream of the Delta.

20 Regarding CM2-CM22, the measures or components of these measures that would be implemented
 21 in areas upstream of the Delta would be: 1) the Yolo Bypass Fishery Enhancement (CM2), 2)
 22 Conservation Hatcheries (CM18), and 3) Urban Stormwater Treatment (CM19). CM2 is a fish
 23 enhancement measure and, thus, is not expected to alter water quality upstream of the Delta. CM18
 24 involves the operation of a new fish hatchery, discharges from which would be required to meet
 25 NPDES permit requirements to protect water quality and beneficial uses. CM19 may involve actions
 26 to improve stormwater quality coming from urban areas outside the Delta, but that drain to Delta
 27 waters, and would result in either no effect or beneficial effects on water quality upstream of the
 28 Delta. All other conservation measures would be implemented in the Delta region. Maintenance
 29 activities associated with the physical structures would not result in substantial, adverse effects on
 30 water quality. Consequently, the implementation of CM2-CM22 is not expected to contribute
 31 considerably to any cumulative water quality condition within the affected environment, upstream
 32 of the Delta.

33 **NEPA Effects:** Implementation of BDCP Alternatives 1A-9 facilities operations and maintenance
 34 (CM1), and their associated CM2-CM22, would have negligible, if any, water quality effects on water
 35 bodies of the affected environment located upstream of the Delta. Any negligible effects that may
 36 occur would not contribute considerably to any adverse cumulative water quality condition in water
 37 bodies upstream of the Delta, nor would Alternatives 1A-9 effects make an otherwise non-adverse
 38 cumulative water quality condition for any constituent/parameter adverse.

39 **CEQA Conclusion.** Because the potential effects of operations and maintenance of CM1-CM22 on
 40 water quality upstream of the Delta would be minimal, implementation of Alternatives 1A-9 would
 41 not contribute considerably to any significant adverse cumulative water quality condition upstream
 42 of the Delta, No mitigation is required.

1 **Cumulative Impact WQ-3: Cumulative Impacts on Water Quality in the Delta and SWP/CVP**
2 **Export Service Areas Resulting from Facilities Operations and Maintenance (CM1) and**
3 **Implementation of Conservation Measures 2–22**

4 When the effects of implementing any one of the BDCP Alternatives 1A–9 on water quality are
5 considered (including the new conveyance facilities, fish screens, gates and other physical structures
6 and their operations and maintenance activities) together with the potential effects of projects listed
7 in Appendix 3D (and Table 8-73), *Defining Existing Conditions, No Action Alternative, No Project*
8 *Alternative, and Cumulative Impact Conditions*, the cumulative water quality condition in the Delta
9 Region and SWP/CVP Export Service Areas for the following constituents is considered to not be
10 adverse. Additional discussion for these water quality constituents is provided below.

- 11 • Ammonia
- 12 • Boron
- 13 • Dissolved oxygen
- 14 • Nitrate + Nitrite
- 15 • Pathogens
- 16 • Phosphorus
- 17 • Trace metals
- 18 • Turbidity/TSS

19 ***Ammonia***

20 Ammonia levels are not expected to be adverse under the cumulative condition as a result of the
21 Sacramento Regional Wastewater Treatment Plant, and other publicly owned treatment works
22 (POTWs) that discharge to the Delta, nitrifying their effluent that is discharged to Delta tributaries
23 and waters.

24 ***Boron***

25 The lower San Joaquin River is listed on the State's CWA section 303(d) list of impaired water bodies
26 for salt and boron (State Water Resources Control Board 2011). Boron is paired with salt in this
27 listing due to its regular association with saline waters. The Central Valley Water Board has
28 prepared a TMDL with an implementation program where it is expected that actions taken to
29 control salts also will control boron as well (Central Valley Water Board 2004). With regulatory
30 actions being taken to improve boron concentrations (and salinity in general on the San Joaquin
31 River), the cumulative condition for boron is considered to not be adverse.

32 ***Dissolved Oxygen***

33 Dissolved oxygen throughout the Delta is generally suitable for beneficial use protection, with the
34 notable exception of the Stockton Deep Water Ship Channel. The TMDL for dissolved oxygen as well
35 as CM14 (Stockton Deep Water Ship Channel DO improvement) of the BDCP is expected to further
36 improve DO levels in the future. Thus, dissolved oxygen levels under the cumulative condition are
37 not expected to be adverse.

1 **Nitrate/Nitrite**

2 Similar to ammonia levels, nitrate/nitrite levels in the Delta may be reduced in the future as
3 Sacramento Regional Wastewater Treatment Plant and other POTWs discharging to Delta waters
4 implement de-nitrification processes. The Central Valley Water Board is currently permitting such
5 requirements with regularity and thus notable reductions in POTW-related nitrate/nitrite
6 discharges are expected in the future, and other new or greater sources are not anticipated that
7 would offset such point-source reductions. Thus, nitrate/nitrite levels under the cumulative
8 condition are not expected to be adverse.

9 **Pathogens**

10 Similarly, increasingly stringent state regulations on both POTWs and urban runoff through the
11 NPDES program is anticipated to reduce pathogen loading to Delta waters from these sources. As
12 discussed in the project-specific analyses of alternatives, pathogen levels in the Delta are most
13 affected by local factors, primarily local land uses and associated runoff from such lands. Conversion
14 of Delta agricultural lands to tidal wetlands under the action alternatives may alter levels of
15 coliforms and *E. coli* (either up or down), but would be expected to reduce loading of
16 *Cryptosporidium*. Moreover, increased municipal wastewater discharges resulting from future
17 population growth would not be expected to measurably increase pathogen concentrations in
18 receiving waters due to State and Federal water quality regulations requiring disinfection of effluent
19 discharges and the State's implementation of Title 22 filtration requirements for many wastewater
20 dischargers in the Sacramento River and San Joaquin River watersheds. Municipal stormwater
21 regulations and permits have become increasingly stringent in recent years, and such further
22 regulation of urban stormwater runoff is expected to continue in the future. Implementation of
23 BDCP CM19 (Urban Stormwater Treatment) also may reduce pathogen loading to Delta waters. The
24 ability of these BMPs to consistently reduce pathogen loadings and the extent of future
25 implementation is uncertain, but would be expected to improve as new technologies are continually
26 tested and implemented. Also, some of the urbanization may occur on lands used by other
27 pathogens sources, such as grazing lands, resulting in a change in pathogen source, but not
28 necessarily an increase (and possibly a decrease) in pathogen loading. In sum, Delta pathogen levels
29 are not anticipated to be adverse under the cumulative condition.

30 **Phosphorus**

31 Primary sources of phosphorus to Delta waters include agriculture, municipal POTWs, individual
32 septic treatment systems, urban runoff, stream bank erosion, and decaying plant material. Currently,
33 Delta phosphorous levels are not of substantial concern to state water quality regulatory agencies,
34 nor is there clear evidence that phosphorous levels are adversely affecting Delta beneficial uses. Due
35 to increased regulations and regulatory monitoring anticipated in the future, which may include
36 water quality objectives for phosphorus at some point in the future, loading from agriculture,
37 municipal POTWs, individual septic treatment systems, and urban runoff are all expected to remain
38 at similar levels to that under current conditions, or decline, under the future cumulative condition.
39 Loadings from stream bank erosion and decaying plants are not expected to change notably in the
40 future. Hence, phosphorus levels are not anticipated to be adverse under the cumulative condition.

41 **Trace Metals**

42 Primary sources of trace metals to Delta waters include acid mine drainage (e.g., zinc, cadmium,
43 copper, lead) from abandoned and inactive mines (i.e., Iron Mountain and Spring Creek mines) in the

1 Shasta watershed area, which enter the Sacramento River system through Shasta Lake and Keswick
 2 Reservoir, agriculture (e.g., copper and zinc), POTW discharges (e.g., copper, zinc, and aluminum),
 3 and urban runoff (e.g., zinc, copper, lead, cadmium). Continued efforts to control acid mine drainage
 4 into the Sacramento River system and increasingly stringent regulations are expected in the future.
 5 Monitoring and regulatory controls on agricultural runoff, POTW discharges, and urban runoff are
 6 anticipated to prevent trace metal concentration under the cumulative condition from becoming
 7 adverse.

8 ***Turbidity/TSS***

9 Future land use changes could have minor effects on TSS concentrations and turbidity levels
 10 throughout the affected environment. Site-specific and temporal exceptions may occur due to
 11 localized temporary construction activities, dredging activities, development, or other land use
 12 changes. These localized actions would generally require agency permits that would regulate and
 13 limit both their short-term and long-term effects on TSS concentrations and turbidity levels to less-
 14 than substantial levels. Construction activities are closely regulated under construction NPDES
 15 permits, which require the preparation of SWPPPs and the implementation of agency permitted
 16 construction BMPs that will minimize sedimentation into adjacent water bodies which would, in
 17 turn, increase turbidity/TSS. Moreover, construction projects are short-term in nature and thus
 18 their effects on turbidity/TSS tend not to be additive among multiple construction activities over
 19 time. Consequently, Delta turbidity/TSS levels under the cumulative condition are not expected to
 20 be adverse.

21 Because the cumulative water quality condition in the Delta for the constituents discussed above are
 22 considered to not be adverse in the Delta when considering all past, present, and reasonably
 23 foreseeable projects and regulatory actions, and because this cumulative condition includes the
 24 anticipated effects of implementing the facilities operations and maintenance (CM1) of any one of
 25 the BDCP Alternatives 1A–9, along with their associated CM2–CM22, none of these alternatives
 26 would contribute to an adverse cumulative condition for these constituents either in the Delta
 27 Region or the SWP/CVP Export Service Areas.

28 Cumulative water quality conditions for the constituents listed below are considered to be adverse,
 29 or have reasonable potential to be adverse, in portions of the Delta. Adverse cumulative water
 30 quality conditions for these constituents are expected when the effects of implementing any one of
 31 the BDCP Alternatives 1A–9 on water quality are considered (including the new conveyance
 32 facilities, fish screens, gates and other physical structures and their operations and maintenance
 33 activities) together with the effects of past, present, and reasonably foreseeable projects, including
 34 those listed in Appendix 3D, *Defining Existing Conditions, No Action Alternative, No Project*
 35 *Alternative, and Cumulative Impact Conditions.*

- 36 ● Bromide
- 37 ● Chloride
- 38 ● Electrical Conductivity
- 39 ● Mercury
- 40 ● Organic Carbon
- 41 ● Pesticides and Herbicides
- 42 ● Selenium

1 Each of the constituents listed above, for which the cumulative Delta conditions are determined to
2 be adverse, or potentially adverse, are discussed further below to determine whether
3 implementation of the BDCP Alternatives 1A–9 would contribute considerably to these adverse
4 cumulative water quality conditions.

5 ***Bromide***

6 The cumulative condition for bromide is considered adverse in the Delta, because of marked
7 increases in bromide concentrations anticipated to occur in the northwest Delta, including at the
8 North Bay Aqueduct intake at Barker Slough. Alternatives 1A–6 and 9 would increase long-term
9 average bromide concentrations at Barker Slough to levels substantially higher than those under
10 Existing Conditions. Alternative 7 would not increase the long-term average bromide concentration
11 at this location, and Alternative 8 would only increase it slightly. However, all alternatives would
12 increase the drought period average bromide concentration at Barker Slough substantially, relative
13 to concentrations during the drought period analyzed under Existing Conditions (Appendix 8E,
14 Bromide). Increased levels would not occur in the SWP/CVP Export Service Areas south of the Delta
15 due to greater source fraction of Sacramento River water on an annual average basis at the south
16 Delta pumps under all alternatives. Based on their causing substantially increased average bromide
17 concentrations at Barker Slough in the northwest Delta on a long-term average basis and/or during
18 drought periods, implementation of facilities operations and maintenance (CM1) under Alternatives
19 1A–9 would contribute substantially to this adverse cumulative condition for bromide.
20 Implementation of CM2–CM22 would not contribute substantially to this adverse cumulative
21 condition.

22 ***Chloride***

23 The cumulative condition for chloride is considered adverse in the Delta, because of marked
24 increases in chloride concentrations anticipated to occur in the western Delta, including Suisun
25 Marsh, and the interior Delta, but not in the SWP/CVP Export Service Areas south of the Delta due to
26 greater source fraction of Sacramento River water on an annual average basis at the south Delta
27 pumps under all alternatives. Alternatives 1A–5 and 9 would substantially increase chloride levels
28 in Suisun Marsh relative to Existing Conditions, primarily during the October through May period,
29 whereas alternatives 6A–8 would result in somewhat lesser (but still substantial) increases in
30 Suisun Marsh. With regards to the frequency of exceeding the 150 mg/L Bay-Delta WQCP objective
31 at Antioch and Contra Costa Canal Pumping Plant #1, Alternatives 1A–9 would result in a substantial
32 increase in the frequency of objective exceedance. With regards to the frequency of exceeding the
33 250 mg/l chloride objective at Antioch, Alternatives 1A–5 would result in a substantial increase in
34 the frequency of exceeding this objective, relative to Existing Conditions, whereas Alternative 9
35 would cause only a minor increase in frequency of exceedance and Alternatives 6A–8 would result
36 in a reduction in frequency of exceeding the 250 mg/L chloride objective (Appendix 8G, *Chloride*).
37 Hence, based on their respective effects on increased chloride levels in Suisun Marsh and increased
38 frequency of exceeding Bay-Delta WQCP objectives at Antioch and Contra Costa Canal Pumping
39 Plant #1, implementation of facilities operations and maintenance (CM1) under Alternatives 1A–9
40 would contribute substantially to this adverse cumulative condition for chloride. Additionally,
41 implementation of tidal habitat restoration under CM4 would increase the tidal exchange volume in
42 the Delta, and thus may contribute to increased chloride concentrations in the Bay source water as a
43 result of increased salinity intrusion. As such, CM4 is expected to contribute to this adverse
44 cumulative condition. Implementation of CM2, CM3, and CM5–CM22 would not contribute
45 substantially to this adverse cumulative condition.

1 **Electrical Conductivity**

2 The cumulative condition for EC is considered to be adverse, at various Delta locations and Suisun
3 Marsh, depending on BDCP alternative implemented. EC levels at the south Delta export pumps
4 would improve under all alternatives and thus the cumulative EC condition at the export pumps
5 would not be adverse. As such, cumulative EC levels in the SWP/CVP Export Service Areas would not
6 be adverse. Alternatives 1A–5 and 9 would substantially increase EC levels in Suisun Marsh relative
7 to Existing Conditions, primarily during the October through May period, whereas Alternatives 6A–8
8 would result in somewhat lesser (but still substantial) increases in Suisun Marsh. Moreover, in the
9 central Delta at Prisoner’s Point, Alternatives 2A–C, 4 (including all operational scenarios H1
10 through H4), and 6A–8 would result in substantially increased frequency of exceedance of the EC
11 objective, whereas Alternative 5 would cause a lesser increase in frequency of exceedance, and
12 Alternatives 1A–C, 3, and 9 would have little to no effect on frequency of exceedance of the EC
13 objective at Prisoner’s Point (Appendix 8H). Based on their adverse effects on EC levels in Suisun
14 Marsh as well as adverse effects in the western, interior, and/or south Delta, Alternatives 1A–9
15 would all contribute substantially to the adverse cumulative conditions for EC in the Delta and in
16 Suisun Marsh. Additionally, implementation of tidal habitat restoration under CM4 would increase
17 the tidal exchange volume in the Delta, and thus may contribute to increased EC concentrations in
18 the Bay source water as a result of increased salinity intrusion. As such, CM4 is expected to
19 contribute to this adverse cumulative condition. Implementation of CM2, CM3, and CM5–CM22
20 would not contribute substantially to this adverse cumulative condition.

21 **Mercury**

22 Numerous regulatory efforts have been implemented or are under development to control and
23 reduce mercury loading to the Delta, Upstream of the Delta and in the SWP/CVP Export Service
24 Areas, which include a Delta mercury TMDL, methylmercury TMDL, and their implementation
25 strategies (e.g., methylmercury control studies), increased restrictions on point-source discharges
26 such as POTWs, greater restrictions on suction dredging in Delta tributary watersheds, and
27 continued clean-up actions on mine drainage in the upper watersheds. A key challenge surrounds
28 the pool of mercury deposited in the sediments of the Delta which cannot be readily or rapidly
29 reduced, despite efforts to reduce future loads in Delta tributaries, and serves as a source for
30 continued methylation and bioaccumulation of methylmercury by Delta biota. Consequently,
31 mercury levels in Delta waters are considered to be an adverse cumulative condition. Facilities
32 operations and maintenance (CM1) of Alternatives 1A–9 would not be expected to substantially
33 alter the cumulative condition for mercury and the mercury impairment in the Delta or contribute
34 substantially to the cumulative mercury condition in the SWP/CVP Export Service Areas with the
35 exception of Alternative 8, at selected locations, where fish tissue mercury is expected to increase.
36 Implementation of CM4 (tidal wetland habitat), CM5 (floodplain habitat), CM10 (freshwater marsh
37 habitat), and possibly CM2 (Yolo Bypass fisheries enhancements) could create conditions resulting
38 in increased methylation of mercury within the Delta per unit time, increased biotic exposure to and
39 uptake of methylmercury, and resulting increased mercury bioaccumulation in fish tissues. The
40 methylation of mercury in these restored wetland habitats would contribute substantially to the
41 cumulative condition for mercury in the Delta.

42 **Organic Carbon**

43 Delta water quality conditions for DOC are anticipated to be adverse under the cumulative
44 condition. However, facilities operations and maintenance (CM1) for Alternatives 1A–5 would not

1 contribute considerably to the adverse cumulative condition for DOC within Delta waters.
2 Conversely, Alternatives 6A–9 would result in increased DOC levels at Franks Tract, Rock Slough and
3 Contra Costa PP No. 1. Under these alternatives, long-term average DOC concentration could
4 increase by up to 46%, relative to Existing Conditions. Thus, the DOC contributions from alternatives
5 6A–9 at Franks Tract, Rock Slough and Contra Costa PP No. 1 (i.e., interior Delta locations) are
6 determined to contribute considerably to the adverse cumulative condition for DOC in the Delta.
7 However, overall, modeling results for the south Delta pumps and thus the SWP/CVP export service
8 area predict a long-term improvement in export service area water quality, primarily through a
9 reduction in exports of water exceeding 4 mg/L. This is particularly true for Alternatives 6A–9
10 where notable improvements to DOC levels at the south Delta pumps would occur. Hence, facilities
11 operations and maintenance (CM1) for Alternatives 6A–9 would contribute substantially to adverse
12 cumulative conditions in the interior Delta, but would improve cumulative DOC conditions at the
13 south Delta pumps and thus in the SWP/CVP Export Service Areas.

14 In addition, implementation of CM4 (tidal wetland habitat), CM5 (floodplain habitat), and CM10
15 (freshwater marsh habitat) would create substantial new localized sources of DOC to Delta waters,
16 and in some circumstances would substitute for existing sources related to replaced agriculture. In
17 addition, CM2 would create greater localized source loading of DOC to Delta waters, to the degree
18 that the Yolo Bypass is inundated more frequently and/or to a greater geographic extent under the
19 alternatives, relative to the existing condition. Depending on localized hydrodynamics and proximity
20 to municipal drinking water intakes, such restoration activities could contribute substantial
21 amounts of DOC to municipal raw water supplies. The potential for substantial increases in long-
22 term average DOC concentrations related to the habitat restoration elements of CM4, CM5, and
23 CM10 could contribute to long-term water quality degradation with respect to DOC and, thus,
24 adversely affect the MUN beneficial use at various interior Delta locations. Hence, Implementation of
25 CM2–CM22 would contribute substantially to the adverse cumulative condition for DOC.

26 ***Pesticides and Herbicides***

27 Pesticide and herbicide use within and upstream of the Delta are changing continuously.
28 Historically, when society has substituted one class of pesticide for another without a corresponding
29 change in patterns of use (i.e., substitution of organochlorines with organophosphates), incidence of
30 non-target toxicity or environmental harm has changed and perhaps been lessened, but has
31 remained nevertheless. While factors such as TMDLs and future development of more target specific
32 and less toxic pesticides will ultimately influence the future cumulative condition for pesticides,
33 forecasting whether these various efforts will ultimately be successful at resolving current pesticide
34 related impairments requires considerable speculation. As such it is conservatively assumed that
35 the cumulative condition will be adverse with respect to pesticides. Alternatives 1A–C–5 are not
36 expected to contribute considerably to the adverse cumulative condition due to facilities operations
37 and maintenance (CM1). However, implementation of CM1 under Alternatives 6A–9 would result in
38 long-term average San Joaquin River source water fractions at Franks Tract, Rock Slough and Contra
39 Costa PP No. 1 (interior Delta) increasing considerably for some months such that the long-term risk
40 of pesticide-related toxicity to aquatic life could substantially increase at these
41 locations. Additionally, the potential for increased incidence of pesticide related toxicity could
42 include pesticides such as chlorpyrifos and diazinon for which existing Clean Water Act section
43 303(d) listings exist for the Delta, and thus existing beneficial use impairment could be made
44 discernibly worse. In addition, implementation of CM13 (nonnative aquatic vegetation control)
45 under Alternatives 1A–9 would be expected to contribute substantially to the adverse cumulative
46 condition for pesticides and herbicides in the Delta. The greater source fraction of Sacramento River

1 water on an annual average basis at the south Delta pumps under all alternatives would be expected
2 to result in the cumulative condition for pesticides and herbicides in the SWP/CVP Export Service
3 Areas to not be adverse.

4 ***Selenium***

5 The lower San Joaquin River and the western Delta are listed as impaired in accordance with section
6 303(d) of the Clean Water Act for exceeding selenium water quality objectives or bioaccumulation in
7 biota. The San Joaquin River impairment is listed as extending from the Mud Slough confluence to
8 the Airport Way Bridge near Vernalis, a reach distance of about 43 river miles. Selenium occurs
9 naturally throughout the lower San Joaquin River watershed, with elevated concentrations of
10 selenium occurring in the shallow groundwater within the Grassland Watershed. Subsurface
11 agricultural drainage discharges from this area are the major source of selenium to the San Joaquin
12 River and Delta. Load allocations for agricultural subsurface drainage discharges from the Grassland
13 Drainage Area have been developed through completion of the lower San Joaquin River selenium
14 TMDL and the Grassland Bypass Project. The Grassland Bypass Project prevents discharge of
15 subsurface agricultural drainage water into wildlife refuges and wetlands. The Grassland Area
16 Farmers have been successful in meeting TMDL wasteload allocations and continue to utilize and
17 expand the San Joaquin River Water Quality Improvement Project. Moreover, the Grassland Area
18 Farmers continue to work closely with the Central Valley Water Board and U.S. Bureau of
19 Reclamation to further develop and improve their drainage solutions for the Grassland Drainage
20 Area. Despite these improvements in reducing selenium loading to the San Joaquin River and Delta,
21 it is anticipated that the cumulative condition for selenium in the lower San Joaquin River and Delta
22 will remain adverse.

23 Facilities operations and maintenance (CM1) of Alternatives 1A–5 would not be expected to
24 substantially alter the cumulative condition for selenium and selenium impairment in the Delta.
25 Modeled selenium concentrations in sturgeon in the western Delta increased under Alternatives 6A-
26 9 by 20-23%, which may represent a measurable increase in the environment. Because both low and
27 high toxicity benchmarks are already exceeded under the No Action Alternative, these increases
28 would further degrade water quality by measurable levels, on a long-term basis, for selenium and,
29 thus, cause the 303(d)-listed impairment of beneficial use to be made discernibly worse. These
30 potentially measurable increases would contribute substantially to the adverse cumulative
31 condition for selenium in the Delta. Under Alternative 9, modeled selenium concentrations in water
32 would increase at Rock Slough, Franks Tract, and Contra Costa PP, decreasing the available
33 assimilative capacity by more than 10 percent at each of those locations; consequently, selenium
34 concentrations in whole-body fish and in bird eggs (invertebrate and fish diets) at those locations
35 would increase so that Level of Concern benchmarks for biota would be exceeded at Rock Slough
36 and Contra Costa PP (and approach exceedance at Franks Tract). The greater level of selenium
37 bioaccumulation in the vicinities of Rock Slough and Contra Costa PP would further degrade water
38 quality by measurable levels, on a long-term basis, for selenium and, thus, cause the 303(d)-listed
39 impairment of beneficial use to be made discernibly worse. However, the greater Sacramento River
40 flow fraction at the south Delta pumps under all alternatives would be expected to result in reduced
41 selenium concentrations in the SWP/CVP Export Service Areas and thus would not contribute to the
42 adverse cumulative condition. Implementation of CM4 (tidal wetland habitat), CM5 (floodplain
43 habitat), and CM10 (freshwater marsh habitat) could create conditions resulting in increased flow
44 residence time at the restored Delta locations, which could increase biotic exposure to and uptake of
45 selenium, potentially resulting in increased selenium bioaccumulation in fish tissues. The potential
46 for increased biotic exposure in and near these restored wetland habitats would contribute

1 substantially to the adverse cumulative condition for selenium in the Delta. However, Environmental
2 Commitment: Selenium Management (AMM27), which affords for site-specific measures to reduce
3 effects, would be available to reduce BDCP-related effects associated with selenium.

4 **NEPA Effects:** The cumulative water quality conditions are considered to be adverse for bromide,
5 chloride, electrical conductivity, mercury, organic carbon, pesticides and herbicides, and selenium in
6 areas of the Delta, and thus may adversely affect beneficial uses of the Delta such as domestic,
7 agricultural, municipal and industrial water supply and recreation, aesthetic, and fish and wildlife
8 resources. The implementation of BDCP Alternatives 1A–9 would contribute substantially to these
9 adverse cumulative water quality conditions. With respect to bromide, chloride, and electrical
10 conductivity, implementation of Alternatives 1A-9 would improve water quality conditions for these
11 constituents at the Banks and Jones pumping plants in the south Delta and thus in the SWP/CVP
12 Export Service Areas. Mitigation measures (described below) and environmental commitments have
13 been developed to mitigate the alternatives' contributions to the adverse cumulative water quality
14 conditions elsewhere in the Delta for bromide (WQ-5), chloride (WQ-7), electrical conductivity (WQ-
15 11), mercury (see mitigation measure below), organic carbon (WQ-17 and WQ-18), pesticides and
16 herbicides (WQ-21 and WQ-22) and selenium (Environmental Commitment: Selenium Management
17 (AMM27)).

18 **CEQA Conclusion:** The cumulative Delta water quality conditions are anticipated to be significant for
19 bromide, chloride, electrical conductivity, mercury, organic carbon, pesticides and herbicides, and
20 selenium. The incremental effects of Alternatives 1A–9 would be cumulatively considerable with
21 respect to significant cumulative bromide, chloride, and electrical conductivity conditions at various
22 western and interior Delta locations. However, implementation of Alternatives 1A-9 would not
23 contribute considerably, and would, in fact, improve conditions for these constituents at the Banks
24 and Jones pumping plants in the south Delta and thus in the SWP/CVP Export Service Areas.

25 Regarding mercury and selenium, facilities operations and maintenance (CM1) would not be
26 expected to contribute considerably to the significant cumulative mercury and selenium conditions
27 in the Delta (with the exception of Alternative 8 for mercury and Alternative 9 for selenium), but
28 implementation of CM4, CM5, and CM10 would be expected to contribute considerably to certain
29 localized areas (i.e., near where the wetland restoration areas are planned) within the Delta through
30 the potential for increased mercury methylation and selenium bioaccumulation in these restored
31 wetland habitats. However, with implementation of Environmental Commitment: Selenium
32 Management (AMM27), which affords for site-specific measures to reduce effects, the incremental
33 effects of BDCP would not be expected to be cumulatively considerable. Likewise, CM2 would create
34 greater localized source loading of methylmercury to Delta waters, to the degree that the Yolo
35 Bypass is inundated more frequently and/or to a greater geographic extent under the alternatives,
36 relative to the existing condition. Conversely, CM2 is not expected to contribute considerably to
37 future Delta selenium levels and thus would not be expected to affect future bioaccumulation of
38 selenium in Delta fish tissues.

39 For organic carbon, implementation of facilities operations and maintenance (CM1) for Alternatives
40 6A–9 would contribute considerably to the significant cumulative organic carbon condition in the
41 Delta, but Alternatives 1A–C, 2A–C, and 3–5 would not contribute considerably to this cumulative
42 condition. Conservation Measures 4, 5, and 10, through the ability of these new wetlands to load
43 additional organic carbon to Delta waters, would contribute considerably to the significant adverse
44 cumulative organic carbon condition in the Delta. In addition, CM2 would create greater localized
45 source loading of DOC to Delta waters for all alternatives, to the degree that the Yolo Bypass is

1 inundated more frequently and/or to a greater geographic extent under the alternatives, relative to
 2 the existing condition. These cumulative effects are not expected to extend to the south Delta pumps
 3 or the SWP/CVP Export Service Areas, but to the extent that they do, the mitigation measure
 4 proposed also would address such effects.

5 Implementation of facilities operations and maintenance (CM1) for Alternatives 2A–C and 4–9
 6 would contribute considerably to the adverse cumulative pesticide and herbicide condition in the
 7 Delta, but Alternatives 1A–C and 3 would not contribute considerably to this significant cumulative
 8 condition. Also, implementation of CM13 (nonnative aquatic vegetation control) is the only
 9 conservation measure identified that would contribute considerably to the cumulative pesticide and
 10 herbicide condition in the Delta. The cumulative effects for pesticides and herbicides are not
 11 expected to extend to the SWP/CVP Export Service Areas due to the increases in Sacramento River
 12 source fraction at Banks and Jones pumping plants under all alternatives and its generally lower
 13 levels of pesticides relative to the San Joaquin River source water.

14 **Mitigation Measures:**

15 The following mitigation measures and environmental commitments have been developed to
 16 mitigate the alternatives' contributions to the adverse cumulative water quality conditions
 17 described above for bromide (WQ-5), chloride (WQ-7), electrical conductivity (WQ-11), mercury
 18 (see mitigation measure below), organic carbon (WQ-17 and WQ-18), pesticides and herbicides
 19 (WQ-21 and WQ-22) and selenium (Environmental Commitment: Selenium Management (AMM27)).

20 To mitigate the alternatives' contribution to adverse mercury effects, implementation of
 21 conservation measures (CM 2, CM4, CM5, and CM10) associated with wetland/floodplain habitat
 22 shall conform to the relevant requirements of the Delta Mercury Control Strategy of the Central
 23 Valley Water Board Basin Plan. Requirements of the Delta Mercury Control Strategy include the
 24 following.

- 25 • Required participation in efforts to evaluate and minimize health risk associated with eating
 26 mercury contaminated fish.
- 27 • Required participation in monitoring methylmercury loading from wetlands.
- 28 • Implementation of appropriate and site-specific methylmercury control measures.

29 It is anticipated that these same, or similar, measures can be utilized to address and mitigate
 30 wetland-related bioaccumulation issues for selenium, as well.

31 Appropriate mercury and methylmercury selenium control measures shall be developed at the time
 32 of formal restoration planning and design. All practicable measures (i.e., those that are both feasible
 33 and reasonable from a cost-benefit perspective) to reduce methylmercury formation shall be
 34 considered for implementation. Appropriate strategies and control measures may include the
 35 following.

- 36 • Conservation measure design features, such as use of seasonal inundation periods, hydraulic
 37 residence time, sediment basins and vegetation traps to control mercury inputs and exports,
 38 inundation depths and related vegetation type and density selection so as to control oxidation-
 39 reduction conditions.

- 1 • Appropriate consideration of conservation measure location, preferably not in the direct path of
2 large mercury loading sources such as the Sacramento River, Yolo Bypass, Cosumnes River, or
3 San Joaquin River.
- 4 • Prioritization of conservation measures that minimize trophic level transfer of mercury through
5 active or passive operation and maintenance controls, such as targeted control and/or removal
6 of hyperaccumulating plant or animal species.
- 7 • Pre- and post-restoration monitoring of water and biota (sentinel species) for mercury content
8 in the context of a targeted adaptive management strategy whereby new or modified
9 mercury/methylmercury controls would be implemented in order to, at the minimum, maintain
10 methylmercury formation and fish tissue accumulation at baseline conditions.

11 These mitigation measures may not completely eliminate the contributions identified to the adverse
12 cumulative water quality conditions, but would be expected to lessen the contributions to the
13 degree feasible. Hence, some level of contribution to adverse cumulative conditions are anticipated
14 to remain after mitigation.

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