

# Covered Activities and Associated Federal Actions

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# 1 Acronyms and Abbreviations

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Banks	Harvey O. Banks
BDCP or Plan	Bay Delta Conservation Plan
BiOp	biological opinion
Cal-IPC	California Invasive Plant Council
Cal-OSHA	California Division of Occupational Health and Safety
CCWD	Contra Costa Water District
CDFA	California Department of Food and Agriculture
CDFW	California Department of Fish and Wildlife
CESA	California Endangered Species Act
cfs	cubic feet per second
CM	Conservation Measure
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
DBW	California Division of Boating and Waterways
DO	dissolved oxygen
DWR	California Department of Water Resources
ESA	federal Endangered Species Act
FAV	floating aquatic vegetation
FEMA	Federal Emergency Management Agency
HCP	habitat conservation plan
HORB	Head of Old River Barrier
IAV	invasive aquatic vegetation
Jones	C. W. "Bill" Jones
JPOD	Joint Points of Diversion
kV	kilovolt
MIST	minimum impact suppression tactics
NCCP	natural community conservation plan
NCCPA	California Natural Community Conservation Planning Act
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
QA/QC	quality assurance/quality control
Reclamation	U.S. Department of the Interior, Bureau of Reclamation
ROA	Restoration Opportunity Area
RWQCB	Regional Water Quality Control Board
SAV	submerged aquatic vegetation
Skinner Fish Facility	John E. Skinner Delta Fish Protective Facility
SR	State Route
State Water Board	California State Water Resources Control Board
SWP	State Water Project
TMDL	total maximum daily load
USDA-ARS	U.S. Department of Agriculture-Agriculture Research Service
USFWS	U.S. Fish and Wildlife Service

## Covered Activities and Associated Federal Actions

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### 4.1 Introduction

The BDCP (or Plan) is intended to provide the basis for the issuance of regulatory authorizations under the federal Endangered Species Act (ESA) and the California Natural Community Conservation Planning Act (NCCPA) for a broad range of ongoing and anticipated activities that are associated with the operations of the State Water Project (SWP) and the Central Valley Project (CVP) in the Sacramento–San Joaquin River Delta (Figure 4-1). This chapter identifies and describes the activities that are addressed by the BDCP. The chapter further categorizes these activities on the basis of the party chiefly responsible for their implementation, characterizing activities as either *covered activities* for those actions undertaken by nonfederal parties or as *associated federal actions* for those actions that are authorized, funded, or carried out by the U.S. Department of the Interior, Bureau of Reclamation (Reclamation). With regard to the associated federal actions, the BDCP is intended to provide the basis for a biological assessment, and the issuance of regulatory authorizations to Reclamation under Section 7 of the ESA.

The potential effects of all of these activities on covered species, their habitats, and natural communities have been evaluated as part of an overall assessment of the effects of the BDCP, as described in Chapter 5, *Effects Analysis*. All covered activities and associated federal actions will comply with the avoidance and minimization measures described in *CM22 Avoidance and Minimization Measures*, to minimize incidental take of covered species.

As a joint habitat conservation plan (HCP) and natural community conservation plan (NCCP), the BDCP has been designed to meet the requirements of both state and federal endangered species laws and provide the basis for nonfederal entities to obtain take authorizations from the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) pursuant to Section 10 of the ESA and from the California Department of Fish and Wildlife (CDFW) under Section 2835 of the NCCPA, and potentially under Section 2081 of the California Endangered Species Act (CESA).<sup>1</sup>

Specifically, the California Department of Water Resources (DWR) and certain SWP contractors are seeking regulatory coverage under the ESA and the NCCPA to ensure that many of their activities within the geographic scope of the BDCP, including water conveyance, diversions, exports, and habitat restoration, comply with these laws. To meet these regulatory objectives, the BDCP sets out a comprehensive conservation strategy that addresses the effects of SWP, the Central Valley Project (CVP), and certain existing and future actions that may occur within the Plan Area on aquatic and terrestrial species, including those listed or proposed for listing under the ESA or CESA as threatened, endangered, or candidates for listing, as well as on critical habitat, if any, that has been designated for these species (Chapter 3, *Conservation Strategy*).

Those activities carried out by Reclamation that may affect federally proposed or listed threatened or endangered species, or their designated critical habitat, will be addressed through the Section 7

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<sup>1</sup> The BDCP has also been developed to meet the permit issuance standards of the CESA for the activities described in this chapter.

consultation process of the ESA. Additionally, water management activities associated with Delta diversions by Reclamation, DWR, and participating contractors are currently covered under existing biological opinions (BiOps) and will continue to be covered under those BiOps until such time as the new north Delta diversions become operational, in approximately year 10 (i.e., water operations in the near term are not covered by the BDCP). Thereafter, DWR and the participating contractors will receive regulatory coverage for the covered activities through the Section 10 permits issued pursuant to the BDCP.

Under the Section 7 compliance process, the biological assessment for federal actions will incorporate the BDCP conservation strategy as it relates to those actions in the Delta. The BDCP does not attempt to distinguish precisely between the effects on covered species and their habitat attributable to the CVP-related federal actions and to covered activities associated with the SWP. Rather, the BDCP includes a comprehensive analysis of the effects related to both the SWP and the CVP within the Plan Area, and sets out a conservation strategy that adequately addresses the totality of those effects.

## **4.1.1 History and Overview of the State Water Project and Central Valley Project**

This section provides an overview and a summary of the history of the SWP and the CVP. Additional detail is provided by DWR (2010a).

### **4.1.1.1 State Water Project**

The SWP is operated to provide water for agricultural, municipal, industrial, recreational, and environmental purposes, and to control flooding. As conditions of the water right permits and licenses, the California State Water Resources Control Board (State Water Board) requires that the SWP meet specific water quality, quantity, and operational criteria in the Delta. The development of the SWP was necessitated by the tremendous population growth that occurred in California after the Second World War. The State of California recognized at the time that local water supplies alone would not be sufficient to meet future regional demands, prompting the legislature in 1945 to commission an investigation of statewide water needs. That investigation resulted in recommendations for substantial new water infrastructure, including the development of various aqueducts and channels, a multipurpose dam and reservoir near Oroville on the Feather River, and an aqueduct to carry water from the Delta to the San Joaquin Valley and southern California (California Department of Water Resources 2010).

In 1960, California voters authorized the first phase of the SWP, which enabled water deliveries from watersheds of northern California to the cities of southern California and to farmers in the Tulare Basin that were beyond the reach of the CVP. After the SWP was passed by voters in 1960, the California Aqueduct, the main conveyance for the SWP, Clifton Court Forebay, and Harvey O. Banks (Banks) Pumping Plant west of Tracy were constructed (Figure 1-1, *Plan Area Location*, in Chapter 1, *Introduction*, and Figure 4-1 depict both CVP and SWP facilities).

Today, the SWP consists of 34 storage facilities (reservoirs and lakes), 20 pumping plants, 4 pumping-generating plants, 5 hydroelectric power plants, and about 701 miles of open canals and pipelines. It provides water that supplements local sources for approximately 25 million Californians and about 750,000 acres of irrigated farmland (California Department of Water Resources 2010).

1 The SWP distributes water to 29 urban and agricultural water suppliers in northern California, the  
2 San Francisco Bay Area, the San Joaquin Valley, the Central Coast, and southern California. These  
3 suppliers, known as the SWP contractors, receive specified annual amounts of water as provided by  
4 contracts with DWR.<sup>2</sup> These contracts are subject to renewal during the period 2035 through 2042.  
5 Of the total water supply under contract, 70% is allocated to urban users and 30% to agricultural  
6 users (California Department of Water Resources 2010).

#### 7 **4.1.1.2 Central Valley Project**

8 Beginning in the late 1800s, the State of California recognized the potential to deliver water from the  
9 Sacramento River to the dry, but potentially productive, San Joaquin Valley (Alexander et al. 1874).  
10 In the 1930 State Water Plan (Department of Public Works 1930), the State of California identified  
11 that the development of upstream storage capacity along the Sacramento River could  
12 simultaneously resolve two major water problems: water shortages in the San Joaquin Valley, where  
13 pumping in excess of natural groundwater recharge was occurring; and salinity intrusion into the  
14 Delta, which could be addressed with a hydraulic salinity barrier created through controlled  
15 releases of water from upstream storage (Lund et al. 2007). This water plan served as a blueprint  
16 for the eventual CVP.

17 In 1933, the California State Legislature and the voters of California approved the CVP. Shortly  
18 thereafter, California ceded control of the project to the federal government to maximize federal  
19 financial contributions during the Great Depression. Construction of Shasta Dam, one of the primary  
20 components of the CVP, began in 1938. In the 1940s, federal agencies agreed on an approach to  
21 divert water from the Sacramento River, which relied on a small cross-channel to move water  
22 through the Delta. This channel, which was constructed by Reclamation in 1944, is known as the  
23 Delta Cross Channel.

24 Following the construction of the Friant Dam (1942) and the Friant-Kern Canal (1948), the CVP  
25 began diverting San Joaquin River water to supply irrigators on the east side of the San Joaquin  
26 Valley. Subsequent projects on the west side of the Sacramento Valley, notably the Tehama-Colusa  
27 Canal (1980), increased capacity for upstream diversions from the Sacramento River. The CVP's  
28 major water storage facilities are located at the Shasta, Trinity, Folsom, and New Melones Dams  
29 (Bureau of Reclamation 2008) (Figure 4-1). The primary water pumping facility for the CVP is the  
30 C. W. "Bill" Jones (Jones) Pumping Plant, which is located west of the City of Tracy.

31 The CVP presently consists of 20 dams and reservoirs, 11 power plants, and 500 miles of major  
32 canals, as well as conduits, tunnels, and related facilities. These facilities provide sufficient quantities  
33 of water to irrigate approximately one-third of the agricultural land of California and to provide for  
34 municipal and industrial use to support close to 1 million households for 1 year (Bureau of  
35 Reclamation 2011). Over 250 contractors in 29 out of 58 counties in California have entered into  
36 long-term contracts for CVP water (California Department of Water Resources 2008).

37 The Central Valley Project Improvement Act (CVPIA) of 1992 redefined the purposes of the CVP to  
38 include protection, restoration and enhancement of fish, wildlife and associated habitats, and  
39 protection of the San Francisco Bay/Sacramento-San Joaquin Delta Estuary. Overall, the CVPIA  
40 sought to "achieve a reasonable balance among competing demands for use of [CVP] water,

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<sup>2</sup> Under existing contract conditions, in 2010 DWR was obligated to make 4.167 million acre-feet per year of water available to its contractors, except under certain conditions specified in the contract, including shortage of supply availability, under which a lesser amount may be made available.

including the requirements of fish and wildlife, agricultural, municipal and industrial and power contractors.” The CVPIA provided for dedication and management annually of 800,000 acre-feet of CVP yield for fish, wildlife, and habitat restoration purposes, a habitat restoration fund financed by water and power users, and a moratorium on new water contracts until such time as fish and wildlife goals are achieved (Bureau of Reclamation 2010). Implementation of the CVPIA is included in the project description of CVP operations for the purpose of consultation under Section 7 of the ESA.

#### 4.1.1.3 Joint Point of Diversion Operations

Under State Water Board Decision 1641 (D-1641) (December 1999, revised March 2002), Reclamation and DWR are authorized to use/exchange diversion capacity between the SWP and CVP to enhance the beneficial uses of both projects. The use of one project’s diversion facility by the other project is referred to as the Joint Points of Diversion (JPOD). There are a number of requirements in D1641 that restrict JPOD to protect water quality and fishery resources.

In general, JPOD capabilities are used to accomplish four basic SWP and CVP objectives.

- When wintertime excess pumping capacity becomes available during Delta excess conditions (all in-Delta conditions have been met) and total SWP/CVP San Luis storage is not projected to fill before the spring pulse flow period, the project with the deficit in San Luis storage may elect to use JPOD capabilities.
- When summertime pumping capacity is available at the Banks Pumping Plant and CVP reservoir conditions can support additional releases, the CVP may elect to use JPOD capabilities to enhance annual CVP south of Delta water supplies.
- When summertime pumping capacity is available at the Banks or Jones Pumping Plants to facilitate water transfers, JPOD may be used to further facilitate the water transfer.
- During certain coordinated SWP/CVP operation scenarios for fishery entrainment management, JPOD may be used to shift SWP/CVP exports to the facility with the least fish species entrainment effect while minimizing export at the facility with the most fish species entrainment effect.

All in-Delta JPOD operations are included as either covered activities or federal actions associated with the BDCP, as described later in this chapter. Those actions associated with Reclamation will receive authorization through the ESA Section 7 consultation process and those actions associated with DWR will be covered under ESA Section 10 permits and Section 2835 permits issued pursuant to the NCCPA.

## 4.2 Covered Activities

The SWP and CVP function as two interbasin water storage and delivery systems that divert and redivert water from the southern portion of the Delta. The SWP and CVP use reservoirs upstream of the Delta to store water, and use both natural watercourses and canal systems to transport water to areas south and west of the Delta. The CVP also includes facilities and operations on the Stanislaus and San Joaquin Rivers, such as the New Melones and Friant Dams.



The SWP and CVP are permitted by the State Water Board to store water during wet periods, divert water that is surplus to the Delta<sup>3</sup>, and redivert water that has been stored in upstream reservoirs. Both SWP and CVP operate pursuant to water right permits and licenses issued by the State Water Board that allow for the appropriation of water by diverting to storage or by directly diverting to use and rediverting releases from storage later in the year. As conditions of their water right permits and licenses, the State Water Board requires that the SWP and CVP meet specific water quality, quantity, and operational criteria within the Delta.<sup>4</sup> Reclamation and DWR closely coordinate their management of the operations of the SWP and CVP to meet these conditions.

All covered activities described in this chapter will be covered for the duration of the 50-year permits. The BDCP does not seek coverage for current SWP and CVP operations, which will continue to be regulated under Section 7 of the ESA and the CESA. The BDCP covers SWP and CVP operations once the new north Delta intakes become operational, beginning in approximately year 10.

Therefore, references to SWP and CVP operations in the following discussion relate to operations that occur in conjunction with the new infrastructure. Construction and maintenance of the new infrastructure are described below, in Section 4.2.1, *CM1 Water Facilities and Operation*. Design and operations of the new infrastructure are described in Chapter 3, Section 3.4.1, *Conservation Measure 1 Water Facilities and Operation*.

The covered activities consist of activities in the Plan Area associated with the conveyance and export of water supplies from the SWP's Delta facilities and with the implementation of the conservation strategy (Chapter 3, *Conservation Strategy*, sets out the conservation measures and the adaptive management and monitoring program). The 22 conservation measures (Table 4-1)<sup>5</sup> are designed to achieve the biological goals and objectives of the conservation strategy.

Each covered activity falls into one of the following six categories.

- New water facilities construction, operation, and maintenance
- Operation and maintenance of SWP facilities
- Nonproject diversions<sup>6</sup>
- Habitat restoration, enhancement, and management
- Monitoring activities
- Research

<sup>3</sup> *Water surplus to the Delta* refers to water that is excess to all other SWP contractual needs and is available for allocation after all these needs have been met.

<sup>4</sup> DWR has a separate contract to provide water to the North Delta Water Agency and that contract has separate water quality standards.

<sup>5</sup> For the rest of this chapter, conservation measures will be referred to by their CM number (CM1, CM2, etc.) Please refer to this table for complete titles of the conservation measures.

<sup>6</sup> Nonproject diversions are those diversions not included as part of SWP and CVP operations.

1 **Table 4-1. Summary of Conservation Measures**

CM	Title	Intended Outcomes
1	Water Facilities and Operation	Operate a water facility that improves conditions for covered species and natural communities in the Delta while improving water supply.
2	Yolo Bypass Fisheries Enhancement	Increase the frequency, duration and extent of floodplain inundation to provide beneficial outcomes for covered fish species.
3	Natural Communities Protection and Restoration	Protect, restore, enhance, and manage natural communities and physical habitat to expand the extent and quality of habitats available to covered species in the Delta.
4	Tidal Natural Communities Restoration	
5	Seasonally Inundated Floodplain Restoration	
6	Channel Margin Enhancement	
7	Riparian Natural Community Restoration	
8	Grassland Natural Community Restoration	
9	Vernal Pool and Alkali Seasonal Wetland Complex Restoration	
10	Nontidal Marsh Restoration	
11	Natural Communities Enhancement and Management	Reduce adverse effects on covered species from various stressors that persist in the Delta.
12	Methylmercury Management	
13	Invasive Aquatic Vegetation Control	
14	Stockton Deep Water Ship Channel Dissolved Oxygen Levels	
15	Localized Reduction of Predatory Fishes	
16	Nonphysical Fish Barriers	
17	Illegal Harvest Reduction	
18	Conservation Hatcheries	
19	Urban Stormwater Treatment	
20	Recreational Users Invasive Species Program	
21	Nonproject Diversions	
22	Avoidance and Minimization Measures	Avoid and minimize adverse effects and direct take of covered species and the natural communities upon which they depend.

2

3 Implementation of the conservation measures and the monitoring activities are covered activities

4 under the BDCP and its associated authorizations.

5 The BDCP-associated federal actions comprise those activities that are primarily the responsibility

6 of Reclamation, including actions that are carried out, funded, or authorized by Reclamation in the

7 Plan Area, and that would receive appropriate ESA coverage through Section 7. These actions relate

8 to the operation of the CVP's Delta facilities to meet CVP purposes. These actions include the

9 operation of existing CVP Delta facilities to convey and export water for project purposes, associated

10 maintenance and monitoring activities, and the creation of habitat. The CVP is operated in

11 coordination with the SWP under the Coordinated Operations Agreement.

Certain other actions associated with the SWP and CVP are not within the scope of the BDCP. These actions occur upstream of the Delta, outside of the Plan Area, and include the operations of certain reservoirs and the diversion and delivery of certain water supplies.

The implementation of the conservation measures will be guided by the schedules provided in Chapter 6, *Plan Implementation*. The schedules for BDCP implementation were developed to meet the following goals.

- Ensure that key implementation actions occur early in the permit term to offset expected effects of covered activities and meet the NCCPA requirement for rough proportionality of effects and conservation.
- Ensure that implementation actions occur by the implementation deadlines established in Chapter 3, *Conservation Strategy*.
- Ensure that implementation actions occur on a feasible schedule and allow adequate time for landowner negotiation for acquisition, project planning, permitting, funding, design, and construction.
- Group the related implementation actions or covered activities together or in the proper sequence (e.g., implementing riparian restoration and channel margin enhancement together).
- Require natural community protection and restoration to occur in almost every time period to ensure that progress is always being made toward the total conservation requirement in year 40.

The covered activities are described in more detail in the following sections. Covered activities are grouped by conservation measure according to Table 4-1 above. In addition to the conservation measures, monitoring activities and transfers or other voluntary water market transactions are also described as covered activities.

## 4.2.1 CM1 Water Facilities and Operation

Design and operations of new water facilities are described in Chapter 3, Section 3.4.1, *Conservation Measure 1 Water Facilities and Operation*. The construction and maintenance of new water facilities are described in the sections that follow.

### 4.2.1.1 North Delta Diversions Construction and Operations

#### 4.2.1.1.1 Facilities Design and Construction

##### Overview

DWR will construct new diversion and conveyance facilities that will be designed and operated to improve conditions for fish by conveying water from the Sacramento River in the north Delta to the existing water export pumping plants in the south Delta (Figures 4-2 to 4-5). This new tunnel/pipeline conveyance facility will allow for reductions in diversions at the existing SWP and CVP south Delta facilities, thereby minimizing reverse flows and reducing entrainment of covered fish species by the SWP and CVP in the south Delta.

The new facility will entail three intake structures (Intakes 2, 3, and 5), located between river miles 37 and 41, fitted with state-of-the-art positive barrier fish screens (Table 4-2). A schematic and a

conceptual rendering of an on-bank intake facility are presented in Figures 4-6 and 4-7. Water will travel in pipelines from each intake bay to a sedimentation basin and thence to intake pumping plants. From the intake pumping plants, pipelines from Intake Pumping Plants 2 and 3 will connect to a 29-foot interior diameter single-bore tunnel leading to a 40-acre intermediate forebay to be constructed on Glannvale Tract (Figure 4-8; also known as Glannvale Tract on some maps), adjacent to Twin Cities Road. This tunnel will convey water nearly 9 miles to the intermediate forebay. A 20-foot interior diameter single-bore tunnel will be constructed between Intake Pumping Plant 5 and the intermediate forebay. These tunnels will include launch/retrieval shafts, safe haven work areas, and vent shafts about every 4 miles.

The intermediate forebay will store water between the north Delta intake and conveyance facilities and the main tunnel conveyance segment. It will include an emergency spillway to prevent the forebay from overtopping. This spillway will divert water during high flow periods to an approximately 120-acre emergency inundation area adjacent to and surrounding the intermediate forebay. From the intermediate forebay, water will be conveyed by a gravity bypass system through an outlet control structure into a dual-bore 40-foot-diameter tunnel for about 30 miles to an expanded Clifton Court Forebay. This north Delta water diversion configuration will enhance water supply operational flexibility, using forebay storage capacity to regulate flows from north Delta intakes to south Delta pumping plants.

The existing Clifton Court Forebay (Figure 4-9) will be expanded to the south, and dredged, to provide additional storage capacity. New embankments will be constructed around the interior of the forebay and an embankment will be constructed across the middle of the forebay to create separated north and south cells. The north cell will receive water pumped from the north Delta through the proposed intakes and conveyance facilities, while the south cell will receive water conveyed through the existing through-Delta system. The north cell water surface area will be approximately 1,300 acres, while the south cell will have a water surface area larger than 1,400 acres. This represents an expansion of approximately 700 acres, compared to the existing forebay facilities.

New connections will be constructed between the expanded Clifton Court Forebay and the Banks and Jones Pumping Plants, along with control structures to regulate the relative quantities of water flowing from the north Delta and the south Delta. An approximately 4,000-foot-long canal will convey water from the north cell of the expanded Clifton Court Forebay, under the Byron Highway through a culvert siphon, and to the existing approach canal to the Banks Pumping Plant. From this existing canal, another 6,000-foot-long canal will convey water to the existing approach canal for the Jones Pumping Plant. These facilities will continuously provide water to Jones Pumping Plant 24 hours per day while minimizing on-peak pumping at north Delta intakes and allowing pumping criteria to limit diversions to two 6-hour ebb tide periods per day. The enlarged Clifton Court Forebay will alleviate some of the impacts of these operational constraints by providing additional storage to balance inflow with outflow. The Banks Pumping Plant will operate to minimize overall electrical power costs, by pumping at near maximum capacity during off-peak electrical demand periods, and at lower capacities during peak demand periods.

The major components of CM1, both permanent and temporary, are described below. More detail on specific features of the tunnel/pipeline facility is provided in Appendix 5.H, *Aquatic Construction and Maintenance Effects*. Restoration and stressor reduction conservation measures (CM2 to CM22) could also include physical/structural components related to new roads for site access, levee work, and similar elements.

1 **Table 4-2. Specifications for North Delta Intakes and Associated Construction Footprints**

North Delta Intake No.	Intake Construction Duration	Pile Driving Duration <sup>a</sup>	Location (River Mile)	Length of Screened Intake (feet) <sup>b</sup>	Total Intake and Transition Wall Length (feet) <sup>b</sup>	In-Water Area Temporarily Isolated inside Cofferdam (acres)	In-Water Area Permanently Affected by Screened Intake Footprint (acres)	Dredging Area Outside of Cofferdams (acres)
2	December, Year 2 <sup>c</sup> to September, Year 6	August to October Year 3	41	1,800	2,400	3.1	2.1	4.5
3	October, Year 2 to August, Year 6	June to August, Year 3	40	1,300	1,560	1.6	1.1	2.7
5	November, Year 2 to August, Year 6	July to September Year 3	37	1,650	2,400	2.8	1.9	4.9
<b>Total</b>				<b>4,420</b>	<b>6,360</b>	<b>7.5</b>	<b>5.1</b>	<b>12.1</b>
<sup>a</sup> It is anticipated the barge landing pile driving will occur during the same time period as the cofferdam pile driving.								
<sup>b</sup> Estimates based on intake designs from GIS Revision 10b.								

2 **Intakes**

3 Three new on-bank water intake facilities will be constructed on the east bank of the Sacramento  
4 River between about Clarksburg and Courtland (river miles 37 to 41). Each facility will have a  
5 diversion capacity of 3,000 cubic feet per second (cfs) and will rise approximately 55 feet from river  
6 bottom to top of structure, with lengths of between 1,560 to 2,400 feet, depending on location  
7 (Table 4-2). Depending on the stage of the river at the intake location, the intake will rise above the  
8 river's surface by 20 to 30 feet. All intakes will be equipped with vertical, structurally reinforced  
9 wedge wire screen panels of stainless steel with 1/16-inch openings (fish screens). The fish screen  
10 sizes will vary depending on location and will range from 10 to 22 feet in height and from 970 to  
11 1,800 feet in length. These self-cleaning, positive- barrier fish screens will be designed to the  
12 established protection standards for salmonids and delta smelt, and will comply with CDFW, NMFS,  
13 and USFWS fish screening criteria as discussed in Appendix 5.B, *Entrainment*.

14 New intake facilities will necessitate widening the existing levees on the land side, increasing the  
15 crest width to facilitate intake construction and accommodate the realignment of State Route 160, as  
16 well as along with offshore dredging and channel modification activities.

17 Each intake will require approximately 3.5 to 4.5 years to construct; construction of multiple intakes  
18 will overlap such that several intakes undergo simultaneous construction, potentially with all three  
19 intakes constructed concurrently. Intakes will be constructed using cofferdams in the river to create  
20 an isolated construction area that will encompass the intake site. These cofferdams will be  
21 constructed during the first in-water construction season. Cofferdams will be supported by steel  
22 sheet piles and/or king piles (heavy H-section steel piles). Installation of these piles will require  
23 both impact and vibratory pile drivers; piles will be driven using barge-mounted cranes and cranes  
24 mounted on temporary decks. The cofferdams will be installed from upstream to downstream, with

the downstream end closed last. The distance between the face of the intake and the face of the cofferdam will depend on the foundation design and overall dimensions. The length of each cofferdam will vary by intake location, but will range from about 1,560 to 2,400 feet, which includes the length of the intake structure and the transition walls. While the cofferdam walls in front of the intake will be removed when the intake is completed, the sections upstream and downstream of the intake will remain in place and form the transition walls, as an integral part of the intake structure within the existing water side levee.

Intake cofferdams will each temporarily occupy 1.6 to 3.1 acres of in-water habitat (7.5 acres total for the 3 cofferdams), while the permanent intake structures will occupy between 1.1 and 2.1 acres of in-water habitat (5.1 acres total), replacing about 2.6 miles of steep-banked, riprapped shoreline. The Sacramento River will remain navigable during construction of the intakes. River channel width at the intake sites typically varies from about 400 to 600 feet, while the anticipated protrusion of cofferdams into the river is about 40 to 60 feet.

Once the cofferdam is completed, the enclosed area will be excavated to the level of design subgrade using clamshell or long-reach backhoe before ground improvements and installation of foundation piles. After installing the foundation piles, a tremie slab will be placed. The anticipated ground improvement methods may include jet grouting and deep soil mixing. Foundation construction will either be carried out by in-the-wet construction or conventional construction using dewatering methods. Regardless of the foundation construction method, after the tremie slab is installed, all subsequent construction within the cofferdam will be conducted in the dry.

After intake structure construction is complete, the cofferdam will be flooded and the sheet pile walls in front of the intake structure removed. Sheet pile wall removal will be performed by underwater divers using torches or plasma cutters to trim the sheet piles at the finished intake structure slab grade. After removing the cofferdams, the riverbed in front of the intakes will be dredged to provide smooth hydrologic conditions along the face of the intake screens. The dredged areas will range in size from 2.7 to 4.9 acres (12.1 acres total for the 3 intakes), although the dredge volumes have not yet been determined. Foundation type, dimensions, and construction methods will be revised further when additional site-specific subsurface geotechnical data become available.

### **Pumping Plants**

Intake pumping plants, each with a capacity of 3,000 cfs provided by six individual 500-cfs pumps (plus one spare pump), will convey water from intake facilities into pipelines connecting to the intermediate forebay (Table 4-3). Each pumping plant and its associated facilities will encompass up to 60 acres adjacent to the intake facility. At each intake pumping plant site, a new perimeter berm will be constructed, and the existing levee widened. The space enclosed by the berm will be filled to the elevation of the top of the levee, creating a building pad for the pumping plant. Cutoff walls will be constructed to avoid seepage, and the minimum slope of levee or berm walls will be three units horizontal to one unit vertical. All levee/berm construction will comply with applicable state and federal flood management engineering and permitting requirements.

1 **Table 4-3. Summary of Tunnel/Pipeline Conveyance Physical Characteristics**

Feature Description/Surface Area <sup>a</sup>	Approximate Characteristics
<b>Overall project (intakes, tunnels, forebays)/2,000 acres</b>	
Conveyance capacity (cfs)	9,000
Overall length (miles)	45
<b>Intake facilities/90 acres per site</b>	
Number of on-bank screened intakes	3
Maximum diversion capacity at each intake (cfs)	3,000
<b>Intake pumping plants/(included with intake facilities)</b>	
Six pumps per intake plus one spare, capacity per pump (cfs)	500
Total dynamic head (feet)	59-73
<b>Tunnels/170 acres (permanent subsurface easement = 1,720 acres)</b>	
<b>Tunnel 1a connecting Intakes 2 and 3 to the Intermediate Forebay</b>	
Tunnel length (feet)	47,400
Number of tunnel bores; number of shafts (total)	1; 4
Tunnel finished inside diameter (feet)	20 (between Intakes 2 and 3); 29 (between Intake 3 and the intermediate forebay)
<b>Tunnel 1b connecting Intake 5 to the Intermediate Forebay</b>	
Tunnel length (feet)	24,900
Number of tunnel bores; number of shafts (total)	1; 3
Tunnel finished inside diameter (feet)	20
<b>Tunnel 2 connecting Intermediate Forebay to Clifton Court Forebay</b>	
Tunnel length (feet)	159,000
Number of tunnel bores; number of shafts (total)	2; 9
Tunnel finished inside diameter (feet)	40
<b>Intermediate Forebay/245 acres</b>	
Water surface area (acres)	41
Active storage volume (acre-feet)	710
Emergency spillway inundation area (acres)	125
<b>Expanded Clifton Court Forebay/2,950 acres (total finished area)</b>	
Forebay dredging area (acres)	2,030
Expanded water surface area (acres)	690
Active storage volume (acre-feet)	9,260 (north cell) 8,110 (south cell)
<b>Power requirements</b>	
Total conveyance electric load (MW)	50-60
af = acre-feet cfs = cubic feet per second ft = feet MW = megawatts <sup>a</sup> Acreage estimates represent the permanent surface footprints of selected facilities. Characteristics of other areas including temporary work areas and those designated for borrow, spoils, and resubable tunnel material are reported in Appendix 3.C, <i>Avoidance and Minimization Measures</i> . Overall project acreage includes some facilities not listed, such as permanent access roads.	

Pumping plant associated facilities will include sedimentation basins, transition structures, surge shafts or towers, one or two substations, a transformer, a mechanical room, an access road, and other associated facilities and utilities (Figure 4-6). Each intake will include six sedimentation basins, divided into three sedimentation channels, each 500 feet long by 200 feet wide by 23 feet deep. The adjacent solids lagoons will be lined with concrete to prevent seepage to the groundwater or adjacent riverbed, will be approximately 15 feet deep, a bottom width of 200 feet, and a bottom length of 400 feet. Each intake pumping plant will be served by a 69-kilovolt (kV) substation with a footprint of about 150 by 150 feet.

## **Pipelines**

Intake pipelines will carry water between intakes and intake pumping plants. Each intake facility will convey water through six 12-foot-diameter pipelines to the adjacent pumping plant. Construction could involve trenchless methods or open-cut trenching. If open-cut trenching is used and the native materials are generally of good quality in the area of conduit construction, excavated material from the trench will be used as embedment and backfill materials. Excess material will be stored at the borrow site adjacent to Intake 2. If the native soils are not suitable as foundation materials for the trench, those suitable materials will be imported to the site. Cut-and-cover construction will likely be used for land side pipe placement using long reach backhoes, scrapers, and excavators placed on levees or on the land side of the levees.

Conveyance pipelines will carry water between intake pumping plants and other conveyance facilities such as tunnels and forebays. Two or four 16-foot-diameter conduits will be used for conveyance pipelines.

## **Tunnels**

Tunnel 1a consists of a single-bore 20-foot-inside-diameter tunnel segment between Intakes 2 and 3, and a 29-foot-inside-diameter tunnel segment between Intake 3 and the intermediate forebay on Glannvale Tract, adjacent to Twin Cities Road. Tunnel 1a will be about 9 miles long, extending from Intake 2 to the new intermediate forebay.

Tunnel 1b consists of a single-bore 20-foot-inside-diameter tunnel, which will convey water approximately 5 miles from Intake 5 to the intermediate forebay.

Tunnel 2 (main tunnel), consists of a dual-bore 40-foot-inside-diameter tunnel segment, which will convey water approximately 30 miles from the intermediate forebay to the Clifton Court Forebay, including a culvert siphon conveyance structure under Italian Slough.

The proposed tunnels will be constructed in soft, alluvial soils with high groundwater pressures. Because of this, the tunnels will be constructed using mechanized soft-ground tunnel-boring machines (TBMs). The final depth and profile of the tunnel will be determined after detailed geotechnical investigations have been completed. Each tunnel will require appropriately sized launch/retrieval shafts, safe haven work areas, and vent shafts to accommodate equipment and construction activities.

The main construction or launch shafts for each tunnel will be about 120 feet in diameter to accommodate construction and construction support operations. The TBM retrieval shaft will be approximately 90 feet in diameter, and 50-foot-diameter ventilation shafts will be located approximately every 3 miles. Tunnel ventilation will adhere to California Division of Occupational Health and Safety (Cal-OSHA) tunnel ventilation requirements. The tunnels will be lined with



1 precast concrete bolted-and-gasketed segments. The tunnel concrete liner will serve as permanent  
2 ground support and will be installed immediately behind the tunnel-boring machine, thereby  
3 forming a continuous watertight vessel.

4 Upon completion of construction, launching, retrieval, and ventilation shafts will be converted to  
5 permanent access shafts so that personnel can gain access to the tunnel for inspections and  
6 maintenance. The large-diameter construction shafts will be modified to approximately 20-foot  
7 diameter access shafts that will rise approximately 20 feet above existing grade. The twin-bore  
8 tunnels will have two shafts, and will be surrounded by an earthen pad with approximate  
9 dimensions of 250 feet by 125 feet, and approximately 20 feet high. Road access to the top of the pad  
10 will be provided for maintenance vehicles.

11 Reusable tunnel material (RTM) generated by the boring process is a plastic mix consisting of soil  
12 cuttings and soil conditioning agents (water, air, bentonite, foaming agents, and/or polymers/  
13 biopolymers). Before the RTM, or elements of the RTM, can be reused or returned to the  
14 environment, it must be managed and, at a minimum, go through a drying/water-solids separation  
15 process and a possible physical or chemical treatment. The daily volume of RTM withdrawn from  
16 the tunneling operations is estimated at approximately 7,000 cubic yards per day. It is assumed that  
17 RTM transport will be continuous, without substantial RTM storage at the tunnel work site, as long  
18 as tunneling is advancing. The RTM will either be pumped through a pipeline or carried on a  
19 conveyor belt from the TBM to the base of the launch shaft. The RTM will be withdrawn from the  
20 tunnel shaft and placed directly into the RTM work area using the pipeline or a conveyor belt.

21 The RTM will be deposited in designated storage areas, ranging in size from approximately 100 to  
22 570 acres. In total, approximately 1,595 acres will be devoted to RTM storage. A retaining dike—a  
23 berm of compacted imported soil—will be built around the perimeter of each RTM storage area to  
24 ensure containment. The RTM area will be subdivided by a grid of interior earthen berms into a  
25 system of ponds for dewatering. The dewatering process will consist of surface evaporation and  
26 leaching through a drainage blanket (2-foot-thick pea gravel or a similar material placed over an  
27 impervious liner) placed on the invert of the pond. The invert of the pond will be sloped a minimum  
28 of 1% toward a leachate collection system. The leachate will be pumped from the drainage system to  
29 leachate ponds for additional treatment, if needed. The depth of stored RTM will be less than 25 feet,  
30 as measured from the lowest exterior ground level, and the maximum capacity of individual RTM  
31 storage ponds will be less than 50 acre-feet.

32 To ensure that underlying groundwater is not contaminated, the invert of the RTM ponds will be a  
33 minimum of 5 feet above the seasonal high groundwater table, and an impervious liner will be  
34 placed on the invert of the RTM ponds and along the interior slopes of the berms to prevent any  
35 contact between the RTM and groundwater. Because groundwater tables are high, it is anticipated  
36 that there will be minimal excavation for construction of the RTM ponds.

### 37 **Forebays**

38 A 40-acre intermediate forebay located on Glannvale Tract will provide approximately 368 acre-feet  
39 of storage and will feed into an outlet control structure to the main tunnel, leading to the Clifton  
40 Court Forebay. The passage of water from the intermediate forebay will rely exclusively on gravity  
41 flow. This structure will include open channels, a point of access, and a series of gates to control the  
42 flow of water from the intermediate forebay into the main tunnel. An emergency spillway will  
43 prevent the intermediate forebay from overtopping by spilling to an approximately 125-acre  
44 inundation area immediately south of the forebay.

From the intermediate forebay outlet structure, water will flow through the dual-bore main tunnel to the south Delta, conveyed through a siphon under Italian Slough, and into an expanded Clifton Court Forebay. The existing Clifton Court Forebay will be dredged and expanded by approximately 690 acres to the southeast of the existing forebay, requiring the removal of approximately 12 million cubic yards of material (4 million cubic yards excavated from the expanded portion, and 8 million cubic yards from dredging to increase the existing forebay depth by an average of about 2 feet). Additionally, a new embankment will be constructed around the interior perimeter of the forebay, as well as an embankment dividing the forebay into a northern cell and a southern cell. The northern cell will receive water from the main tunnel (from the north Delta intakes, and will provide 9,260 acre-feet of active storage. The southern cell of the forebay will continue to provide functionality for the existing through-Delta conveyance system and will provide 8,110 acre-feet of active storage. These modifications to the Clifton Court Forebay are needed to ensure that water from the north Delta intakes that will be free of fish (screened at the diversions) is not mixed with water in Clifton Court Forebay that contains fish from the south Delta (fish that are collected, trucked, and released elsewhere in the Delta).

Forebay dewatering will be required for excavation operations. Much of the excavated material is expected to be high in organics and unsuitable for use in embankment construction; however, some of the excavated material below the peat layers may be suitable for use in constructing the embankments. To the extent possible, excavated material to be used for the embankments will be stored onsite. Dredged material will be transported to and stored at designated RTM storage area west of, and adjacent to Clifton Court Forebay. Guidelines for the handling, storage, disposal and reuse of dredged material are provided in Appendix 3.C, *Avoidance and Minimization Measures*.

#### **Connections and Control Structures for the Banks and Jones Pumping Plants**

New culvert siphon and canal connections will be constructed between the north cell of the expanded Clifton Court Forebay and the Banks and Jones pumping plants, along with control structures to regulate the relative quantities of water flowing from the north Delta and south Delta. A culvert siphon will be constructed under Byron Highway and a 4,000-foot-long canal will be constructed to convey water to the Banks Pumping Plant, downstream of the Skinner Fish Facility. Another 6,000-foot-long canal will carry water to the existing approach canal for the Jones Pumping Plant.

A set of gates will be installed in the approach canal to the Banks Pumping Plant downstream of the connection with the new facilities, allow operational flexibility to regulate pumping water from the north Delta (north cell) and the south Delta (south cell). However, only water from the south cell will be conveyed through the Skinner Fish Facility to the Banks Pumping Plant.

A set of gates will be installed in the approach canal to the Jones Pumping Plant upstream of the connection with the new facilities, to allow operational flexibility to regulate pumping water from the north Delta (north cell) and pumping from the south Delta (south cell).

#### **Concrete Batch Plants and Fuel Stations**

The volume of concrete needed for the conveyance facilities will require locating concrete batch plants at the project work sites rather than importing concrete from outside suppliers. A suitable source of clean water will be required for each batch plant. Batch plants and fuel stations will be constructed side by side and range in size from approximately 2 acres to up to 40 acres. While it is

anticipated that precast tunnel segments will be purchased and transported from existing plants, if it is necessary to construct precast segment yards, they will be built adjacent to concrete batch plants. The planned concrete batch plants and fuel stations are:

- An approximately 2-acre concrete batch plant and 2-acre fuel station at Intake 2 (within the work area identified for Intake 2).
- An approximately 2-acre concrete batch plant and 2-acre fuel station at Intake 5 (within the work area identified for Intake 5).
- An approximately 40-acre concrete batch plant and 2-acre fuel station near Twin Cities Road and Interstate 5 (within a designated RTM storage site).
- An approximately 40-acre concrete batch plant and 2-acre fuel station between Byron Highway and Italian Slough (within a designated RTM storage site).

### **Temporary Barge Unloading Facilities**

These facilities will be constructed at locations along the alignment for the delivery of construction materials and will be sized to accommodate various deliveries (e.g., tunnel segments, batched concrete, major equipment). Access roads from these facilities to the construction work area will be necessary. The docks will be approximately 50 by 300 feet and typically supported on approximately 32 steel piles. However, floating barge landings may be used, where feasible, to minimize potential effects of underwater sound produced by pile driving on fish and other aquatic species. Piles will be driven within the allowable window for in-river construction, typically with a vibratory hammer, also to minimize underwater sound levels. However, some piles will likely require an impact hammer. The barge unloading facilities will be removed following construction. These facilities will be constructed at the locations listed below and shown in Figure 4-3.

- Bacon Island
- Victoria Island
- Byron Tract on Italian Slough
- Bouldin Island on San Joaquin River
- Staten Island on South Mokelumne River

### **Electricity**

The electrical power delivery system needed to construct and operate the water conveyance facilities will connect to the existing grid in two different locations—one in the northern section of the alignment, and one in the southern section of the alignment. The northern point of interconnection will be located north of Lambert Road and west of Highway 99. From here, a 230-kV power line will run west, along Lambert Road, where one segment will run south to the intermediate forebay on Glannvale Tract, and then on to tunnel shaft locations on Staten Island, and another segment will run north to connect to a substation where 69-kV lines will connect to the intake pumping plants. The point of interconnection for the southern section of the alignment may be located in one of two possible locations: southeast of Brentwood near Brentwood Boulevard, or adjacent to the Jones Pumping Plant. While only one of these points of interconnection will be used, both are depicted in figures, and the effects of constructing power lines leading from both sites are combined and accounted for in resource-specific impact analyses. A 230-kV line will run from one of these locations to a tunnel shaft northwest of Clifton Court Forebay and will continue north,

servicing all tunnel shaft locations, to Bouldin Island, where a 34.5-kV line will run to the southern end of Staten Island. Because power required during operation of the water conveyance facilities will be much less than that required during construction, and because it will largely be limited to the intake pumping plants and intermediate forebay, all of the power lines extending from the southern point of interconnection will be temporary, providing service only during the construction schedule for the relevant tunnel reaches and features associated with Clifton Court Forebay, and thereafter removed. The segment extending south of the intermediate forebay to tunnel shaft locations on Staten Island will also be removed following construction of associated tunnel facilities.

Construction of 230-kV, 69-kV and 34.5-kV transmission lines will require a corridor width of 100 feet and, at each tower or pole, 100 feet on one side and 50 feet on the other side for construction laydown, trailers, and trucks. Construction will also require about 350 feet along the corridor (measured from the base of the tower or pole) at conductor pulling locations, which include any turns greater than 15 degrees and/or every 2 miles of line.

#### **Bulk Materials Borrow, Storage and Disposal**

Borrow areas and areas identified for the storage and/or disposal of RTM and dredged material will be located adjacent to intake and conveyance facilities (Figures 4-3, 4-4, 4-5, 4-8, and 4-9). RTM and associated decant liquid will undergo chemical characterization prior to reuse or discharge, respectively, to meet National Pollutant Discharge Elimination System (NPDES) and the Central Valley Regional Water Quality Control Board (RWQCB) requirements. Should the RTM or decant liquid constituents exceed discharge limits, these tunneling byproducts will be treated to comply with NPDES permit requirements. To ensure that underlying groundwater is not contaminated, the storage areas ponds will be lined with an impervious membrane. Dredged material will be handled in a similar manner or may be disposed of in the 200-acre borrow site that will be located adjacent to Intake 2, to help ensure that the material will not be in contact with surface water. Construction of additional sites required for the disposal of dredge material will likely be subject to the State Water Board General Permit (Order No. 2009-0009-DWQ). Hazardous materials excavated during construction will be segregated from other construction spoils and handled in accordance with applicable state and local regulations. Siting considerations for bulk materials storage areas are further detailed below.

#### **Material Storage Site Determination**

The locations of the storage areas for RTM (Figures 4-3, 4-4, 4-5, 4-8, and 4-9) have been designed to be close to where the material will be brought to the surface, as well as close to where reuse is expected to occur. In some cases storage areas are located adjacent to barge landings to facilitate easy movement to other reuse locations in the Delta (Bouldin Island). However, the size of the storage areas is flexible depending on several factors:

- The speed with which material is brought to the surface, stored, dried, tested, and moved to reuse locations. If material can be dried faster and moved offsite more quickly, less area will be needed at each location.
- The height of the material storage piles. Taller piles will require less area but may dry more slowly. The analysis assumes 6-foot-high piles but these could be increased to 10 feet to reduce storage surface area.
- The proportion of material at one storage area or another. There will be flexibility during construction to allocate material storage between different areas.

To preserve this flexibility during construction, the analysis assumes the maximum storage area footprint that could be needed. DWR expects to be able to use less of this storage area footprint during construction. DWR will also work directly with landowners to refine the storage area footprint (within the maximum envelope assumed) to further minimize impacts to surrounding land uses.

RTM and dredged material temporary storage areas have been selected using the following criteria:

- Material may be placed in designated borrow areas.
- Areas for material storage will be located within 10 miles of the construction feature.
- Areas for material storage will not be located within 100 feet of existing residential or commercial buildings.
- Areas for material storage will not be located within 100 feet of a military facility.
- Areas for material storage will not be located within 100 feet of existing roads, rail lines, or infrastructure.
- Placement of material in sensitive natural communities and habitat areas, such as wetlands, vernal pools, alkali wetlands or grassland, native grasslands, riparian areas, or crane roost sites, will be minimized.
- Landowner preferences will be considered in designating sites for material storage. DWR will consult directly with landowners to refine the storage area footprint to further minimize impacts to surrounding land uses, including agricultural operations.
- Where feasible, dredged material will be stored on higher elevation land that is set back from surface water bodies. Upland disposal will help ensure that the material will not be in contact with surface water prior to its draining, characterization, and potential treatment.

#### **4.2.1.1.2 Facilities Operations**

includes a description of the long-term operations criteria for SWP and CVP with dual operations. These measures have been designed to minimize the potential effects of water conveyance and diversion actions associated with the new intakes and tunnel/pipeline facilities on covered fish species and their habitat.

Operations of the North Delta diversions will be coordinated with operations of other regional water control facilities, and in particular with operations of the other water facilities covered by the Plan: the South Delta SWP facilities (Section 4.2.1.2, *State Water Project Facilities Operations and Maintenance*), the Suisun Marsh facilities (Section 4.2.1.3, *Suisun Marsh Facilities Operations and Maintenance*), the North Bay Aqueduct Alternative Intake (Section 4.2.1.4, *North Bay Aqueduct Alternative Intake Project*), the Delta Cross Channel (Section 4.3.1, *Delta Cross Channel*), and the South Delta CVP facilities (Section 4.3.2, *C. W. "Bill" Jones Pumping Plant*, Section 4.3.3, *Tracy Fish Collection Facility*, and Section 4.3.4, *Central Valley Project Diversions*). Operational constraints on the North Delta diversions include design constraints, operational phasing, and bypass flow criteria.

Design constraints include criteria adhered to in design of the facility, which constrain operational characteristics. These include the following constraints.

- The new north Delta diversions will consist of three separate intake units with a total, combined intake capacity not exceeding 9,000 cfs (maximum of 3,000 cfs per unit).

- 1 • Project conveyance will be provided by a tunnel capacity sized to provide for gravity flow from  
2 an intermediate forebay to the south Delta pumping facilities.
- 3 • The facility will, during operational testing and as needed thereafter, demonstrate compliance  
4 with the then current NMFS fish screening design and operating criteria, which govern such  
5 things as approach and passing velocities and rates of impingement. In addition, the screens will  
6 be operated to achieve the following performance standard and will be deemed to be out of  
7 compliance with permit terms if the standard is exceeded. The standard is to maintain survival  
8 rates through the reach containing new north Delta intakes (0.25 mile upstream of the  
9 upstream-most intake to 0.25 mile downstream of the downstream-most intake) to 95% or  
10 more of the existing survival rate in this reach. The reduction in survival of up to 5% below the  
11 existing survival rate will be cumulative across all screens and will be measured on an average  
12 monthly basis.
- 13 • The facility will precede full operations with a phased test period during which DWR, in  
14 collaboration with NMFS, will develop detailed plans for appropriate tests and use those tests to  
15 evaluate facility performance across a range of pumping rates and flow conditions. DWR will  
16 also implement operational constraints that minimize adverse impacts on covered fish species  
17 within that operational range, and demonstrate that biological performance standards are being  
18 achieved. This phased testing period will include biological studies and monitoring efforts to  
19 enable the measurement of survival rates (both within the screening reach and downstream to  
20 Chipps Island), and other relevant biological parameters which may be affected by the operation  
21 of the new intakes.
- 22 • Operations will be managed at all times to avoid increasing the magnitude or frequency of flow  
23 reversals in Georgiana Slough.
- 24 • The fish and wildlife agencies will retain final authority over the operational criteria and  
25 constraints (i.e., which pumping stations are operated and at what pumping rate) during testing.  
26 The fish and wildlife agencies are also responsible for evaluating and determining whether the  
27 diversion structures are achieving performance standards for covered fishes over the course of  
28 operations. Consistent with the experimental design, the fish and wildlife agencies will also  
29 determine when the testing period should end and full operations consistent with developed  
30 operating criteria can commence. In making this determination, fish and wildlife agencies expect  
31 and will consider that, depending on hydrologies, it may be difficult to test for a full range of  
32 conditions prior to commencing full operations. Therefore, tests of the facility to ensure  
33 biological performance standards are met are expected to continue intermittently after full  
34 operations begin, to enable testing to be completed for different pumping levels during  
35 infrequently occurring hydrologic conditions.
- 36 • DWR will contract with the Delta Science Program to host an independent review of the  
37 engineering design and approach to meeting biological criteria, including lessons learned from  
38 other large screening programs.

39 The fourth and sixth constraints include the requirement for operational phasing, which refers to a  
40 gradual start-up of the facility during which time a variety of studies are conducted to verify that the  
41 facility functions as intended, to optimize techniques for performing facility operations, and to  
42 collect data on environmental effects of the facility.

43 During facilities operations, allowable diversions are conditioned upon bypass flow criteria, which  
44 define the minimum allowable flows in the Sacramento River bypassing the facility.

Although DWR will own and operate the new intake and conveyance facilities and their operations will be covered activities as described in Section 4.2, *Covered Activities*, an agreement to wheel CVP water through the new conveyance facility will be executed by DWR, and this action by DWR will be a covered activity.

#### **4.2.1.1.3 Maintenance Activities**

##### **Intakes and Screens**

The intake facilities will require ongoing periodic maintenance, including cleaning and replacement of screens, trash racks, and associated machinery and dredging to maintain intake capacity. The facilities will require routine or periodic adjustment and tuning to ensure that operations are managed consistent with design intentions. Facility maintenance is part of long-term asset management and includes activities such as painting, cleaning, repairs, and other routine tasks to ensure the facilities are operated in accordance with design standards after construction and commissioning.

Routine visual inspection of the facilities will be conducted to monitor performance and prevent mechanical and structural failures of project elements. Maintenance activities associated with river intakes could include removal of sediments, debris, and biofouling materials. These maintenance actions could require suction dredging or mechanical excavation at or in the intake structures; dewatering; or use of underwater diving crews, boom trucks or rubber wheel cranes, and raft- or barge-mounted equipment. In-water maintenance activities will be accomplished during the approved in-water construction window unless emergency work was required.

It is expected that all intake panels will require annual removal (at a minimum) for pressure washing. Additionally, individual intake bays will require dewatering (one pair at a time) for inspection and assessment of biofoul growth rates. Dewatering will be accomplished by closing off portals with prefabricated bulkheads.

Two other maintenance activities, dredging and riprap placement, could contribute to incidental take in the areas adjacent to the intakes. Sediment deposition commonly plagues engineered infrastructure in natural waterways. It can bury intakes and reduce intake capability to divert or force shutdowns completely until working conditions are restored. The planned operation of proposed intakes will help mitigate sediment deposition within the intake bays and conveyance conduits.

Despite the design considerations, periodic maintenance dredging will be required in front of the intake facilities, and is assumed similar to the areas described above for the construction phase. However, the frequency of this dredging will likely vary by intake location and in response to high-flow events that redistribute sediment within the river channel. A dredging plan with further details on specific maintenance dredging activities will be developed prior to dredging activities. This will include a predredge sampling and analysis plan to evaluate the potential presence of contaminants that may affect water quality, and appropriate plans to handle and dispose of dredged spoils similar to those described above for construction-related dredging. Riprap placement may also be occasionally needed to protect the intake or riverbank from erosion, and the frequency of such actions will also vary by location and over time.

The only systems associated with the intakes involving power-driven and routinely moving parts are the screen cleaning systems and gantry crane hoist systems. Lubrication of bearings, continuity

checks of limit/torque switches, and periodic inspections of equipment in accordance with manufacturer recommendations will be the primary operations and maintenance tasks anticipated for these systems. Strip brushes for the screen cleaning systems will need replacement every several years.

Intake facilities will be designed such that all mechanical elements can be removable from the top surface for convenience of inspection, cleaning, and repairs as needed. The intakes will feature top-side gantry crane systems for removal and insertion of screen panels, louver assemblies, and bulkheads. It is expected that all panels will require annual removal (at a minimum) for pressure washing. Additionally, individual intake bays will require dewatering (one pair at a time) for inspection and assessment of biofoul<sup>7</sup> growth rates. Dewatering is accomplished by closing off portals with prefabricated bulkheads. Metalwork in intakes is expected to consist of plastics and austenitic steels (stainless); therefore, corrosion is not expected to be detrimental to the life of the facilities. Maintenance associated with these systems consists of replacing sacrificial (zinc) anodes at multiyear intervals.

Continuous general inspections will be important for monitoring and logging performance, recording the history of facility conditions and deterioration, and preventing mechanical and structural failures of project elements. Sediment removal will be carried out through suction dredging, mechanical excavation, and dewatering to remove sediment buildup. If large debris is found to have accumulated around intakes, removal will require underwater diving crews, boom trucks or rubber wheel cranes, and possibly a small barge and crew to rig the leads to the debris. While the screens will require cleaning at a frequency commensurate with debris load conditions in the river, the continuous traveling brush mechanisms or other screen cleaning technologies are expected to maintain a relatively clean screen face and adequate open area. Nevertheless, biofouling can occlude the screens and jeopardize function over time.

Damage incurred by the intake facilities (e.g., boat collisions, debris impact, stone and sediment abrasion) may require repairs.

Maintenance will be needed for the intake pumping plants and sedimentation basins. This includes service based on a schedule recommended by the manufacturers, mussel and sediment removal, and checking and replacing worn parts. Major equipment repairs and overhauls will be conducted at a centralized maintenance shop. Routine site maintenance will include landscape maintenance, trash collection, and outdoor lighting repair or replacement.

## **Tunnel/Pipeline**

Among the important steps involved in the maintenance of the tunnel/pipeline will be the evaluation and determination of an inspection schedule, including the frequency that the facility will need to be taken out of service to allow for such inspections. Typically, new water conveyance facilities are inspected at least every 10 years for the first 50 years and more frequently thereafter. Dewatering of the tunnel/pipeline facility for maintenance purposes is expected to be conducted but it is assumed that only one of the tunnel/pipelines at a time will be dewatered, allowing continued north Delta diversions to the intermediate forebay. Depending on the monthly demands, diversion needs could be met or may be temporarily reduced. The entire dewatering and nonroutine maintenance process will likely be completed in a month and will be timed for low-diversion periods. Dewatering for maintenance will be conducted approximately once every 5, 10, or 20 years.

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<sup>7</sup> Biofouling is the attachment of an organism or organisms to a surface in contact with water for a period of time.



This type of periodic maintenance will require an additional set of pumps, temporarily located at either the Clifton Court Forebay or at one of the shafts along the tunnel/pipeline route. While these pumps will have some noise associated with them, their operation will last less than a month per use and will occur at 5-, 10-, or 20-year intervals. A crane at the shaft site will launch and retrieve remotely operated vehicles for inspection of the interior of the tunnel/pipeline; a portable generator to supply power may also be necessary at the site. All work will be within the right-of-way at the shaft.

### **Forebays**

Forebay maintenance considerations include regular harvesting of pond weed to maintain flow and forebay capacity, the installation of automatic trash raking equipment and disposal facilities, and potential sediment dredging approximately every 50 years. Maintenance requirements for the forebay embankments include control of vegetation and rodents, embankment repairs in the event of island flooding and wind wave action, and monitoring of seepage flows. Maintenance requirements for the spillway include the removal and disposal of any debris blocking the outlet culverts. Debris in the stilling basin will require removal to ensure normal water flow through outlet culverts.

### **Canals**

Canal maintenance will be similar to the requirements described above of the forebay embankments, including the control of vegetation and rodents (particularly for earthen canals), removal of debris, and periodic sediment removal. The canals may include sediment traps to reduce the accumulation of sediment in the siphons and tunnels. Removal of sediment will vary depending on location and overall sediment load in the canals, but will typically occur every 3 to 5 years. The maintenance of gates and control structures will include periodic (every 5 to 10 years) maintenance of the gates and annual inspection and maintenance of motors, compressors and control systems. Maintenance of the motors, compressors, and control systems will occur annually and require service truck access using existing access roads.

### **Other Maintenance Activities**

Additional activities that could be necessary are listed below.

- Powerline and substation maintenance; e.g., insulator washing, routine tower and pole maintenance and replacement.
- Road and fence repairs.
- Excavation to access pipelines.
- Testing or replacement of backup power supplies.

In summary, all construction, operations and maintenance of the new intakes, screens, pumps, conveyance facilities and forebays described in this section are covered activities and the effects of those activities are addressed by the BDCP (Chapter 3, *Conservation Strategy* and Chapter 5, *Effects Analysis*).

#### 4.2.1.2 State Water Project Facilities Operations and Maintenance

This section describes covered activities that will be carried out by DWR to operate and maintain SWP facilities in the Delta after the north Delta intakes become operational. These activities involve the daily operation of water diversion, conveyance, and delivery systems and appurtenant facilities within the Plan Area. The flow diversions associated with these operations will be constrained as described under Section 4.2.1, *CM1 Water Facilities and Operations*.

SWP facilities in the Plan Area consist of the Clifton Court Forebay; Banks Pumping Plant; Skinner Fish Facility; installation, operation, and removal of temporary barriers in the south Delta; the northern portion of the California Aqueduct; Barker Slough Pumping Plant; and eastern portions of the North Bay Aqueduct (Figure 1-1, *Plan Area Location*, in Chapter 1, *Introduction*, and Figure 4-1). Additional facilities that will be built during construction of the new north Delta intakes include the intakes, sedimentation basins, intake pumping plants, perimeter berms, pipelines and tunnels to convey water from the intake pumping plants to the new intermediate forebay, the intermediate forebay, tunnels to convey water under the Delta to an expanded Clifton Court Forebay, the Clifton Court Forebay, and canals to the existing Jones and Banks pumping plants. These SWP facilities will be used to export water from the Delta into canals and pipelines that carry it to municipal, industrial, and agricultural water contractors in the San Francisco Bay Area and southern California. These facilities are integral components of the SWP and contribute to the functional capacity of the overall system. This section describes these facilities, their operational requirements, and the actions necessary to maintain their viability. The manner in which these facilities are operated and maintained is not only integral to the proper functioning of the water supply system, but integrated with the actions in the conservation strategy to provide for the conservation of the aquatic ecosystem and for several but not all covered fish species.

The following descriptions of SWP-related covered activities are intended to be sufficiently broad to cover all aspects of the operation and maintenance of identified SWP facilities that may potentially affect resources covered by this Plan, including covered species and their habitats. The measures to address the effects of these covered activities on covered resources are set out in the conservation strategy (Chapter 3, *Conservation Strategy*). Potential environmental effects of these activities will be minimized through implementation of the avoidance and minimization measures described under CM22 and the environmental commitments described in Appendix 3.C, *Avoidance and Minimization Measures*, as well as requirements of the permits necessary to construct these facilities.

##### 4.2.1.2.1 Clifton Court Forebay

Under existing conditions, water for the SWP is diverted into Clifton Court Forebay and pumped at Banks Pumping Plant. Clifton Court Forebay is located in the southwestern edge of the Delta, about 10 miles northwest of the City of Tracy. Inflows to Clifton Court Forebay from surrounding channels are controlled by radial gates, which are generally operated based on the tidal cycle to reduce approach velocities, prevent scour in adjacent channels, and minimize water level fluctuation in the south Delta by taking water in through the gates at times other than low tide. When a large head differential (difference in water surface elevation) exists between the outside and the inside of the gates, theoretical inflow can be as high as 15,000 cfs for a short time, although actual inflow will be constrained on an average basis and in accordance with the conservation strategy. Thus, the instantaneous peak diversion may still occur when the gates are opened, but they will generally be opened less frequently for shorter periods.

Under the BDCP, Clifton Court Forebay will be dredged and expanded by approximately 690 acres to the southeast of the existing forebay. Additionally, a new embankment will be constructed around the perimeter of the forebay, as well as an embankment dividing the forebay into a northern cell and a southern cell. The northern end will receive water from the north Delta intakes, which will pass under Italian Slough in a culvert siphon before entering Clifton Court Forebay (north). The northern cell will provide storage of approximately 6,070 af. The southern cell of the forebay will continue to provide functionality for the existing through-Delta conveyance system and will provide storage of approximately 26,000 af. Withdrawals to Clifton Court Forebay will be performed in accordance with CM1. DWR is seeking ESA Section 10 and NCCPA Section 2835 permits for operations and maintenance of Clifton Court Forebay from the time the proposed north Delta intakes become operational.

#### **4.2.1.2.2 Harvey O. Banks Pumping Plant**

The Banks Pumping Plant is in the south Delta, about 8 miles northwest of Tracy, and marks the beginning of the California Aqueduct. By means of 11 pumps, including two rated at 375-cfs capacity, five at 1,130-cfs capacity, and four at 1,067-cfs capacity, the Banks Pumping Plant provides the initial lift of water 244 feet into the aqueduct. The nominal capacity of the Banks Pumping Plant is 10,300 cfs. The pumps can be operated at full capacity to enable diversions to utilize power in off-peak periods.

CM1 includes a description of the operations criteria and adaptive limits for south Delta operations of the SWP and CVP. These measures have been designed to address the effect on covered fish species of water conveyance and diversion actions associated with the Banks Pumping Plant. Refer to Section 4.2.1.2.10, *Maintenance and Monitoring Activities*, for a description of the types of maintenance activities that may occur. DWR is seeking ESA Section 10 and NCCPA Section 2835 permits for all operations and maintenance of Banks Pumping Plant from the time the proposed north Delta intakes become operational.

#### **4.2.1.2.3 John E. Skinner Delta Fish Protective Facility**

The John E. Skinner Delta Fish Protective Facility (Skinner Fish Facility) is located at the head of the Intake Channel that connects Clifton Court Forebay to the Banks Pumping Plant. The Skinner Fish Facility screens some fish away from the pumps. Debris is directed away from the pumps by a 388-foot-long trash boom. Fish are diverted from the intake channel into bypasses by a series of metal louvers, while the main flow of water continues through the louvers and toward the pumps. These fish pass through a secondary system of screens and pipes into seven holding tanks, where they are later counted and recorded. The salvaged fish are then returned to the Delta in oxygenated tank trucks, at locations where they are unlikely to again be entrained.

DWR is seeking ESA Section 10 and NCCPA Section 2835 permits for all operations and maintenance of the Skinner Fish Facility from the time the proposed north Delta intakes become operational. Refer to the background description above with respect to operations of this facility, and to Section 4.2.1.2.10, *Maintenance and Monitoring Activities*, for a description of the types of maintenance activities that may occur.

#### **4.2.1.2.4 Barker Slough Pumping Plant and North Bay Aqueduct**

The Barker Slough Pumping Plant diverts water from Barker Slough into the North Bay Aqueduct for delivery in Napa and Solano Counties. The North Bay Aqueduct intake is located approximately

10 miles from the mainstem Sacramento River at the end of Barker Slough. The maximum pumping capacity is 175 cfs (pipeline capacity). During the last few years, daily pumping rates have ranged between 0 and 140 cfs. Each of the 10 North Bay Aqueduct pump bays is individually fitted with a positive barrier fish screen consisting of a series of flat, stainless steel, wedge-wire panels with a slot width of 3/32 inch. This configuration is designed to exclude fish 25 millimeters or larger from being entrained. The bays tied to the two smaller units have an approach velocity of about 0.2 foot per second. The larger units were designed for an approach velocity of 0.5 foot per second, but actual approach velocity is about 0.44 foot per second. The screens are routinely cleaned to prevent excessive head loss, thereby minimizing increased localized approach velocities.

DWR is seeking ESA Section 10 and NCCPA Section 2835 permits for all operations and maintenance of the Barker Slough Pumping Plant from the time the proposed north Delta intakes become operational. Operations will include authorization for a future peak withdrawal of up to 240 cfs at the Barker Slough Pumping Plant.

#### **4.2.1.2.5 Proposed North Delta Intakes**

A key element of the BDCP is the proposed intake facilities in the north Delta, which will allow for more effective screening of fish and less reliance on the south Delta facilities. The operation of the north Delta intakes will provide additional flexibility for the export of water through the south Delta SWP/CVP intake facilities. This component of the BDCP is intended to reduce fish entrainment and impingement through changes in Delta water management. Potential entrainment or impingement of fish may be associated with the state-of-the-art intake screens at the north Delta intakes and a reduced rate of entrainment or impingement at the south Delta diversions (see *Reduced Entrainment* sections for each species, in Chapter 5, *Effects Analysis*).

Operational scenarios will also result in changes in flow and potentially changes in water quality, habitat, and predation. Operational impacts on fish may include changes in spawning, migration, and rearing habitat associated with changes in reservoir operations, diversion of water, and the consequent changes in flow in the Sacramento River and water circulation and quality through the Delta. Placement and operation of intakes may also result in changes in the potential for predation (see *Impact of Take on Species* sections for each species, in Chapter 5, *Effects Analysis*).

#### **4.2.1.2.6 Intermediate Forebay**

The intermediate forebay will provide storage and a transition between the north Delta intakes and the tunnels leading to the modified Clifton Court Forebay. This will provide a buffer to increase the flexibility within the system to regulate flows (pumping rates) at the north and south Delta intake facilities to minimize effects on covered species and reduce operational costs by reducing pumping during period of peak electricity rates. From the intermediate forebay, water will be conveyed by a gravity bypass and outlet control structure, into the main tunnel, and then to the Clifton Court Forebay.

#### **4.2.1.2.7 Tunnels and Pipeline Conveyance**

The primary covered activities associated with the operation of the proposed project conveyance facilities are the periodic maintenance activities. Maintenance of the conveyance systems (including tunnels, pipelines, and gates) is dependent on the materials of construction. For metal pipelines, maintenance will include inspection of current cathodic protection systems and internal inspections and repair of joints and welds. Concrete conduits will also require periodic inspections and repair of

internal concrete surfaces and cement mortar lining at the joints. Regular inspections will occur along the conduit routes, looking for signs of leakage or erosion of soil cover. Radial gates will be inspected and operated periodically to ensure proper operations, and repaired, as needed. These activities will typically occur in the closed portion of the system, where fish are excluded, thereby minimizing potential effects. This will including activities that require dewatering of portions of the system.

#### **4.2.1.2.8 Diversions**

The amount of water delivered by the SWP in any year has been and will continue to be variable. In any given year, it is equal to the amount of water that is hydrologically available and that can be diverted under DWR's water rights, consistent with the terms and conditions of the BDCP and other applicable permits and regulations. SWP project water is water made available for delivery to the contractors through the project conservation. transportation, and other facilities included in the system. In 2010, under DWR's long-term water supply contracts, DWR could make 4.167 million acre-feet per year of water available to its contractors, except where certain conditions specified in the contract, including shortage of supply availability, result in a lesser amount being available. The 4.167 million acre-feet per year incrementally increases to a maximum amount of 4.173 million acre-feet per year in 2021. This quantity may be exceeded if DWR determines surplus water is available above and beyond that needed to satisfy all regulations, permits, and operational requirements.

The California Water Code requires the state to allow the use of SWP facilities to convey water from a "bona fide transferor" of water as long as the conveyance will not interfere with SWP operations and it meets other statutory requirements. Conveyance capacity has been made available in SWP facilities for the transfer of water by other entities. Such nonproject water has been conveyed for drought water banks, dry water purchase programs, and individual transfers through SWP facilities in the past and this use is expected to continue into the future. SWP facilities are also used to support groundwater banking programs, such as the Semitropic Water Banking and Exchange Program.

CM1 includes a description of the operations criteria and adaptive limits for the SWP and CVP under the BDCP. This measure has been designed to address the effects on several covered fish species of water conveyance and diversion actions associated with conveyance through the SWP and CVP facilities. As such, the BDCP provides the basis for federal and state regulatory authorizations under the ESA and NCCPA for coverage of all diversion activities of the SWP and CVP in the Plan Area from the time the proposed north Delta intakes become operational. Water passing through the Delta associated with water transfers or other voluntary water market transactions (Section 4.2.7, *Transfers and Other Voluntary Water Market Transactions*) is also a covered action.

#### **4.2.1.2.9 Temporary Barriers in the South Delta**

The South Delta Temporary Barriers Project consists of four barriers across south Delta channels for the purpose of benefitting southern Delta agricultural diverters by increasing water levels, improving circulation, and improving water quality, and for the purpose of benefitting San Joaquin River fall-run Chinook salmon by keeping them away from the export facilities. The existing South Delta Temporary Barriers Project consists of the annual installation, operation (full or partial) and removal of temporary barriers at the following locations.

- Middle River near Victoria Canal, about 0.5 mile south of the confluence of Middle River, Trapper Slough, and North Canal.
- Old River near Tracy, about 0.5 mile east of the Delta-Mendota Canal intake.
- Grant Line Canal near Tracy Boulevard Bridge, about 400 feet east of the Tracy Boulevard Bridge.
- Head of Old River (in Old River near its divergence from the San Joaquin River).

The barriers on Middle River, Old River near Tracy, and Grant Line Canal are tidal control facilities composed of rock and gated culverts designed to improve water levels and circulation for agricultural diversions and are in place during the growing season.

A fourth barrier, the Head of Old River Barrier (HORB), will also be installed to benefit San Joaquin River salmonids and their habitat. It can be installed in the spring and the fall. To date, the South Delta Temporary Barriers Project has installed temporary rock barriers and temporary nonphysical barriers at the head of Old River. It is also possible that a permanent barrier fitted with operable gates might be installed, but this option has been on hold pending further study of fish movement, survival, and predation in the vicinity of the temporary barriers. The final, long-term design of this barrier has also not been developed.

CM1 provides for installation and operation of temporary barriers in the South Delta. The Middle River, Old River, and Grant Line Canal barriers and the HORB will likely continue to be used in the near term in conjunction with the BDCP near-term conservation measures. The four barriers are generally installed beginning in mid-March to early April. The three tidal control barriers are partially operated and the HORB is fully operated through the end of May while salmon are migrating down the San Joaquin River and delta smelt are in south Delta channels. During June, once the risk to delta smelt and the salmon migration have passed, the HORB is removed and the tidal barriers are allowed to begin full operations and continue full operations through the remaining summer and fall. Removal of the barriers begins in early November and the barriers are completely removed by November 30.

#### **4.2.1.2.10 Maintenance and Monitoring Activities**

From the time the proposed north Delta intakes become operational, maintenance activities are covered activities. Maintenance activities include actions necessary to maintain the capacity and operational features of the existing water diversion and conveyance facilities, as described in this chapter, including Banks and Jones pumping plants, Clifton Court Forebay, the Temporary Barriers Project, Barker Slough Pumping Plant, North Bay Aqueduct, the Skinner Fish Facility, and the new north Delta intake and conveyance facilities described previously.

Maintenance activities include:

- facility structure repair or replacement,
- canal and levee maintenance,
- placement of riprap for bank protection and erosion control around diversion and conveyance facilities,
- vegetation management and weed control, and
- operation and maintenance of electrical power supply facilities.

Monitoring activities for the operation of the SWP are also covered activities. These include activities to monitor water quality and water levels. For fish and other biological monitoring activities, see Chapter 3, Section 3.6, *Adaptive Management and Monitoring Program*. DWR's Division of Operations and Maintenance monitors chemical, physical and biological parameters to evaluate conditions of concern for drinking water, recreation, and fish and wildlife. Fish monitoring may also be conducted by DWR for the Temporary Barriers Project.

All SWP maintenance and monitoring described in this section that could affect species or modify critical habitat protected under the ESA or CESA are covered activities from the time the proposed north Delta intakes become operational (Chapter 3, *Conservation Strategy*).

For the operable HORB, periodic maintenance of the gates, motors, compressors, and control systems will occur, as well as maintenance dredging around the gates to clear out sediment deposits. Dredging around the gates will be conducted using a sealed clamshell dredge every 3 to 5 years, depending on the rate of sedimentation. Because of constraints related to fish and other species of concern, the timing and duration of maintenance dredging will be limited. Spoils will be dried in the areas adjacent to the gate site. A formal dredging plan with further details on specific maintenance dredging activities will be developed prior to dredging activities.

Levee systems must be maintained to provide reasonable assurance of protection from the base flood (1% annual chance of exceedance or 100-year flood), and in accordance with an officially adopted maintenance plan. Maintenance activities include periodic addition of waterside armoring material, which may necessitate access and work either from the levee crest (e.g., using an excavator to place riprap) or from the water (e.g., using a barge and crane to place riprap). Levee maintenance may also include operations designed to prevent and repair damage from animal burrowing within the levee. Vegetation control measures will be performed as part of levee maintenance.

Levees construction and modification associated with the BDCP include the following actions.

- Approximately 50 miles of temporary levees required during construction activities for CM4. Because these are temporary levees, no maintenance is likely to be required.
- Approximately 44 miles of permanent levees constructed for CM4. These levees will be included in the conservation reserve system and subject to maintenance prescribed in Section 4.2.3.9.6 *Levee Maintenance*.
- Approximately 62 miles of permanent levee setback constructed for CM5 and CM6. These levees will be included in the conservation reserve system and subject to maintenance prescribed in Section 4.2.3.9.6, *Levee Maintenance*.
- Approximately 1 mile of permanent levee/berm constructed for CM1, not included in the conservation reserve system.
- Approximately 2.5 miles of permanent levee constructed for CM1, not included in the conservation reserve system.
- Approximately 6 miles of temporary or permanent levee modifications to construct barge unloading facilities, improve levee roads required for access to construction sites, and construct power lines over existing levees (not included in the conservation reserve system).

Levee maintenance activities will vary between project levees (levees that will be part of a federal flood control project) and non-project levees (levees that will not be part of a federal flood control project).

For project levees constructed or modified by the BDCP, the Implementation Office will pay for operation and maintenance throughout the 50-year permit term, either directly or indirectly through agreements with local agencies. All applicable operations and maintenance standards and manuals will apply, including, but not limited to, FEMA requirements for maintenance pursuant to agency authority under the National Flood Insurance Plan, and USACE requirements pursuant to Public Law 84-99.

For non-project levees constructed or modified by the BDCP, construction or modification will meet USACE Delta-specific Public Law 84-99 design standards, the Implementation Office will pay for operation and maintenance throughout the 50-year permit term, either directly or indirectly through agreements with local agencies. All applicable operations and maintenance standards and manuals will apply, including, but not limited to, FEMA requirements for maintenance pursuant to agency authority under the National Flood Insurance Plan, and USACE requirements pursuant to Public Law 84-99.

All levee maintenance activities must be under the jurisdiction of a federal or state agency, an agency created by the federal or state law, or an agency of a community participating in the National Flood Insurance Program that assumes ultimate responsibility for maintenance. The plan must document the formal procedure that ensures that the stability, height, and overall integrity of the levee and its associated structures and system are maintained. At a minimum, maintenance plans shall specify the maintenance activities to be performed, the frequency of their performance, and the person, by name or by title, responsible for their performance.

#### **4.2.1.3 Suisun Marsh Facilities Operations and Maintenance**

The existing Suisun Marsh facilities consist of the following elements.

- Suisun Marsh Salinity Control Gates
- Morrow Island Distribution System
- Roaring River Distribution System
- Goodyear Slough Outfall
- Various salinity monitoring and compliance stations throughout Suisun Marsh

Since the early 1970s, the California State Legislature, State Water Board, Reclamation, CDFW, Suisun Resource Conservation District, DWR, and other agencies have engaged in efforts to preserve beneficial uses of Suisun Marsh to mitigate for potential impacts on salinity regimes associated with reduced freshwater flows to the marsh. Initially, salinity standards for Suisun Marsh were set by the State Water Board's Decision 1485 to protect alkali bulrush production, a primary waterfowl plant food. Subsequent standards set under the State Water Board's Decision 1641 reflect the intention of the State Water Board to protect multiple beneficial uses. A contractual agreement between DWR, Reclamation, CDFW, and the Suisun Resource Conservation District includes provision for measures to mitigate the effects of SWP and CVP operations and other upstream diversions on Suisun Marsh channel water salinity. The Suisun Marsh Preservation Agreement requires DWR and Reclamation to meet specified salinity standards, sets a timeline for implementing the Plan of Protection, and delineates monitoring and mitigation requirements.

The existing operation of the Suisun Marsh facilities is covered for ESA and CESA compliance under the Operations Criteria and Plan BiOps and the related consistency determination. The Suisun Marsh



1 facilities will be covered under the BDCP for existing operations criteria and for future criteria  
2 discussed below.

3 The BDCP includes conservation actions that will change land use and water operations in Suisun  
4 Marsh over time. These changes in land use and water operations are covered activities and are  
5 addressed by the BDCP. See Chapter 3, *Conservation Strategy*, for descriptions of tidal brackish  
6 marsh restoration (CM4) and water operations (CM1). The existing operation and maintenance of  
7 the Suisun Marsh Salinity Control Gates and other facilities will not change until covered activities  
8 require changes in their operation. Operations of the Suisun Marsh facilities under the existing  
9 operational criteria as well as changes to operation as described in CM1 will be covered by the  
10 BDCP. Generally, as habitat restoration in Suisun Marsh is conducted with the implementation of  
11 conservation measures, and changes in land uses occur, the operation of the Suisun Marsh Salinity  
12 Control Gates will trend towards limiting the operation of the gates and increasing the period during  
13 which the gates allow tidal inflows into Montezuma Slough to provide for the conservation of  
14 covered fish species in conjunction with all other water operations under the BDCP.

15 The BDCP covers operations of the Suisun Marsh Salinity Control Gates and other Suisun Marsh  
16 facilities under the existing and future operational criteria and future construction and maintenance  
17 of tidal habitat in Suisun Marsh identified in CM1 and CM4 in Chapter 3, *Conservation Strategy*.  
18 These activities and actions are included as covered activities and associated federal actions. Those  
19 actions associated with Reclamation will receive authorization through the ESA Section 7  
20 consultation process and those actions associated with DWR will be covered under the ESA Section  
21 10 permit and NCCPA Section 2835 permit issued to the Authorized Entities.

#### 22 **4.2.1.4 North Bay Aqueduct Alternative Intake Project**

23 The BDCP will cover operation of the North Bay Aqueduct Alternative Intake Project. The project  
24 includes an additional intake on the Sacramento River that will operate in conjunction with the  
25 existing North Bay Aqueduct intake at Barker Slough. The project will accommodate projected  
26 future peak demand of up to 240 cfs. DWR is the lead agency for the North Bay Aqueduct Alternative  
27 Intake Project, partnering with the Solano County Water Agency and the Napa County Flood Control  
28 and Water Conservation District. Both are state water contractors. The construction of any new  
29 facilities (any intakes, pipelines, and supporting facilities) associated with the North Bay Aqueduct  
30 Alternative Intake Project is not covered under the BDCP. Consequently, any such state and/or  
31 federal regulatory compliance requirements that will be applicable to the development of the  
32 project will be addressed through processes separate and apart from the BDCP.

33 Combined operations of a new intake on the Sacramento River and the existing intake at Barker  
34 Slough will be included under covered activities for future peak demand of up to 240 cfs. Operations  
35 of the North Bay Aqueduct Sacramento River intake will adhere, in combination with the new intake  
36 facilities on the Sacramento River, to the water operations criteria and adaptive range as described  
37 in Chapter 3, *Conservation Strategy*. The North Bay Aqueduct Alternative Intake Project may also  
38 consider an alternative that will involve the export of water from the Sacramento River through the  
39 new north Delta facilities.

#### 40 **4.2.2 CM2 Yolo Bypass Fisheries Enhancement**

41 The purpose of this activity is to modify the Fremont Weir and Yolo Bypass and operate the Fremont  
42 Weir to increase the availability of floodplain habitat for spawning and rearing for covered fish

species, enhance aquatic food production within and downstream of the Yolo Bypass, and improve fish passage within and nearby the Yolo Bypass (for details, see descriptions of CM2 in Chapter 3, *Conservation Strategy*). Specifically, the Fremont Weir and Yolo Bypass modifications and operations will accomplish the following benefits.

- Improve rearing and spawning habitat for several but not all covered fish species.
- Provide for a higher frequency and duration of inundation of the targeted portion of the Yolo Bypass.
- Improve fish passage into, through and out of the Yolo Bypass, Putah Creek, and past the Fremont and Sacramento weirs.

CM2 will be implemented in four phases. The discussion below identifies and summarizes the various conceptual component projects implemented as part of CM2, and identifies which projects are currently considered Category 1, 2, or 3 actions. The Category 2 and 3 actions would be more fully defined and evaluated in the Yolo Bypass Fisheries Enhancement Plan (YBFEP) and/or YBFEP EIR/EIS, as appropriate.

#### 4.2.2.1 Phases 1 and 2 (Year 1 to Year 10)

- **Fish Rescue.** Provide funding to accelerate fish rescue and improvements to fish stranding assessments (Phase 1, Category 1 Action).
- **Monitoring and Research.** Perform compliance and effectiveness monitoring, research actions, and adaptive management (Phase 1, Category 1 or 2 Action).
- **Fish-Rearing Pilot Project at Knaggs Ranch (not to exceed 10 acres).** Evaluate the use of water from Knights Landing Ridge Cut to solely provide or supplement flows, and evaluate the effectiveness of applying water pond by pond, rather than across a contiguously inundated, heterogeneous floodplain (Phase 1 or before, Category 1 Action).
- **Expanded Fish Rearing at Knaggs Ranch.** Expand pilot project fish rearing via supplemental or sole flows from Knights Landing Ridge Cut to broader area over multiple years (Phase 1 or 2, Category 2 Action).
- **Fish Ladder Operations Study at Fremont Weir.** Experiment with different approaches to operating the existing ladder (e.g., removing wooden baffles and monitoring fish passage) (Phase 1 or before, Category 1 or 2 Action).
- **Experimental Sturgeon Ramps at Fremont Weir.** Construct and study up to four experimental ramps at the Fremont Weir to test whether they can provide effective passage for adult sturgeon and lamprey from the Yolo Bypass over the Fremont Weir to the Sacramento River when the river overtops the weir by approximately 3 feet. The species-specific biological goals and objectives for both green and white sturgeon include the reduction of stranding at the Fremont Weir. Developing effective passage through experimental sturgeon ramps will contribute toward reducing stranding at Fremont Weir. Monitoring technologies will be used to collect information on fish passage to evaluate its efficacy at passing adult fishes (Phase 1, Category 3 Action).
- **Auxiliary Fish Ladders at Fremont Weir.** Construct up to three sets of auxiliary fishways. At least one set will serve the western length of Fremont Weir. Because Fremont Weir is nearly 2 miles long and is constructed in two distinct lengths, these auxiliary fish ladders will help fish

pass the weir regardless of the location from which they approach it. At least one of the fish ladders will replace, and possibly increase the width of, the existing Fremont Weir fish ladder. At least one multistage, multispecies fishways will be placed adjacent to the main gated seasonal floodplain inundation channel (in its ultimate location) to provide passage when velocities or partially opened gates will otherwise be impassable or provide poor fish passage. Fish ladder placement will result in positive drainage from the stilling basin, with very little, if any, additional work on the stilling basin (Phase 1 or 2, Category 3 Action).

- **Fish Screens for Small Yolo Bypass Diversions.** If YBFEP determines screening small Yolo Bypass diversions to be an appropriate means to hold existing irrigation practices harmless, construct fish screens on small Yolo Bypass diversions. Such work will be applied toward the 100 cfs per year remediation target identified in CM21 (Phase 2, Category 2 Action).
- **New or Replacement Impoundment Structures and Agricultural Crossings at the Tule Canal and Toe Drain.** Replace agricultural crossings of the Tule Canal and Toe Drain with fish-passable structures such as flat car bridges or earthen crossings with large, open culverts. Construct new or replacement operable check-structures to facilitate continued agriculture in the Yolo Bypass while promoting fish passage in season (Phase 1, Category 3 Action).
- **Lisbon Weir Improvements.** Replace the Lisbon Weir with a structure that improves fisheries management and improves the ability to impound water for irrigation, while reducing maintenance (Phase 1, Category 3 Action).
- **Lower Putah Creek Improvements.** Lower Putah Creek will be realigned to improve upstream and downstream passage of Chinook salmon and steelhead. The action will also include floodplain habitat restoration to provide benefits for multiple species on existing public lands. This action will be designed so that it will not create stranding or migration barriers for juvenile salmon (Phase 1, Category 3 Action)<sup>8</sup>. This action will be covered in the YBFEP, and may be covered in separate environmental analysis because it is a required action under the 2009 BiOp.
- **Water Supply Improvement for the Yolo Bypass Wildlife Area.** Improve Yolo Bypass Wildlife Area water supply at Lisbon Weir to support wildlife management in the Yolo Bypass Wildlife Area (by reducing reverse flows in the Toe Drain) and potentially benefit the aquatic foodweb and downstream fish. Other actions not yet fully defined or developed will be considered. These may include a subsidy of Yolo Bypass Wildlife Area pumping costs or procurement of additional water from western tributary sources. This project incorporates goals of the Westside Concept (Phase 1 or 2, Category 3 Action).
- **Use of Supplemental Flow through Knights Landing Ridge Cut.** Evaluate the desirability of using supplemental flows through Knights Landing Ridge Cut, introduced by means of redesign of Colusa Basin Drain Outfall Gates, increased operation of upstream unscreened pumps, or other means. If currently unscreened pumps were to be used for more than a pilot period, the pumps will need to be screened or replaced with fish-friendly pumps. This project incorporates goals of the Westside Concept (Phases 1 and 2, Category 3 Action).
- **Flood-Neutral Fish Barriers.** Construct and test flood-neutral fish barriers to prevent fish from straying into Knights Landing Ridge Cut and the Colusa Basin Drain. These barriers will be most

<sup>8</sup> Improvements to Upper Putah Creek, outside the Plan Area, will be included as part of the YBFEP. Improvements to Upper Putah Creek will support fish passage, water quality, and spawning habitat improvements in Putah Creek upstream of the Yolo Bypass Wildlife Area and downstream of Solano Diversion Dam (Phase 1).

effective when employed in association with attraction flows to a location, such as at Fremont Weir, that is fish-passable and leads to the mainstem Sacramento River. This project incorporates goals of the Westside Concept (Phase 2, Category 3 Action).

- **Gated Seasonal Floodplain Inundation Channel Past Fremont Weir.** Modify a section of the Fremont Weir to enable introducing managed flows to the Yolo Bypass at times when Fremont Weir is not overtopping. The seasonal floodplain inundation flows will attract fish migrating upstream. Therefore, the gates and the fishways will be designed to provide seasonal floodplain inundation flows, and the efficient upstream and downstream passage of sturgeon and salmonids between the Yolo Bypass and the Sacramento River. If additional work to ensure positive drainage of the entire length of Fremont Weir is required, it would be completed as part of this project (Phase 2, Category 3 Action).
- **Nonphysical or Physical Barriers to Attract Juvenile Salmon into the Yolo Bypass.** If deemed necessary to enhance the attraction of juveniles into Yolo Bypass through the gated seasonal floodplain inundation channel (described above), construct and operate nonphysical or physical barriers in the Sacramento River. Examples of such barriers include bubble curtains or log booms (Phase 2 or 3, Category 3 Action).
- **Support Facilities.** Construct associated support facilities (e.g., operations buildings, parking lots, access facilities such as roads and bridges) throughout the Yolo Bypass necessary to provide safe access for maintenance, monitoring, and fish rescue (Phase 2, Category 3 Action).
- **Levee Improvements.** Improve levees adjacent to the Fremont Weir Wildlife Area, as necessary, to maintain existing level of flood protection, or to beneficially reuse excavated earth (Phase 2, Category 3 Action).
- **Yolo Bypass Modifications to Direct or Restrain Flow.** If necessary, improve the distribution (e.g., wetted area) and hydrodynamic characteristics (e.g., residence times, flow ramping, and recession) of water moving through the Yolo Bypass. Typical activities include grading, removing existing berms, levees, and water control structures (including inflatable dams), constructing berms or levees, reworking agricultural delivery channels, and grading or constructing structures to reduce Tule Canal and Toe Drain channel capacities. The overall purpose is to allow water to inundate certain areas of the bypass to maximize biological benefits and reduce stranding of covered fish species in isolated ponds, minimize effects on terrestrial covered species (including giant garter snake), and accommodating other existing land uses (e.g., wildlife, public, recreation and agricultural use areas). Necessary lands will be acquired in fee-title or through conservation or flood easement (Phase 2, Category 3 Action).

#### 4.2.2.2 Phase 3 (Year 11 to Year 25)

Final permissions/permits from the permitting agencies for construction of the component projects not obtained in Phase 1 or 2 will occur in Phase 3, at the latest. Those component projects that are not permitted and constructed during Phases 1 and 2 will do so in Phase 3. Full buildout is estimated to be completed in years 10, 11 or 12, at which time operations of these component projects would begin.

The following project will be designed, permitted and if feasible, constructed in Phase 3.

- **Sacramento Weir Improvements.** At a minimum, modifications will be made to reduce leakage at the Sacramento Weir and thereby reduce attraction of fish from the Yolo Bypass to the weir where they cannot access the Sacramento River and could become stranded. The YBFEP will

review the benefits and necessity of constructing fish passage facilities at the Sacramento Weir to improve upstream adult fish passage and positive drainage to reduce juvenile fish stranding. This action may require excavation of a channel to convey water from the Sacramento River to the Sacramento Weir and from the Sacramento Weir to the Toe Drain; construction of new gates at all or a portion of the weir; and modifications to the stilling basin (Phase 3, Category 3 Action).

#### **4.2.2.3 Phase 4 (Year 26 to Year 50)**

Phase 4 will encompass project operation, monitoring, and continued adaptive management. A matrix of criteria will be developed and tested prior to Phase 4, and operations will be adjusted accordingly. For example, if results of monitoring and studies indicate that shorter or earlier gate operations within the adaptive management range yield equivalent or better fish benefits, operation of the gated channel at Fremont Weir will be modified accordingly and additional environmental analysis completed, as appropriate. If scientific results indicate that the wetter, later end of the adaptive management range is more effective biologically, operations will shift accordingly.

#### **4.2.2.4 Fremont Weir and Yolo Bypass Maintenance**

Routine maintenance of the Fremont Weir and Yolo Bypass are covered activities. Vegetation maintenance activities may include mowing, discing, livestock grazing, dozing, spraying, and/or hand-cutting of young willow groves, cottonwoods, arundo, brush, debris, and young selected oak trees. Trees with a trunk diameter of 4 inches or greater may be pruned up 6 feet from the ground. Clearing will be done in stripes to open areas for water flow and to avoid islands and established growth.

On a nonroutine but periodic basis, sediment will be removed from the Fremont Weir area using graders, bulldozers, excavators, dump trucks, or other machinery. Outside of the new channel, sediment removal of approximately 1 million cubic yards within 1 mile of the weir can be reasonably expected to occur on an average of approximately every 5 years based on recent maintenance history. Primarily inside the new channel, an additional 1 million cubic yards every other year of sediment removal is anticipated as a conservative estimate of sediment management. Where feasible, work will be conducted under dry conditions; if necessary some dredging may be required to maintain connection along the deepest part of the channel for fish passage. Where agreements can be made with landowners, sediment may be disposed of on properties in the immediate vicinity of the Fremont Weir area. It may also be used as source material for levee or restoration projects, or otherwise beneficially reused.

Maintenance activities will extend from the Sacramento River to the Fremont Weir, the Fremont Weir to the southern end of the Yolo Bypass, and between the associated levees.

In summary, all activities related to the construction, maintenance, replacement, and operations of the facilities described in this section, as well as access road improvements, are covered by the BDCP. The construction of facilities necessary to provide electrical power to these facilities will also be covered by the BDCP. The operations of the new Fremont Weir gates under the near- and long-term criteria and adaptive range as described in Chapter 3, *Conservation Strategy*, are also covered by the BDCP. Potential environmental effects of these activities will be minimized through implementation of CM22 and the environmental commitments described in Appendix 3.C, *Avoidance*

1 *and Minimization Measures*, as well as requirements of the permits necessary to construct these  
2 facilities.

### 3 **4.2.3 CM3 to CM11: Habitat Restoration, Enhancement, and** 4 **Management Activities**

5 CM3 to CM11 present the Plan's natural community and habitat protection, restoration,  
6 enhancement, and management activities. These conservation measures include actions that may be  
7 undertaken to implement the physical habitat conservation measures described in Chapter 3,  
8 *Conservation Strategy*. CM3 consists of land acquisition to assemble the reserve system, and thus  
9 does not have the potential to result in incidental take. CM4 to CM11, however, all entail  
10 performance of physical activities intended to alter the extent or suitability of habitat for covered  
11 species, and thus entail some potential to take covered species, or to modify their habitat. Types of  
12 actions necessary to implement the habitat restoration and enhancement conservation measures  
13 are anticipated to include, but are not limited to the following actions.

- 14 • Grading, excavating, and placement of fill material.
- 15 • Breaching, modifying, or removing existing levees and construction of new levees.
- 16 • Modifying, demolishing, and removing existing infrastructure (e.g., buildings, roads, fences,  
17 electric transmission and gas lines, irrigation infrastructure).
- 18 • Removing existing vegetation and planting or seeding of vegetation.
- 19 • Controlling the establishment of nonnative vegetation to encourage the establishment of target  
20 native plant species.
- 21 • Reducing nonnative predator and competitor species (e.g., feral cats, rats, and nonnative foxes).

22 The extent of the proposed habitat and natural communities conservation actions is summarized in  
23 Table 4-4.

**Table 4-4. Extent of Natural Communities and Habitat Types Conserved over the Term of the BDCP**

Conserved Natural Community/ Habitat Type	Extent of Natural Community and Habitat Type Conserved <sup>a</sup>	
	Protected <sup>b</sup>	Restored <sup>b</sup>
Seasonally inundated floodplain	0	10,000 <sup>c</sup>
Tidal wetlands of all types <sup>d</sup>	0	65,000
Channel margin	0	20 linear miles
Riparian	750	5,000 <sup>e</sup>
Grassland	8,000 <sup>f</sup>	2,000 <sup>g</sup>
Nontidal marsh	50 <sup>e</sup>	1,200
Alkali seasonal wetland complex	150	Up to 72 (no net loss)
Vernal pool complex	600	Up to 67 (no net loss)
Managed wetland	6,600 <sup>e</sup>	500
Cultivated lands	48,125 (other than rice) 500 (rice)	0
	3,000 (rice or equivalent) <sup>h</sup>	A portion of the 3,000 may be restoration
<b>Total</b>	<b>67,775</b>	<b>83,839</b>

<sup>a</sup> All values are in acres unless otherwise noted.  
<sup>b</sup> Though not included in the *Restored* column, all protected natural communities/habitat types will also be managed to maintain or increase their habitat functions for covered species. Similarly, all restored natural community types will occur on protected lands, some of which will need to be acquired in fee title or easement from willing landowners.  
<sup>c</sup> Enhancement of the existing Yolo Bypass floodplain will be provided with operation of a modified Fremont Weir to increase the duration and frequency of seasonally inundated floodplain habitat. The conditions under which this increased inflow will be provided are described in CM2.  
<sup>d</sup> Includes restored tidal wetlands and transitional uplands to accommodate 3 feet of sea level rise during and beyond the permit term.  
<sup>e</sup> Riparian habitat restoration will occur primarily in association with the restoration lands for seasonally inundated floodplain, channel margin, and freshwater nontidal areas.  
<sup>f</sup> Managed wetland will be acquired to support salt marsh harvest mouse habitat (1,500 acres) and to enhance habitat for wintering waterfowl and shorebirds (5,000 acres).  
<sup>g</sup> Some of the restored grassland may be restored within the transitional component of restored tidal habitat and thus the total land base required for grassland restoration may be less than shown.  
<sup>h</sup> 3,000 acres of "rice or equivalent" will be protected or restored to contribute to giant garter snake conservation. Rice equivalent is muted tidal that meets the reserve design criteria described in CM4, nontidal marsh as described in CM10, grassland protection as described in CM3, or grassland restoration as described in CM8.

#### 4.2.3.1 CM3 Natural Communities Protection and Restoration

As noted above, CM3 assembles the reserve system by acquiring land, and will not result in incidental take.

### 4.2.3.2 CM4 Tidal Natural Communities Restoration

CM4 calls for restoration of 65,000 acres of tidal natural communities in the Plan Area, including tidal perennial aquatic, tidal mudflat, tidal brackish emergent wetland, and tidal freshwater emergent wetland natural communities, and adjacent uplands to accommodate 3 feet of sea level rise where possible. The restoration will be done by breaching or eliminating levees to increase the amount of tidal environments across the Delta. Grading and fill will likely also be necessary at some sites. Restoration sites will be designed to support a variety of habitats and an ecological gradient of shallow subtidal aquatic, tidal mudflat, tidal marsh, transitional upland, and riparian habitats, and uplands (e.g., grasslands, agricultural lands) for sea level rise accommodation, as appropriate to specific restoration sites. A 200-foot-wide swath of grasslands will be restored and maintained within the transitional uplands adjacent to restored emergent wetlands.

Tidal habitat restoration is expected to provide habitat for most of the covered fish species, although the use of specific restored areas will vary by species and life stage. CM4 will occur in the restoration opportunity areas (ROAs) of Suisun Marsh, Cache Slough, West Delta, South Delta, and the Cosumnes-Mokelumne Rivers.

The 65,000 acres of restored tidal natural communities and protected transitional uplands includes 6,000 acres of tidal brackish emergent wetland and 24,000 acres of tidal freshwater emergent wetland. The remainder of the 65,000 acres will consist of a combination of any of the restored tidal natural communities and protected transitional uplands. The intent of this conservation measure is to gain tidal wetlands and accommodate sea level rise, and while a portion of the 65,000 acres will consist of subtidal aquatic areas (tidal perennial aquatic natural community), these areas are expected to be a byproduct of the tidal restoration and not the primary restoration goal. Therefore, restoration will be designed to maximize tidal emergent wetlands and minimize deep subtidal areas.

Below is a list of construction activities for tidal habitat restoration. In-water work will occur from June to October of each year.

- Excavating channels to encourage the development of sinuous, high-density, dendritic channel networks within restored marsh plain.
- Modifying ditches, cuts, and levees to encourage more natural tidal circulation and better flood conveyance based on local hydrology.
- Removing or relocating infrastructure, including levee breaching to restore tidal connectivity.
- Removing existing levees or embankments or creating new structures to allow restoration to take place while protecting adjacent land.
- Prior to breaching, recontouring the surface to maximize the extent of surface elevation suitable for establishment of tidal marsh vegetation (marsh plain) by scalping higher elevation land to provide fill for placement on subsided lands to raise surface elevations.
- Prior to breaching, importing dredged or fill material and placing it in shallowly subsided areas to raise ground surface elevations to a level suitable for establishment of tidal marsh vegetation (marsh plain).
- Possibly constructing dikes to maintain existing land uses when tidal habitat is restored adjacent to farmed lands or lands managed as freshwater seasonal wetlands.



- Prior to breaching, cultivate stands of tules through flood irrigation for sufficiently long periods to raise subsided ground surface to elevations suitable to support marsh plain; breach levees when target elevations are achieved.

Additional methods specific to freshwater and brackish tidal natural communities are discussed below.

#### **4.2.3.2.1 Freshwater Tidal Natural Communities Restoration**

Freshwater tidal natural communities will be restored by breaching or removing levees along Delta waterways. Restoration on deeply subsided Delta tracts and islands may require construction of cross levees or berms to isolate deeply subsided lands from inundation, avoiding the creation of large areas of subtidal aquatic natural communities that could favor nonnative predator or competitor species and disfavor covered fish species. Where required, levees or berms will be constructed to prevent inundation of adjacent lands.

Where practicable and appropriate, portions of restoration sites will be raised to elevations that will support tidal marsh vegetation following breaching. Depending on the degree of subsidence and location, lands may be elevated by grading higher elevations to fill subsided areas, importing clean dredged or fill material from other locations, or planting tules or other appropriate vegetation to raise elevations in shallowly subsided areas over time through organic material accumulation. Surface grading will provide for a shallow elevation gradient from the marsh plain to the upland transition habitat. Based on assessments of local hydrodynamic conditions, sediment transport, and topography, restoration activities may be designed and implemented in a manner that accelerates the development of tidal channels within restored marsh plains.

#### **4.2.3.2.2 Brackish Tidal Natural Community Restoration**

The brackish tidal natural communities will be restored by breaching or removing dikes along Montezuma Slough and other Suisun Marsh sloughs and channels and Suisun Bay. Disconnected remnant sloughs will be reconnected to Suisun Bay and remnant slough levees will be removed to reintroduce tidal connectivity to slough watersheds. Tidal natural communities restored adjacent to cultivated lands or lands managed as freshwater seasonal wetlands may require construction of dikes to maintain those land uses. Where appropriate, portions of restoration sites will be raised to elevations that will support tidal marsh vegetation.

Depending on the degree of subsidence, location, and likelihood for natural accretion through sedimentation, lands may be elevated by grading higher elevations to fill subsided areas, importing dredged or fill material from other locations, or planting appropriate native vegetation to raise elevations in shallowly subsided areas over time through organic material accumulation prior to breaching dikes. Surface grading will be designed to result in a shallow elevation gradient from the marsh plain to the upland transition habitat. Remnant disconnected tidal channels will be restored, if present in restoration sites, to accelerate development of marsh functions. Existing tidal channels may also be deepened or widened, if necessary to increase tidal flow. Based on assessments of local hydrodynamic conditions, sediment transport, and topography, restoration sites may be graded to accelerate the development of tidal channels within restored marsh plains. Following reintroduction of tidal exchange, tidal marsh vegetation is expected to naturally establish at suitable elevations relative to the tidal range. Depending on site-specific conditions and monitoring results, patches of native emergent vegetation may be planted to accelerate the establishment of native marsh vegetation on restored marsh plain surfaces.

Because land surface elevations in Suisun Marsh are relatively homogenous, opportunities to provide linkages to upland habitats are limited to restoration sites that are located along the fringe of Suisun Marsh. Dikes constructed to restore tidal natural communities in the interior of Suisun Marsh will be designed with low gradient slopes supporting high marsh and upland vegetation to provide flood refuge habitat. Where appropriate, higher-elevation islands of upland within restored tidal natural communities may also be created to provide flood refuge for marsh wildlife.

- **Marsh plain vegetation.** Restoration in Suisun Marsh ROA will be designed to provide 6,000 acres of tidal brackish emergent wetland natural community, with 1,500 acres consisting of middle and high marsh. Other ROAs will be vegetated primarily with tules and other native freshwater emergent vegetation to reflect the historical composition and densities of Delta tidal marshes.
- **Hydrodynamic conditions.** Tidal natural communities restoration will be designed, within restoration site constraints, to produce sinuous, high-density, dendritic networks of tidal channels that promote effective tidal exchange throughout the marsh plain and provide foraging habitat for covered fish species.
- **Flow velocities.** Marsh channels and levee breaches will be designed to maintain flow velocities that minimize conditions favorable to the establishment of nonnative submerged aquatic vegetation (SAV) and floating aquatic vegetation (FAV) and habitat for nonnative predatory fish.
- **Environmental gradients.** As determined by site-specific constraints, tidal natural communities restoration projects will be designed to provide an ecological gradient among subtidal, tidal mudflat, tidal marsh plain, and riparian areas, and transitional uplands (within the sea level rise accommodation area) and uplands to accommodate the movement of fish and wildlife species and provide flood refuge habitat for marsh-associated wildlife species during high-water events. In addition, by protecting higher-elevation lands adjacent to restored marsh plains, transitional uplands will be available for future marsh establishment that may occur as a result of sea level rise.
- **Subtidal aquatic habitat.** Tidal restoration projects will be designed to maximize establishment of emergent wetland natural communities, and subtidal areas are expected to be established only as a byproduct of tidal restoration rather than the primary goal. Deep subtidal aquatic areas will be minimized when designing restoration projects.

### 4.2.3.3 CM5 Seasonally Inundated Floodplain Restoration

Under CM5, the Implementation Office will modify flood conveyance levees and infrastructure to restore 10,000 acres of seasonally inundated floodplain along river channels throughout the Plan Area. The floodplain restoration is separate from fisheries enhancement in the Yolo Bypass (CM2). CM2 augments existing floodflows in the Yolo Bypass, whereas CM5 restores floodplains that historically existed elsewhere in the Plan Area, but have been lost as a result of flood management and channelization activities. Although seasonally inundated floodplains may be restored along channels in the north, east, and south Delta, the most promising opportunities for large-scale floodplain restoration are in the south Delta.

Seasonally inundated floodplain restoration involves actions such as substantial levee setbacks (on the order of hundreds or thousands of feet) to allow for lateral channel migration and natural fluvial disturbances. In-water work will occur from June to October of each year. Actions to restore seasonally inundated floodplain habitats may include but are not limited to the following.

- Set levees back along selected river corridors and remove or breach levees thereby rendered nonfunctional.
- Create and expand new floodway bypasses to expand floodplain habitat and redirect flood flows along distributary channel networks into the estuary.
- Remove existing riprap or other bank protection to allow for channel migration between the setback levees through the natural processes of erosion and sedimentation.
- Modify channel geometry in unconfined channel reaches or along channels where levees are set back in order to create backwater salmonid and splittail rearing and splittail spawning habitat.
- Selectively grade restored floodplain surfaces to provide for drainage of overbank flood waters such that the potential for fish stranding is minimized.
- Lower the elevation of restored floodplain surfaces or modify river channel morphology to increase inundation frequency and duration and to establish elevations suitable for the establishment of riparian vegetation by either active planting or allowing natural establishment.
- Continue to farm in the floodplain consistent with achieving biological objectives, engaging in farming practices and crop types that provide high benefits for covered fish species.
- In cases where farming is no longer feasible or compatible with floodplain habitat goals, discontinue farming within the setback levees and allow native riparian vegetation to naturally establish on the floodplain or actively plant native riparian vegetation.

CM5 activities include clearing and grubbing, demolition of existing structures, surface water quality protection, dust control, establishment of storage areas and stockpile areas, temporary utilities and fuel storage, and erosion control. Development of the seasonally inundated floodplains could include setting back levees, removal of existing levees, removal of riprap to allow for channel meander between the setback levees, grading to restore drainage patterns and increase inundation frequency and duration, and establishment of riparian habitat.

Seasonally inundated floodplain modifications must be designed, implemented, and maintained to allow the passage of flood flows at the required flood system design flow and to comply with other flood management standards and permitting processes. This will be coordinated with USACE, DWR, Central Valley Flood Protection Board, and other flood management agencies to assess the desirability and feasibility of channel modifications. To the extent consistent with floodplain land uses and flood management requirements, if applicable, woody riparian vegetation will be allowed to naturally establish, or plant stock will be derived from adjacent riparian vegetation.

During design, the need for grading will be determined to reduce risk of fish stranding as water recedes. Grading could also be required to convey water from the floodplain into tidal marsh restoration areas.

#### **4.2.3.4 CM6 Channel Margin Enhancement**

Under CM6, the Implementation Office will enhance 20 miles of channel margin along important salmonid migration routes in the Plan Area by improving channel geometry and restoring riparian, marsh, and mudflat habitats on the river side of levees. Channel margin enhancement will consist of constructing a shallow gradient from lower-elevation, submerged, shallow benches along existing river channels to higher elevation riparian habitat. The design will involve modifying or setting back levees to create low benches with variable surface elevations to create hydrodynamic complexity

and support emergent vegetation to provide an ecological gradient of habitat conditions, and higher elevation benches that support riparian and tidal marsh vegetation.

CM6 includes but is not limited to the following actions.

- Modify the waterward side of levees or set back levees landward to create low floodplain benches. Construct the floodplain benches with variable surface elevations and water depths (laterally and longitudinally) to create hydrodynamic complexity, support emergent vegetation, and provide an ecological gradient of environmental conditions.
- Install large woody debris (e.g., tree trunks, logs, and stumps) into constructed benches to provide physical complexity. Use finely branched material to minimize refuge for aquatic predators. Large woody debris will be installed to replace debris lost during enhancement; woody debris also is expected to increase or be replaced over time through recruitment from adjacent riparian vegetation.
- Plant native riparian and/or emergent wetland vegetation on constructed benches; open mudflat habitat may be appropriate too, depending on elevation and location.

These actions will be implemented along channels protected by levees in the Plan Area. Channel margin enhancements associated with federal project levees will not be implemented on the levee, but rather on benches to the waterward side of such levees, and flood conveyance will be maintained as designed.

Channel margin enhancement actions often will be implemented in conjunction with seasonally inundated floodplain and riparian natural community restoration conservation measures (CM5 and CM7, respectively). All in-water work will occur from June to October of each year.

The implementation schedule assumes that channel margin enhancements will be completed in increments of 5 miles of channel (achieved at multiple properties for a total of 5 miles of channel margin length) by years 5, 10, 20, and 30 and that channel margin enhancement will be a component of seasonally inundated floodplain and riparian natural community restoration (CM5 and CM7, respectively). Implementation will be informed through compliance and effectiveness monitoring, and adaptive management, as described in Chapter 3, Section 3.4.6, *Conservation Measure 6 Channel Margin Enhancement*) Because actions under CM6 have the potential to provide habitat for nonnative predatory fish, monitoring will evaluate the use of enhanced channel margin sites and associated woody debris by predators.

#### **4.2.3.5 CM7 Riparian Natural Community Restoration**

The Implementation Office will restore 5,000 acres of valley/foothill riparian natural community by implementing site-specific restoration projects. The general location and attributes of riparian restoration will be directed by the biological goals and objectives. Specific site selection and design will be guided by this conservation measure (see below). Prior to construction of each restoration project, preparatory actions may include interagency coordination, feasibility evaluations, site acquisition, development of restoration plans (Chapter 3, Section 3.4.3.4.2, *Site-Specific Restoration Plans*), and additional environmental compliance. Construction of each restoration project will then occur consistent with the site-specific restoration plan, and will be monitored and adaptively managed to ensure that the success criteria outlined in the restoration plan are met. This planning and preparation process is described further in CM3.

The valley/foothill riparian natural community will be restored primarily in association with the tidal and floodplain restoration and channel margin enhancements. Consistent with the riparian biological goals and objectives, discussed in Chapter 3, Section 3.4.7.5, *Consistency with the Biological Goals and Objectives*, the 5,000 acres of restored riparian natural community will be restored as follows.

#### **4.2.3.5.1 Siting and Design Considerations**

Riparian restoration will be sited and designed to meet the applicable biological goals and objectives (Table 3.4.7-4, *Biological Goals and Objectives Addressed by CM7 and Related Monitoring Activities*, in Chapter 3, Conservation Strategy). When siting riparian restoration projects, potential changes in salinity due to sea level rise and other factors will be considered, and the riparian natural community will be restored in areas that are likely to sustain this community.

#### **Connectivity**

The 5,000 acres of restored riparian natural community must meet numerous requirements for mid- and late-successional stage vegetation structure, and for species habitat, as summarized in Table 3.4.7-1, *Habitat Requirements for Riparian Restoration*, in Chapter 3, *Conservation Strategy*, and described below. The location of riparian restoration will be determined during implementation in order to meet these specific geographic and species requirements. Site selection will also be guided, in part, by the needs of three other conservation measures, which have overlapping goals with riparian restoration: CM4, CM5, and CM6. Some riparian restoration will be accomplished in locations that can meet these dual requirements. Approximately 3,000 acres of the riparian restoration will take place in restored floodplains.

Riparian restoration sites will also be guided by priorities developed by those other programs whose conservation goals overlap the BDCP.

- Central Valley Restoration Program (Bureau of Reclamation 2011)
- Central Valley Joint Venture (Riparian Habitat Joint Venture 2004; Central Valley Joint Venture 2006)
- Great Central Valley Ecoregional Assessment (The Nature Conservancy 1998, in process of revision)

Riparian restoration sites will be prioritized in areas where they will improve linkages to allow terrestrial covered and other native species to move between protected habitats within and adjacent to the Plan Area. Some of this connectivity will be accomplished through planting native riparian vegetation along channel margins as described in CM6. However, channel margin enhancement will consist mostly of narrow riparian bands that will likely be flanked by agriculture and highways, with limited value for wildlife movement. Therefore, projects that involve restoration of large riparian areas will focus on connecting existing wildlife habitat along riparian corridors to meet the riparian habitat connectivity objective.

#### **Vegetation Diversity and Structure**

##### ***Species Diversity and Structural Heterogeneity***

Restoration projects will incorporate a diversity of native riparian species into planting schemes. This will include the use of uncommon native shrubs characteristic of riparian communities,

1 including but not limited to buttonwillow (*Cephalanthus occidentalis*) and elderberry  
2 (*Sambucus* sp.).

3 Restoration projects will be designed to provide structural heterogeneity with adequate vertical and  
4 horizontal overlap among vegetation components. This will be accomplished by selecting native  
5 plant species for restoration that include herbaceous groundcover, small trees, and shrubs to  
6 provide understory and midstory vegetation, and large trees to provide high-canopy overstory  
7 vegetation. Riparian restoration projects will also be designed to provide native riparian vegetation  
8 that overlaps with adjacent channels, freshwater emergent wetlands, and grasslands.

#### 9 ***Early- to Mid-Successional Vegetation***

10 The Implementation Office will restore native riparian vegetation with the long-term objective of  
11 maintaining 1,000 acres (of the 5,000-acre total) of early- to mid-successional vegetation with a  
12 well-developed understory of dense shrubs. Because the riparian natural community is structurally  
13 dynamic, flooding and scouring events will remove vegetation, and the community will naturally  
14 regenerate through a process of succession. CM5 will provide the necessary conditions for this  
15 dynamic process to occur under the existing riverine flow regime. Because of this dynamic nature of  
16 the riparian natural community, the 1,000 acres of early- to mid-successional vegetation are not  
17 expected to be maintained in a single location; rather, the Implementation Office will ensure that  
18 1,000 acres of early- to mid-successional riparian vegetation with a well-developed understory of  
19 shrubs are present throughout the reserve system starting in year 15. This will be accomplished  
20 through a combination of riparian restoration, riparian protection (CM3), and, if necessary, riparian  
21 enhancement and management (CM11). Of early- to mid-successional riparian vegetation, 300 acres  
22 will be located in Conservation Zone 7 within or adjacent to occupied riparian brush rabbit habitat,  
23 as described under *Riparian Brush Rabbit*, below.

#### 24 ***Late-Successional Vegetation***

25 The Implementation Office will restore native riparian vegetation with the long-term objective of  
26 maintaining at least 500 acres of mature vegetation in Conservation Zones 4 or 7 (i.e., the entire  
27 requirement will be met in a single zone, not distributed among both zones). The mature riparian  
28 vegetation will include tall-growing trees, such as oaks, sycamores, and cottonwoods, with a  
29 sufficiently open canopy to provide light for understory growth and a high level of structural  
30 understory diversity. It will not be a senescent community with a 100% closed canopy, in which new  
31 growth is suppressed. For additional details on this late-successional riparian vegetation, see  
32 *Riparian Woodrat* and *Western Yellow-Billed Cuckoo* under *Species-Specific Actions* below.

33 Because of the dynamic nature of the riparian natural community (see *Early- to Mid-Successional*  
34 *Vegetation*, above), the 500 acres of late-successional vegetation are not expected to be maintained  
35 in a single location; rather, the Implementation Office will ensure that at least 500 acres of late-  
36 successional riparian vegetation are present throughout either Conservation Zone 4 or 7 at any  
37 given point in time. This will be accomplished through a combination of riparian restoration and  
38 riparian protection (CM3). In siting locations for management of mature riparian vegetation within  
39 floodplains, sea level rise and locations of likely fluvial disturbance will be considered (i.e., mature  
40 riparian will be sited in areas that are rarely flooded such as above the 50-year floodplain).

41 Additional siting and design requirements to address species-specific needs of the riparian brush  
42 rabbit, riparian woodrat, western yellow-billed cuckoo, and valley elderberry longhorn beetle are

described in CM7 (Chapter 3, Section 3.4.7, *Conservation Measure 7 Riparian Natural Community Restoration*).

#### **4.2.3.6 CM8 Grassland Natural Community Restoration**

Under CM8, the Implementation Office will restore 2,000 acres of grassland in Conservation Zones 1, 8, and/or 11 by implementing site-specific restoration projects. Actions under CM8 will be phased, with 140 acres restored by year 10 and 2,000 acres (cumulative) restored by year 40 of Plan implementation. Prior to construction of each restoration project, preparatory actions will include interagency coordination, feasibility evaluations, site acquisition, development of restoration plans, and potentially additional environmental compliance. Construction of each restoration project will then occur consistent with the site-specific restoration plan, and will be monitored and adaptively managed to ensure that the success criteria outlined in the restoration plan are met.

##### **4.2.3.6.1 Restoration Actions**

Grassland restoration will involve converting nongrassland areas (e.g., ruderal or cultivated lands) into grassland. Grasslands restored as a component of vernal pool complexes will also count toward the 2,000-acre restoration target for CM8. Grassland restoration will increase the extent, distribution, and density of native perennial grasses intermingled with other native species, taking into consideration current knowledge, limitations of grassland restoration techniques, and site suitability.

The restored grasslands will be planted with native species and managed to encourage native biodiversity but will not require a predominance of natives for the restored lands to contribute to the 2,000-acre target. As long as the restored grasslands have some native component (i.e., they can still be dominated by nonnative species), and they are not dominated by nonnative species that substantially reduce grassland function, the grassland restoration will count towards the restoration requirement.

Rather than completely eliminating nonnatives, grassland restoration focuses on increasing native biodiversity by planting natives, controlling or removing nonnative invasive species, and improving native wildlife habitat functions by increasing habitat extent and connectivity. The grassland restoration strategy may be adjusted with the development of new restoration techniques and other pertinent information as it becomes available.

The following techniques may be applied to grassland restoration projects, although the Implementation Office is not limited to these techniques. Other approaches and techniques may be applied to grassland restoration projects based on the best information available at the time the restoration project is being planned and designed, and approaches that have been proven successful for past restoration projects. CM11 provides techniques for grazing and invasive plant control to promote establishment of native grassland species in nonnative grasslands.

Sites that have been highly disturbed may require pretreatment before grassland restoration techniques are applied. For example, invasive weeds may need to be removed using a variety of techniques such as livestock grazing, herbicide treatment<sup>9</sup>, tilling, soil removal and treatment (to

<sup>9</sup> Herbicide or pesticide use is not covered by the federal Section 10(a)(1)(B) permits due to on-going litigation with the EPA over pesticide certification. Therefore, the use of herbicides or pesticide must avoid take of federally listed species. This activity is covered by the state NCCP permit.

remove the weed seed bank), or a combination of these or other treatments. Restoration may also require the recontouring of graded land as appropriate.

Native grasses grow better if the seeds are collected from a nearby site (Stromberg and Kephart 1996). Seed sown on grassland restoration sites will be collected from the nearest practicable natural site with similar ecological conditions. Seed nurseries may be established in some of the restored grasslands to produce seed for subsequent restoration projects.

Seeding will be done in fall or early winter after the first rains. Many California native grasses can be successfully started when seeded at about 3 to 4 pounds per acre (Stromberg and Kephart 1996). The seed may be broadcast using a tractor-mounted or handheld broadcast seeder, or a seed drill may be used. Plugs may be used rather than seeding in some areas, especially on steep hillsides. Survivorship for plugs is often 95% or better, as the critical time period for native grasses is the seedling stage (Stromberg and Kephart 1996).

Once seedlings are established, the restored grasslands will be managed consistent with long-term, site-specific management plans. Grassland management techniques are described in CM11.

#### **4.2.3.6.2 Siting and Design Considerations**

Restoration will be prioritized where it improves connectivity and increases the habitat functions of existing grassland plant and wildlife habitats, including linking or providing wildlife movement corridors to larger habitat areas immediately outside of the Plan Area or providing upland refugia for wildlife adjacent to emergent wetland and riparian natural communities. The most strategically important areas are listed below.

- Areas where restoration will connect small patches of grasslands in Conservation Zones 1 and 11 with larger expanses of grassland in the Jepson Prairie area.
- Areas where restoration will connect grasslands in Conservation Zone 8 to other high-value grassland habitat to the west and southwest of the Plan Area, and support the conservation lands assembled for the Eastern Contra Costa County HCP/NCCP and the San Joaquin County HCP.
- Uplands adjacent to restored tidal brackish emergent wetlands in Suisun Marsh (beyond the transitional uplands protected to accommodate sea level rise)<sup>10</sup>, to provide refugia for salt marsh harvest mouse and other wildlife.
- Areas adjacent to riparian brush rabbit and riparian woodrat habitat along the upper margins of restored floodplains that are expected to be flooded infrequently, and along the outside edges of levees adjacent to floodplain restoration.
- Areas adjacent to restored freshwater emergent wetland restored (CM10), to provide basking sites and upland refugia for giant garter snake.

Grassland restoration will focus on creating a mosaic of different grassland vegetation alliances, reflecting localized water availability, soil chemistry, soil texture, topography, and disturbance

<sup>10</sup> A 200-foot band of riparian or upland habitat suitable for providing cover for Suisun Marsh species will be maintained adjacent to restored tidal marsh within the transitional uplands, above and beyond the 2,000 acres of restored grassland. This 200-foot band will shift in location with sea level rise and continue to be maintained as suitable upland habitat. The grasslands to be restored as a component of CM8 will be located above the elevation necessary for sea level rise accommodation.



regimes, with consideration of historical site conditions. Grassland restoration sites will be selected that support soils suitable for grassland restoration and are adjacent to existing high-value grassland natural community (i.e., supporting covered species or high biodiversity) (Keeley 1993).

Grasslands restored along the upper margins of seasonally inundated floodplain in Conservation Zone 7 will be designed to provide foraging habitat values and upland refugia for riparian brush rabbit. Creeping wild rye (*Elymus triticoides*) will be incorporated as a dominant species in planting mixes adjacent to riparian areas that provide riparian brush rabbit habitat. Creeping wild rye is one of the only floodplain grasses native to the Central Valley that can be easily established through grassland restoration. This flood-tolerant grass allows for the formation of tunnel-like rabbit runways, and thus provides good cover for the riparian brush rabbit (Appendix 3.E, *Conservation Principles for the Riparian Brush Rabbit and Riparian Woodrat*).

Grasslands restored in Suisun Marsh will be at least 200 feet wide (Williams and Faber 2004) beyond the sea level rise accommodation. Restoration in this area will establish grassland plant species such as salt grass and creeping wild rye that provide adequate cover for salt marsh harvest mouse and other native wildlife that may be vulnerable to predation as they seek high ground during extreme high-tide events.

Grasslands restored adjacent to freshwater emergent wetland (CM10) will provide sufficient cover for giant garter snake. USFWS recommends using a seed mix that includes native grass seeds such as annual fescue (*Vulpia* spp.), California brome (*Bromus carinatus*), blue wildrye (*Elymus glaucus*), and needlegrass (*Nassella* spp.), and some native forb seeds. The ultimate seed mix will be based on the best information available at the time of implementation regarding giant garter snake upland habitat needs.

#### **4.2.3.7 CM9 Vernal Pool and Alkali Seasonal Wetland Complex Restoration**

Under CM9, the Implementation Office will restore vernal pool complex and alkali seasonal wetland complex in Conservation Zones 1, 8, or 11 to achieve no net loss of vernal pool and alkali seasonal wetland acreage from covered activities. The restored vernal pool complex will consist of vernal pools and swales within a larger matrix of grasslands. Similarly, the alkali seasonal wetland complex will consist of alkali seasonal wetlands within a larger matrix of grasslands. The Implementation Office will select specific restoration sites in Conservation Zones 1, 8, or 11 based on the suitability of available lands for restoration, biological value, and practicability considerations. Vernal pool and alkali seasonal wetland complex restoration under CM9 is intended to contribute toward achieving biological goals and objectives for the vernal pool and alkali seasonal wetland complex natural communities. The vernal pool complex natural community goals and objectives are detailed in Chapter 3, Section 3.3.6.8, *Vernal Pool Complex*. The alkali seasonal wetland complex goals and objectives are detailed in Section 3.3.6.7, *Alkali Seasonal Wetland Complex*. CM9 consistency with relevant goals and objectives is further described in Section 3.4.9.5, *Consistency with the Biological Goals and Objectives*. It is assumed that 67 acres of restored vernal pool complex and 72 acres of restored alkali seasonal wetland will be restored under this conservation measure.

### 4.2.3.7.1 Restoration Actions

#### Vernal Pool Complex

Vernal pool complex restoration will occur prior to or concurrent with impacts, as defined below. The amount of restoration will be determined during implementation based on the following criteria.

- If restoration is completed (i.e., restored natural community meets all success criteria) prior to impacts, then 1.0 wetted acre of vernal pools will be restored for each wetted acre directly affected (1:1 ratio).
- If restoration takes place concurrent with impacts (i.e., restoration construction is completed, but restored habitat has not met all success criteria, prior to impacts occurring), then 1.5 wetted acres of vernal pools will be restored for each wetted acre directly affected (1.5:1 ratio).

Restoration must offset loss of any wetland features exhibiting the hydrologic and vegetative characteristics of vernal pools (see Chapter 3, Section 3.4.9, *Conservation Measure 9 Vernal Pool and Alkali Seasonal Wetland Complex*, for a description of these characteristics) whether or not they are occupied by covered species. Vernal pool complex restoration must also offset loss of wetland features that do not exhibit typical vernal pool hydrology and vegetation, but only if they are occupied by covered vernal pool crustaceans.

The restored vernal pools and surrounding grasslands will be protected and managed *in perpetuity*. The surrounding grasslands will consist of existing or restored grasslands.<sup>11</sup> The protected lands will include sufficient watershed surrounding the restored vernal pools to sustain the hydrology characteristic of this natural community, at a density representative of intact vernal pool complexes in the vicinity of the restoration site. In lieu of restoration, an equivalent amount of vernal pool restoration credit may be purchased at a USFWS- and CDFW-approved mitigation bank if the bank occurs in the Plan Area and meets the site selection criteria described below.

#### Techniques

The following restoration techniques will be implemented for vernal pool restoration.

- Remnant natural vernal and swale topography will be restored by excavating or recontouring historical vernal pools and swales to natural bathymetry based on their characteristic visual signatures on historical aerial photographs, other historical data, and the arrangement and bathymetry of vernal pools and swales at a reference site.
- The reference site will consist of existing nearby, natural (i.e., unmodified by human activities) vernal pool complex supporting covered vernal pool species.
- To provide for high-functioning habitat, restored vernal pool complex will be vegetated with hand-collected seed from appropriate areas in the same conservation zone. Soil inocula will not be used to establish vernal pool plants and animals in these conservation zones unless the source vernal pools are free of undesirable nonnative plant species such as perennial pepperweed, waxy manna grass, swamp timothy, and Italian ryegrass. These nonnative species establish more rapidly than native species, and create dense populations that are likely to reduce the establishment success of the native plants and also create thatch problems in the

<sup>11</sup> The surrounding grasslands will be a component of restored vernal pool complex and will not count toward the target acreages for grassland protection or restoration.

vernal pools (see Baraona et al. 2007 for problems of nonnative species thatch buildup due to soil inocula).

Vernal pool invertebrates are expected to be passively introduced into the restored vernal pools through the movement of other animals from pool to pool. If monitoring shows that passive introduction is insufficient for meeting restoration success criteria, active propagule (cyst) introduction may be implemented. Any introduction of propagules of covered vernal pool invertebrate species will be sourced from vernal pool soils that are free of undesirable nonnative species such as perennial pepperweed, swamp timothy, and Italian ryegrass.

### **Alkali Seasonal Wetland Complex**

Alkali seasonal wetland complex restoration will occur prior to or concurrent with impacts, as defined below. The amount of restoration will be determined during implementation based on the following criteria.

- If restoration is completed (i.e., restored natural community meets all success criteria) prior to impacts, then 1.0 wetted acre of alkali seasonal wetlands will be restored for each wetted acre directly affected (1:1 ratio).
- If restoration takes place concurrent with impacts (i.e., restoration construction is completed, but restored habitat has not met all success criteria, prior to impacts occurring), then 1.5 wetted acres of alkali seasonal wetlands will be restored for each wetted acre directly affected (1.5:1 ratio).

Restoration must offset loss of any wetland features exhibiting the hydrologic and vegetative characteristics of alkali seasonal wetlands (see Chapter 3, Section 3.4.9, *Conservation Measure 9 Vernal Pool and Alkali Seasonal Wetland Complex*, for a description of these characteristics) whether or not they are occupied by covered species. The restored alkali seasonal wetland complex will contain alkali seasonal wetlands at densities comparable to those where alkali seasonal wetlands are lost as a result of covered activities. The restored alkali seasonal wetlands and surrounding upland natural community will be protected and managed *in perpetuity*. The surrounding upland natural community will consist of existing or restored grasslands.<sup>12</sup> The protected lands will include sufficient watershed surrounding the restored alkali seasonal wetlands to sustain the hydrology characteristic of this natural community, at a density representative of intact alkali seasonal wetland complex in the vicinity of the restoration site. In lieu of restoration, an equivalent amount of alkali seasonal wetland restoration credit may be purchased at a USFWS- and CDFW-approved mitigation bank if the bank occurs in the Plan Area and meets the site selection criteria described below.

### **Techniques**

The following restoration techniques will be implemented for alkali seasonal wetland complex restoration.

- Remnant natural vernal and swale topography will be restored by excavating or recontouring historical alkali seasonal wetlands and swales to natural bathymetry based on their characteristic visual signatures on historical aerial photographs, other historical data, and the arrangement and bathymetry of alkali seasonal wetlands and swales at a reference site.

<sup>12</sup> The surrounding grasslands will be a component of restored vernal pool complex and will not count toward the target acreages for grassland protection or restoration.

- The reference site will consist of existing nearby, natural (i.e., unmodified by human activities) alkali seasonal wetland complex supporting covered species.

To provide for high-functioning habitat, restored alkali seasonal wetland complex will be vegetated with hand-collected seed from appropriate areas in the same conservation zone. Soil inocula will not be used to establish alkali seasonal wetland plants and animals in these conservation zones unless the source wetlands are free of undesirable nonnative plant species such as perennial pepperweed, waxy manna grass, swamp timothy, and Italian ryegrass. These nonnative species establish more rapidly than native species, and create dense populations that are likely to reduce the establishment success of the native plants and also create thatch problems in the alkali seasonal wetlands (see Baraona et al. 2007 for problems of nonnative species thatch buildup due to soil inocula).

#### **4.2.3.7.2 Siting and Design Considerations**

##### **Vernal Pool Complex**

Vernal pool restoration sites will meet the following site selection criteria.

- The site is in Conservation Zone 1, 8, or 11.
- The site has evidence of historical vernal pools based on soils, remnant topography, remnant vegetation, historical aerial photos, or other historical or site-specific data.
- The site supports suitable soils and landforms for vernal pool restoration.
- The adjacent land use is compatible with restoration and long-term management to maintain natural community functions (e.g., not adjacent to urban or rural residential areas).
- Sufficient land is available for protection to provide the necessary vernal pool complex restoration and surrounding grasslands to provide the local watershed for sustaining vernal pool hydrology, with a vernal pool density representative of intact vernal pool complex in the vicinity of the restoration site.

Acquisition of vernal pool restoration sites will be prioritized based on the following criteria.

- The site will contribute to establishment of a large, interconnected vernal pool and alkali seasonal wetland complex reserve system (e.g., adjacent to existing protected vernal pool complex or alkali seasonal wetland complex).
- The site is close to known populations of covered vernal pool species.

##### **Alkali Seasonal Wetland Complex**

Alkali seasonal wetland complex restoration sites will meet the following site selection criteria.

- The site is in Conservation Zone 1, 8, or 11.
- The site has evidence of historical alkali seasonal wetlands based on soils, remnant topography, remnant vegetation, historical aerial photos, or other historical or site-specific data.
- The site supports suitable soils and landforms for alkali seasonal wetland restoration.
- The adjacent land use is compatible with restoration and long-term management to maintain natural community functions (e.g., not adjacent to urban or rural residential areas).

- Sufficient land is available for protection to provide the necessary alkali seasonal wetland complex restoration and surrounding grasslands to provide the local watershed for sustaining alkali seasonal wetland hydrology, with an alkali seasonal wetland density representative of intact alkali seasonal wetland complex in the vicinity of the restoration site.

Acquisition of alkali seasonal wetland restoration sites will be prioritized based on the following criteria.

- The site will contribute to establishment of a large, interconnected vernal pool complex and alkali seasonal wetland complex reserve system (e.g., adjacent to existing protected vernal pool complex or alkali seasonal wetland complex).
- The site is close to known populations of covered alkali seasonal wetland species.

#### **Establishment of Covered Plant Occurrences**

The Implementation Office will establish at least two currently unprotected occurrences of Heckard's peppergrass in Conservation Zones 1, 8, or 11, consistent with Objective VPP1.2, if lands with unprotected occurrences are unavailable for acquisition. Plant occurrences will be established in restored vernal pool complex using seed from the same conservation zone as the restored vernal pool complex. The methods for establishing each occurrence, as well as monitoring methods, success criteria, and contingency measures, will be detailed in the site-specific restoration plan. Occurrences may also be established in protected vernal pool complex, as described in CM3.

### **4.2.3.8 CM10 Nontidal Marsh Restoration**

Under CM10, the Implementation Office will restore 1,200 acres of nontidal marsh in Conservation Zones 2, and 4 and/or 5 by year 40. Additional nontidal marsh may be restored to contribute toward the requirements for protection or restoration of "rice land or equivalent value habitat" for giant garter snake under Objectives GGS1.4 and GGS3.1. This conservation measure also provides for creation of 500 acres of managed wetlands consisting of greater sandhill crane roosting habitat in the Greater Sandhill Crane Winter Use Area (Appendix 2.A, *Covered Species Accounts*) in Conservation Zones 3, 4, 5, or 6.

#### **4.2.3.8.1 Restoration Actions**

##### **Nontidal Marsh**

The Implementation Office will restore 1,200 acres of nontidal marsh in three conservation zones. The restored nontidal marsh will consist of two blocks: 600 acres in Conservation Zone 2 outside the Yolo Bypass and 600 acres in Conservation Zone 4 or 5 (or both). In Conservation Zones 4 or 5, restoration will be contiguous with the 1,500 acres of rice land or equivalent giant garter snake habitat protected or restored. Additional nontidal marsh may be restored in Conservation Zones 1, 2, 4, and/or 5 to contribute toward the requirements for protection or restoration of "rice land or equivalent value habitat" for giant garter snake.

Restored nontidal marsh will be designed and managed primarily to support giant garter snake, but also to support other native wildlife functions, including waterfowl foraging, resting, and brood habitat, and shorebird foraging and roosting habitat, to the extent that management for these species does not reduce habitat value for the giant garter snake. Design measures will also be incorporated for western pond turtle, as described below. Although the restored nontidal marsh

1 may provide nesting habitat value for tricolored blackbird, it will not be designed specifically for this  
2 species (which prefers large, dense patches of emergent vegetation). Instead, restoration sites will  
3 provide a mosaic of open water and relatively open emergent vegetation for the primary benefit of  
4 giant garter snake. Upland habitat consisting of grasslands will be restored or protected adjacent to  
5 restored freshwater emergent wetland to provide upland habitat for giant garter snake and western  
6 pond turtle and nesting habitat for waterfowl; this will be credited toward the 8,000 acres of  
7 grassland to be protected or the 2,000 acres of grassland to be restored. To ensure the feasibility  
8 and function of these dual restoration/protection actions, it is recommended that they be pursued  
9 jointly by the Implementation Office; in some cases, protected grassland may already exist adjacent  
10 to restored nontidal marsh, so protection or restoration of grassland by the BDCP will be  
11 unnecessary.

12 In addition, actions to restore nontidal freshwater emergent wetland natural community, as  
13 appropriate to site-specific conditions, include, but are not limited to, the following.

- 14 • Secure sufficient annual water to sustain habitat function.
- 15 • Establish connectivity with the existing irrigation and drainage conveyance system  
16 (i.e., agricultural ditches and canals) and habitats occupied by giant garter snakes.
- 17 • Prepare site, plant native marsh vegetation, and maintain plantings.
- 18 • Control nonnative invasive plants that impair achievement of reserve system objectives.

19 Nontidal marsh restoration sites will be designed to support the range of habitat conditions  
20 necessary for giant garter snake. By designing the restoration specifically for giant garter snake and  
21 ensuring adequate open basking opportunities, the restored nontidal marsh is also expected to  
22 provide suitable habitat for western pond turtle. Existing cultivated lands will be converted to  
23 nontidal marsh in areas where hydrology and soils are suitable.

24 Restoration may include creating wetland topography by site grading or creation of depressions to  
25 hold water. Grading will establish an elevation gradient to support both open water, perennial  
26 aquatic habitat intermixed with shallower marsh habitat. Additional issues that will be addressed in  
27 each site-specific restoration plan include preventing fish from becoming stranded in the ponds  
28 (e.g., by the use of fish screens or other appropriate devices), if the hydrology source is a perennial  
29 water body that supports fish. Coarse woody debris or anchored basking platforms will be installed  
30 in open-water areas to improve habitat for western pond turtles. This will increase habitat value in  
31 locations with existing western pond turtles and in newly created ponds where it is hoped that new  
32 pond turtle populations will establish.

33 Grassland natural community will be protected (pursuant to CM3) or restored adjacent to restored  
34 nontidal freshwater emergent wetland natural community to provide upland habitat for giant garter  
35 snakes and other native wildlife. The restored nontidal marsh will consist of a combination of  
36 emergent, tule-dominated vegetation and open water, with variable bank slopes.

37 Nontidal freshwater emergent wetland natural community will be allowed to naturally reestablish  
38 along the edges of nontidal perennial aquatic natural community but will also be planted as needed  
39 to facilitate marsh development and to manage species composition. Approximately two-thirds of  
40 the restored nontidal marsh is expected to consist of nontidal perennial aquatic natural community,  
41 and approximately one-third is expected to consist of nontidal freshwater emergent wetland,  
42 although this proportion may shift as needed based on site conditions and as necessary to optimize  
43 habitat value for giant garter snake. The choice of plant species for the nontidal freshwater

emergent wetland natural community restoration sites will be based on a palette of native wetland plants including freshwater emergent and aquatic species. The palette will be specified in each site restoration plan. The plants will preferentially be grown from soil, seed, or plant stock from local wetland sites. In addition, vegetation is expected to change after the original planting such that other native species may colonize the wetland over time. Colonization by undesirable nonnative invasive plants is also likely, so restoration plans will address management of nonnative invasives.

## **Managed Wetlands**

Approximately 500 acres of managed wetlands will be created for greater sandhill crane. The restored wetlands will be protected in association with other protected natural community types (excluding nonhabitat cultivated lands) at a 2:1 upland-to-wetland ratio to provide buffers around the wetlands. The protected uplands will count toward protection requirements for other natural communities. Sites for restoration will be selected that are not expected to be affected by sea level rise. Sites will also be selected to avoid areas that experience local seasonal flood events that may be incompatible with the habitat management needs for greater sandhill crane.

Of the 500 acres of managed wetlands that will be created, 320 will consist of greater sandhill crane roosting habitat in minimum patch sizes of 40 acres within the Greater Sandhill Crane Winter Use Area (Appendix 2.A, *Covered Species Accounts*) in Conservation Zones 3, 4, 5, or 6. The remaining 180 of the 500 acres of managed wetlands will be created as two 90-acre wetland complexes in the Stone Lakes National Wildlife Refuge project boundary (Figure 3.3-6, *Stone Lakes National Wildlife Refuge and Greater Sandhill Crane Habitat* in Chapter 3, *Conservation Strategy*). The complexes will be no more than 2 miles apart and will help provide connectivity between the Stone Lakes and Cosumnes greater sandhill crane populations. Each complex will consist of at least three wetlands totaling 90 acres of greater sandhill crane roosting habitat. One of the 90-acre wetland complexes may be replaced by 180 acres of cultivated lands (e.g., cornfields) that are flooded following harvest to support roosting cranes and provide highest-value foraging habitat, provided such substitution is consistent with the long-term conservation goals of Stone Lakes National Wildlife Refuge for greater sandhill crane.

Greater sandhill crane roost sites will be created as managed seasonal wetlands using the following specifications. A site-specific management plan will be prepared for each roost site, which will include details on water management, plant composition, timing of flood-up and drawdown, vegetation management and control, access, and spring-summer management.

Roost sites will be developed as a series of shallow, open ponds separated by a system of checks and levees. Small upland islands can also be created within the ponds. Cranes often congregate to roost or loaf on the checks and other areas of higher ground and forage in the shallow water contained within the ponds.

The checks, levees, and other upland sites will be designed with sloping banks, which allow cranes to walk from the flooded pond to the adjacent uplands.

In addition to the presence of water, food availability, and loafing opportunities, selection of roosting sites by greater sandhill cranes is based in part on predator avoidance. Therefore, the development of the ponds and checks will consider the ability of predators to access roosting cranes along checks and levees.

Selected roost sites will have direct access to sufficient irrigation water to maintain required water depths.

1 The wetlands will be maintained as described in CM11.

## 2 **4.2.3.8.2 Siting and Design Considerations**

### 3 **Nontidal Marsh**

4 Nontidal marsh restoration sites will be designed to support the range of habitat conditions  
5 necessary for giant garter snake. By designing the restoration specifically for giant garter snake and  
6 ensuring adequate open basking opportunities, the restored nontidal marsh is also expected to  
7 provide suitable habitat for western pond turtle.

8 Existing cultivated lands will be converted to nontidal marsh in areas where hydrology and soils are  
9 suitable. Restoration may include creating wetland topography by site grading or creation of  
10 depressions to hold water. Grading will establish an elevation gradient to support open water,  
11 perennial aquatic habitat intermixed with shallower marsh habitat. Additional issues that will be  
12 addressed in each site-specific restoration plan include preventing fish from becoming stranded in  
13 the ponds (e.g., by the use of fish screens or other appropriate devices), if the hydrology source is a  
14 perennial water body that supports fish.

15 As described in CM3 and CM8, grassland natural community will be protected or restored adjacent  
16 to restored nontidal freshwater emergent wetland natural community to provide upland habitat for  
17 giant garter snakes and other native wildlife. The restored tidal marsh will consist of a combination  
18 of emergent, tule-dominated vegetation and open water, with variable bank slopes.

19 Coarse woody debris or anchored basking platforms will be installed in open-water areas. Nontidal  
20 freshwater emergent wetland natural community will be allowed to naturally reestablish along the  
21 edges of nontidal perennial aquatic natural community but will also be planted as needed to  
22 facilitate marsh development and to manage species composition. Approximately two-thirds of the  
23 restored nontidal marsh is expected to consist of nontidal perennial aquatic natural community, and  
24 approximately one-third is expected to consist of nontidal freshwater emergent wetland, although  
25 this proportion may shift as needed based on site conditions and as necessary to optimize habitat  
26 value for giant garter snake. The choice of plant species for the nontidal freshwater emergent  
27 wetland natural community restoration sites will be based on a palette of native wetland plants  
28 including freshwater emergent and aquatic species. The palette will be specified in each site  
29 restoration plan. The plants will preferentially be grown from soil, seed, or plant stock from local  
30 wetland sites. In addition, vegetation is expected to change after the original planting such that other  
31 native species may colonize the wetland over time. Colonization by undesirable nonnative invasive  
32 plants is also likely, so restoration plans will address management of nonnative invasives.

33 The nontidal marsh will be designed in conjunction with restored or protected grasslands to meet  
34 giant garter snake habitat requirements as follows.

- 35 • The restored nontidal marsh should be characterized by sufficient water during the giant garter  
36 snake's active summer season (March to October) to supply constant, reliable cover and sources  
37 of food such as small fish and amphibians.
- 38 • The restored nontidal marsh should consist of still or slow-flowing water over a substrate  
39 composed of soil, silt, or mud characteristic of those observed in marshes, sloughs, or irrigation  
40 canals.



- Designs will not create large areas of deep, perennial open water that would support nonnative predatory fish. The restored marsh should be characterized by a heterogeneous topography providing the range of depths and vegetation profiles consisting of emergent, herbaceous aquatic vegetation required to provide suitable foraging habitat and refuge from predators at all tide levels.
- Site topography will include areas of terrestrial refuge with ample exposure to sunlight to facilitate snake thermoregulation, and with low vegetation, bankside burrows, holes, and crevices providing critical shelter for snakes throughout the day. Terrestrial features will be sited fewer than 200 feet from aquatic foraging habitats.
- Aquatic margins or shorelines will transition to uplands consisting of grassy banks, with the dense grassy understory required for sheltering. These margins should consist of approximately 200 feet of high ground or upland habitat above the annual high water mark to provide cover and refugia from floodwaters during the dormant winter season.

#### **Managed Wetlands**

Greater sandhill crane roost sites will be created as managed seasonal wetlands using the following specifications. A site-specific management plan will be prepared for each roost site, which will include details on water management, plant composition, timing of flood-up and drawdown, vegetation management and control, access, and spring-summer management.

- Roost sites will be developed as a series of shallow, open ponds separated by a system of checks and levees. Small upland islands can also be created within the ponds. Cranes often congregate to roost or loaf on the checks and other areas of higher ground and forage in the shallow water contained within the ponds.
- The checks, levees, and other upland sites will be designed with sloping banks, which allow cranes to walk from the flooded pond to the adjacent uplands.
- In addition to the presence of water, food availability, and loafing opportunities, selection of roosting sites by greater sandhill cranes is based in part on predator avoidance. Therefore, the development of the ponds and checks will consider the ability of predators to access roosting cranes along checks and levees.
- Selected roost sites will have direct access to sufficient irrigation water to maintain required water depths.
- The wetlands will be maintained as described in CM11.

### **4.2.3.9 CM11 Natural Communities Enhancement and Management**

The Implementation Office will ensure the long-term management of reserve system lands. Natural community management actions include all activities undertaken to maintain the intended functions of protected, restored, and enhanced habitats over the term of the BDCP. Natural community management actions having the potential to result in incidental take of covered species or modification of their habitat are detailed below.

#### **4.2.3.9.1 Fire Management**

Fire management will be a component of each reserve unit management plan. Several natural communities in the Plan Area are adapted to fire (e.g., grasslands, vernal pool complex). Therefore,

some wildfires will be allowed to burn naturally to provide periodic disturbances that will benefit natural communities and covered species, within the larger land-use context. In other instances, fire suppression will be needed to avoid damage to structure and to minimize adverse effects on natural communities and covered species.

Fire management for the reserve system will be based, in part and as applicable, on an agreement with USFWS and CDFW on firefighting techniques. The fire management component will include a range of fire response, from full suppression when wildfires compromise public safety and personal property, to less than full suppression in predetermined areas where public safety and personal property are not compromised and fire-dependent natural communities are present.

The fire management component will describe minimum impact suppression tactics (also known as MIST<sup>13</sup>). Many plans using these techniques and plans with low-impact rehabilitation (restoration) techniques have been developed in recent years. The goal of minimum impact suppression tactics is to safely suppress wildfire using environmentally sensitive suppression methods. Examples of minimum impact suppression tactics guidelines and actions that will be implemented include the following.

- Use environmentally sensitive methods (i.e., procedures, tools, equipment) designed to minimize resource damage and reduce costs.
- Establish equipment wash stations to remove noxious weed seeds from tires and vehicle undersides prior to their first use in a reserve.
- If there is a risk that a hose coming directly from a local unit's cache is contaminated with noxious weed seeds, obtain fresh hose from the regional cache.
- Establish mobilization and demobilization areas outside the reserve to minimize spread of noxious weeds or diseases.
- Consider the use of helibucket with water or foam before calling for airtankers and retardant.

#### **4.2.3.9.2 Vegetation Management and Invasive Plant Control**

Vegetation will be enhanced and managed to reduce fuel loads for wildfires, reduce thatch, minimize nonnative competition with native plant species, increase biodiversity and provide suitable habitat conditions for covered species (see Enhancement and Management Guidelines and Techniques, below).

Invasive plant control efforts in the reserve system will focus on new infestations of terrestrial invasive plants that are relatively easy to eradicate or the most ecologically damaging nonnative plants for which effective suppression techniques are available. Avoidance and minimization measures described in Appendix 3.C, *Avoidance and Minimization Measures*, will be implemented in association with invasive plant control activities to ensure that take of covered species is minimized.

A combination of methods may be implemented to manage vegetation and control invasive plants in the reserve system, including manual control, mechanical control, prescribed burning, grazing, and chemical control.

- **Manual control.** This method involves hand-pulling or digging up weeds using hand tools such as weed wrenches, shovels, or loppers. This can be an effective technique when infestations and

<sup>13</sup> For example, see <[http://www.wildfirelessons.net/documents/GB\\_MIST\\_Guidelines.pdf](http://www.wildfirelessons.net/documents/GB_MIST_Guidelines.pdf)> or the National Wildfire Coordinating Group at <[www.nwcg.gov](http://www.nwcg.gov)>.

plant species are young and root systems are not fully developed, and in areas where disturbance needs to be minimized such as within rare plant populations.

- **Mechanical control.** This method involves the use of machinery such as bulldozers, backhoes, cable yarders and loaders, and may be used where invasive plant density is high and it will not result in adverse effects on sensitive resources such as rare plant populations or critical habitat for vernal pool species.
- **Prescribed burning.** This method consumes above-ground vegetation and kills seeds of some invasive plant species, or breaks seed dormancy, which assists in later plant removal. Prescribed burning also encourages growth of native flora to support its natural resistance to invasion by nonnative species. Prescribed burning will be implemented consistent with the fire management component of reserve unit management plans, as described above.
- **Grazing.** Livestock grazing can be an effective means of controlling invasive plant infestations. However, some invasive species are toxic or undesirable to livestock; also, other effects of livestock grazing may be incompatible with management objectives.
- **Chemical control.** Herbicide application is most successfully used when combined with other methods and not as the primary control method. Herbicides may be necessary to control heavy infestations of certain invasive plants (e.g., Transline herbicide is effective in controlling yellow starthistle). Certified personnel will conduct any herbicide application. Herbicides will be used with great caution, especially near seeps, creeks, wetlands, and other water resources. Herbicide use in reserve system lands will be reserved for instances where no other eradication techniques are effective. See also Pesticides, below.

#### 4.2.3.9.3 Nonnative Animal Control

Control of nonnative and pest vertebrates will be specific to the following natural communities. Refer to the appropriate natural community conservation measures in Chapter 3, Section 3.4, *Conservation Measures*, for details.

- Feral pigs will be controlled as needed in protected and restored aquatic and emergent wetland natural communities, riparian natural community, and managed wetlands.
- Norway rat, feral cats, and red fox will be controlled in emergent wetland natural communities and riparian natural community.
- Cowbirds will be controlled as needed in protected and restored riparian natural community, primarily to benefit nesting least Bell's vireo.
- Feral dogs and cats will be controlled in occupied riparian brush rabbit and riparian woodrat habitat in the reserve system.
- Bullfrogs and nonnative fish that prey on California red-legged frog and California tiger salamander larvae and young giant garter snakes will be controlled in stock ponds and seasonal wetlands associated with grasslands and in restored nontidal marsh.
- Nonnative fish will be controlled in the Plan Area.

If the Implementation Office determines, through monitoring of covered species populations in the reserve system, that other nonnative predatory species are adversely affecting covered species such as California black rail or California clapper rail, then habitat manipulation techniques or trapping will be employed.

#### 4.2.3.9.4 Mosquito Abatement

Enhancement of aquatic and wetland habitats must be balanced with the need to minimize mosquito production to protect human health. Encouraging adequate populations of mosquito predators such as native frogs, swallows, and bats offers an approach to mosquito control that is compatible with management for covered species. Wetlands will be designed to minimize mosquito production by minimizing suitable habitat for mosquitoes (primarily *Culex tarsalis*) and other human disease vectors, particularly between mid-July and late September or October when mosquito productivity is highest. Any mosquito control activities to be performed on reserve system land will be addressed in the reserve unit management plan in consultation with the local vector control district. The reserve unit management plan will detail the nature of mosquito control activities and explain specific measures implemented to avoid and minimize effects on covered species consistent with the BDCP.

#### 4.2.3.9.5 Pesticides

While pesticides may be used in the reserve system, any pesticide use must avoid take of federally listed covered wildlife species because pesticide use is not a covered activity under the federal permits (pesticide use is covered by the state permit). Pesticide use will be minimized or discontinued as needed to reduce negative effects on wildlife including direct, lethal toxicity, reproductive failures, and other adverse effects.

Pesticides will be used only to achieve biological goals and objectives (e.g., invasive plant or invasive animal control), in accordance with label instructions, and in compliance with state and local laws. Additional restrictions may be placed by USFWS, NMFS and CDFW during their review of reserve unit management plans. Any pesticide use must comply with the October 2006 stipulated injunction disallowing use of certain pesticides within habitats and buffer zones established around certain habitats for California red-legged frog and the May 2010 stipulated injunction disallowing use of certain pesticides within habitat and buffer zones established for California tiger salamander and San Joaquin kit fox.

On cultivated lands managed as high- to very high-value foraging habitat for tricolored blackbirds (6,400 acres), use of insecticides will be minimized to the greatest extent practicable during the spring growing season until tricolored blackbird nestlings have fledged or it is documented that no nearby nesting is occurring. This is to insure that an abundant insect prey population is available to support egg development and feeding of the young, as well as to minimize the risk of pesticide toxicity effects.

Pesticides will be used as little as possible in vernal pool complexes. A buffer of at least 1 kilometer will be used for aerial spraying any insecticides (e.g., on adjacent cultivated lands) in the reserve system, during the active flight period of the specialist bees, which coincides with plant bloom.

#### 4.2.3.9.6 Levee Maintenance

Each reserve unit management plan for areas containing levees will incorporate levee maintenance procedures. All levee maintenance that involves ground-disturbing activities will implement relevant measures described in Appendix 3.C, *Avoidance and Minimization Measures*, to avoid and minimize adverse effects on natural communities and covered species. Levees in the reserve system will be maintained in a manner that balances wildlife and habitat needs with the need to maintain the structural integrity of the levees. Levee maintenance managers are generally concerned that

uncontrolled vegetation on levees is a potential hazard. Trees with extensive root systems may create pathways for the piping of water through the levee, potentially leading to levee failure. If large trees are toppled by the wind, they may dislodge large segments of the levee with their fall. Dense vegetation may impair visual inspection of levees. Burrowing animals such as beavers, muskrats, and ground squirrels can pose a direct threat to levee stability (Bay Delta Oversight Council 2002). Wildlife values will be maximized on levees in the reserve system while recognizing these constraints.

Levee maintenance procedures specified in reserve unit management plans will incorporate the following considerations.

- Trees and shrubs will naturally establish and grow on the faces of levees. Typically, a one-lane gravel road is maintained on the crest of a levee to provide access to tide gates and allow for levee repairs. Specific sites with known erosion potential may also need to be kept clear of trees, but ecological function is best met by encouraging dense, natural revegetation of native varieties of trees and shrubs, particularly waterward of levees. Vegetated areas above the intertidal zone provide important habitat functions, including decreased bank erosion and increased bank stability.
- Recent evidence demonstrates that frequent stripping, burning, mowing, grazing, or other practices creating large areas of sparse vegetation actually encourage rather than discourage ground squirrel populations. Increasing vegetative cover for predator hiding and perching may be more effective in controlling ground squirrels on levees (Bay Delta Oversight Council 2002).
- Rodent control may kill nontarget species; reduces burrow availability for burrowing owls, amphibians, and reptiles; and removes a food source for Swainson's hawk, white-tailed kite, giant garter snakes, and other predators.
- Vegetation burning or nonselective herbicide use kills elderberry shrubs required by the valley elderberry longhorn beetle. More selective methods are preferred. For example, managed goat grazing may be an effective and biologically preferred vegetation management method along levees (with goat herds used to limit grazing on desirable species).

Levee maintenance practices will vary depending on the covered species being conserved near the levee. For example, levees adjacent to giant garter snake aquatic habitat will be kept clear of riparian vegetation and will instead be maintained with low-growing grasses and herbaceous vegetation. Levees in managed wetlands within Suisun Marsh will, to the extent possible given the levee stability considerations described above, retain sufficient vegetation to provide cover for salt marsh harvest mouse and breeding or roosting waterfowl.

#### **4.2.3.9.7 Reserve System Connectivity and Permeability**

One important measure of the reserve system's success will be the degree to which it allows native wildlife species to move freely within the reserve system and to other habitat outside the reserve system. The permeability of the reserve system will be increased by the actions listed below, where applicable. While these measures are targeted toward wildlife movement, it is assumed that they will also enhance opportunities for plant dispersal and population expansion.

- Removing fences that serve as barriers or hazards to wildlife movement, or retrofitting them to allow wildlife movement (some fencing will be needed to help manage and control livestock, as well as for human-access controls).

- Improving culverts and other road crossing points to make them more attractive to and safer for wildlife.
- Collecting data on wildlife movement throughout the Plan Area to better inform the location and type of structures that will facilitate safe movement.
- Managing grassland vegetation and thatch to facilitate dispersal of amphibians, such as California tiger salamander, for which dense vegetation may hinder movement.

Most fences in the reserve system will remain and will be used for management purposes, such as grazing management. Those that are unnecessary will be removed to increase reserve system permeability. Additional fences may be installed to better manage grazing timing and locations. Most existing roads in the reserve system will be used for management or monitoring purposes, but those that are unnecessary will be removed and decommissioned (i.e., returned to a natural condition) to reduce hazards to wildlife and the erosion potential associated with dirt and gravel roads. Additional roads may be added to establish access for management or monitoring purposes. These access routes will conform to the natural contours of the surrounding landscape and will only be maintained to the extent necessary for access. Culverts that create a one-way barrier<sup>14</sup> along waterways will be removed or retrofitted if feasible to allow movement of fish and aquatic amphibians both upstream and downstream. In most cases, retrofitting involves replacing small obstructive culverts with larger, straight culverts to allow species to move through more readily. In some instances culverts may be replaced with clear-span bridges to increase the habitat quality of the waterway where it flows under the roadway. This approach enhances the habitat (both aquatic and terrestrial) under the roadway for animal movement. In addition, existing culverts or bridges may be enhanced to increase wildlife movement through or under these permanent barriers. For example, fencing could be installed along the roadway to guide wildlife species away from the roadway and through undercrossings.

The Implementation Office will retain or create connectivity of canals and irrigation ditches within and between giant garter snake reserves to facilitate dispersal and other movement of giant garter snake. Emergent vegetation will be retained in these canals and irrigation ditches within the reserve system to provide escape cover for giant garter snakes.

#### **4.2.3.9.8 Enhancement and Management Actions Specific to Natural Communities**

Enhancement and management actions that are not described above and are specific to natural communities are described below.

#### **Aquatic and Emergent Natural Communities**

##### ***Seed Banking and Nursery***

A cultivated population of Suisun thistle will be founded from collected wild seed to provide additional seed as well as nursery stock for enhancing existing populations or establishing new ones. Seed banking will also be performed for soft bird's beak, slough thistle and delta button celery. Seed banking for slough thistle and delta button celery will be undertaken to protect the genetic diversity of northern San Joaquin Valley populations within the Plan Area. If seeds cannot be

<sup>14</sup> One-way barriers occur when species can move in one direction, but not the other (e.g., fish moving downstream but not upstream).

sourced from a local population, seeds from proximate geographic locales will be collected, banked, and ultimately propagated to support conservation efforts in the Plan Area. Seed collection will consider genetic implications based on collaboration with species experts and wildlife agency staff.

The *Draft Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California* (U.S. Fish and Wildlife Service 2010) proposed the following general guidelines for seed collection efforts to support banking, which will be used as a starting point to develop protocols for the applicable coed plants.

- In general, seeds should be collected in years of peak abundance; however, for Suisun thistle or other plants of extreme rarity, small collections could also occur during adverse population conditions.
- Collection protocols will follow basic scientific guidelines (Center for Plant Conservation 1991); however, in the case of Suisun thistle, manipulation of randomly selected seed parents will be appropriate, including the protection against seed predation by the introduced thistle weevil by muslin bagging of maturing flowering heads.
- Seed collection will not exceed 1% of the estimated total population seed output.
- Collected seed will be stored at two facilities: a seed storage facility approved by the Center for Plant Conservation and a local research or vegetation management/restoration institution with greenhouse and nursery facilities that could propagate seed using conservation techniques and protocols approved by the Center for Plant Conservation.

Banked seeds, cultivated seeds, or nursery stock could be made available through partnerships for public or private efforts to enhance existing populations or to create new ones. Actions to expand or establish populations will be implemented in close coordination with expert and wildlife staff.

## **Riparian Natural Community**

### ***Maintenance of Rare Plant Alliances***

Through nonnative plant control and supplemental plantings, abundance and distribution of riparian natural community vegetation alliances that are rare or uncommon as recognized by CDFW (California Department of Fish and Game 2010), such as *Cephalanthus occidentalis* (button willow thickets) alliance and *Sambucus nigra* (blue elderberry stands) alliance, will be maintained or increased through supplemental plantings.

### ***Stream and Channel Bank Enhancement and Management***

Stream channels and channel banks associated with the riparian natural community will be managed and enhanced to increase the diversity of microhabitats, improve hydrologic conditions that support the regeneration of riparian vegetation, and improve habitat functions for aquatic species, as described below, under Enhancement and Management Guidelines and Techniques, Stream Channel Enhancement and Management.

## **Grasslands and Associated Seasonal Wetland Natural Communities**

### ***Burrow Availability***

Grasslands (including the grassland natural community and grasslands within vernal pool complex and alkali seasonal wetland complex natural communities) will be enhanced and managed to

1 increase the availability of overwintering and nesting burrows for western burrowing owl,  
2 California red-legged frog, and California tiger salamander; and to increase prey availability for San  
3 Joaquin kit fox, Swainson's hawk, white-tailed kite, and other native wildlife predators.

#### 4 ***Artificial Nesting Burrows and Structures***

5 Where appropriate, artificial nesting burrows will be installed or elevated berms, mounds, or debris  
6 piles will be created for western burrowing owl to facilitate use of unoccupied areas (see below,  
7 *Enhancement and Management Guidelines and Techniques, Structures for Covered Wildlife*). Perching  
8 structures will be installed to facilitate use by western burrowing owl, Swainson's hawk, and white-  
9 tailed kite.

#### 10 ***Woody Debris in Stock Ponds***

11 Woody debris will be installed in stock ponds to provide cover and basking opportunities for  
12 western pond turtle.

#### 13 ***Vernal Pool, Alkali Seasonal Wetland, and Stock Pond Hydrology***

14 The hydrology of vernal pool complex and alkali seasonal wetland complex natural communities and  
15 stock ponds will be enhanced and managed as described below in Hydrologic Functions of Vernal  
16 Pools, Seasonal Wetlands, and Stock Ponds.

#### 17 ***Vernal Pool Pollinators***

18 Vernal pool complexes will be enhanced and managed to sustain suitable conditions for vernal pool  
19 pollinators.

#### 20 ***Structures for Covered Wildlife***

21 Various types of structures may be installed and maintained within reserves supporting grasslands  
22 and associated wetlands to enhance habitat values for covered wildlife species. The location and  
23 type of structure to be installed will be based on expected benefits to covered species and likelihood  
24 that the species will occupy the enhanced lands.

25 Perching structures may be installed in grasslands to facilitate use by western burrowing owl,  
26 Swainson's hawk, and white-tailed kite. Perches will be installed away from areas such as roads that  
27 are likely to experience frequent human disturbance.

28 Coarse woody debris or anchored basking platforms may be installed in stock ponds to improve  
29 habitat for western pond turtles (Hays et al. 1999). This modification will be implemented where it  
30 will increase the habitat value in locations with existing western pond turtles and where it is hoped  
31 that new pond turtle populations will establish. These structures may also enhance habitat for  
32 native amphibian species.

#### 33 ***Maintenance of Upland Refugia***

34 Grasslands will be protected or restored adjacent to restored brackish emergent wetland natural  
35 community to provide upland refugia for salt marsh harvest mouse, Suisun shrew, and other wildlife  
36 species that use the wetland communities. Similarly, grasslands will be protected and restored on  
37 the landward side of levees adjacent to restored floodplain to provide upland refugia for riparian  
38 brush rabbit. For these species, grasslands within 150 feet of the emergent wetland or riparian



1 natural communities will not be grazed or will be lightly grazed, to allow for establishment of dense  
2 grasses that provide cover for the covered species.

### 3 ***Vernal Pool Pollinators***

4 Protection of the entire vernal pool complex, including surrounding uplands (CM3), is a key  
5 component to conserving vernal pool pollinators. Additionally, vernal pool complexes will be  
6 managed to sustain appropriate habitat characteristics for solitary bees and other native pollinators  
7 of vernal pool plants. To ensure sufficient upland is conserved, new vernal pools will not be  
8 excavated in existing, intact vernal pool complexes. Pesticides will be restricted in vernal pool  
9 complexes as described in Section 4.2.3.9.5, *Pesticides*. A buffer of at least 1 kilometer will be used  
10 for aerial spraying any insecticides (e.g., on adjacent cultivated lands) in the reserve system, during  
11 the active flight period of the specialist bees, which coincides with plant bloom. The vernal pool  
12 complexes should not be overgrazed, as cattle may trample nests of ground-nesting bees and  
13 consume and trample foliage that feeds larvae of pollinators such as butterflies and moths. When  
14 burning is prescribed for vernal pool complexes, it will be carefully timed to avoid the period when  
15 specialist bee species are active and host flower species are blooming (Hoffman Black et al. 2009).

### 16 ***Cultivated Lands***

#### 17 ***Canals and Ditches***

18 Water in canals and ditches will be maintained during the activity period (early spring through mid-  
19 fall) for the giant garter snake, western pond turtle, and other covered species using waterways (see  
20 Canals and Irrigation Ditches below).

#### 21 ***Patches of Natural Communities and Habitat Features***

22 Existing patches of riparian, grassland, and other natural communities and habitat features that  
23 occur in the cultivated lands matrix will be retained. Existing trees will be retained and new trees  
24 will be planted to provide nesting habitat for Swainson's hawk and white-tailed kite (see Associated  
25 Features below). Hedgerows will be retained and planted on cultivated lands to provide refugia for  
26 rodents, thus increasing rodent prey populations for the Swainson's hawk and the white-tailed kite  
27 (see *Associated Features*, below).

#### 28 ***Associated Features***

29 The Implementation Office will retain wetlands, riparian communities, grassland edges, ponds, and  
30 other natural communities and habitat features that occur in the reserve system within the  
31 cultivated lands matrix. Conservation easements on cultivated lands will stipulate that these natural  
32 community features will be protected and managed to achieve the biological goals and objectives.

33 Tree rows, wood lots or other tree groves, and isolated trees will also be retained under  
34 conservation easements on cultivated lands to provide nesting habitat for Swainson's hawk and  
35 white-tailed kite. Small woodlots may also be planted in field corners or tree rows may be planted  
36 along field borders to provide nesting habitat for these species.

37 Native trees will be planted and maintained along roadsides and field borders within protected  
38 cultivated lands at a rate of at least one tree per 10 acres, to provide nest trees for Swainson's  
39 hawks. These may consist of single, isolated trees or clumps of trees. Trees to be planted will be  
40 sited in areas most likely to be used by nesting Swainson's hawks, adjacent to protected foraging

1 habitat. Trees will not be planted in areas that are less suitable for nesting hawks, such as near high-  
2 activity areas or powerlines.

3 Existing hedgerows will be retained and new hedgerows may be planted in association with  
4 cultivated lands in the reserve system. Hedgerows are expected to provide refugia for rodents, thus  
5 increasing rodent prey populations for Swainson's hawk, white-tailed kite, and western burrowing  
6 owl.

7 Burrowing owl habitat will be created and enhanced in association with cultivated lands in the  
8 reserve system. This will involve the retention or creation of grassland edges, levee slopes, berms, or  
9 patches that provide opportunities for burrowing owl breeding or wintering burrows. Burrowing  
10 owl habitat will also be enhanced along cultivated edges by managing vegetation height, installing  
11 perches and artificial nesting structures, where appropriate, and encouraging ground squirrel  
12 activity.

13 Where conditions permit, stands of emergent vegetation, native blackberry, or other native  
14 vegetation will be established along ditches and canals to provide suitable nesting substrate for  
15 tricolored blackbird. These stands will be located near foraging sites and, where feasible, within the  
16 dispersal range of existing tricolored blackbird nesting colonies.

17 The primary focus of enhancement and management activities on the 5,000-acre managed wetland  
18 reserve will be to maximize food biomass and value for overwintering waterfowl and to increase  
19 vegetation heterogeneity for all native species. Controlling soil salinities is an important  
20 management goal for maximizing food biomass and value as well as increasing vegetation diversity.  
21 Soil salinities are controlled primarily through soil leaching and flood/drain cycles performed in late  
22 winter through spring. The control of the cover and extent of invasive plant species is also an  
23 important management technique for increasing native diversity. Enhancement and management  
24 activities on managed wetlands will include, but will not be limited to, the below-listed activities  
25 consistent with Chapter 3, Section 3.4.11.2.3, *General Enhancement and Management Actions*.

- 26 • The manual, chemical, or mechanized removal of invasive vegetation.
- 27 • The maintenance, enhancement, and replacement of pumping infrastructure.
- 28 • The maintenance and enhancement of levees on reserve lands and on adjacent lands.

### 29 ***Waterfowl and Shorebirds***

30 Native wildlife habitat maintenance and improvements to be implemented in managed wetlands  
31 will include water control and various types of wetland and upland manipulations. Vegetation will  
32 be manipulated to provide winter waterfowl food and habitat, and to provide breeding habitat for  
33 resident waterfowl. Vegetation manipulation activities may include, but are not limited to, flooding,  
34 discing, controlled burns, mowing, herbicide treatment, and planting. Guidelines and techniques for  
35 water control and wetland and upland manipulations are described below. Additional detail can be  
36 found in *A Guide in Waterfowl Habitat Management in Suisun Marsh* (Suisun Resource Conservation  
37 District 1998).

- 38 • **Water control.** Management and enhancement techniques for the 5,000 acres will be guided by  
39 flooding and drawdown regimes associated with the management of seasonal wetlands and  
40 semipermanent wetlands. Seasonal wetlands are typically flooded some time in mid- to late fall  
41 and then drawn down in late winter/early spring so as to maximize germination, sprouting, and  
42 growth of high-value plant species on which overwintering waterfowl forage. Semipermanent

wetlands are also flooded in mid- to late fall but maintain some number of wetted acres into the late spring/early summer to support breeding birds. Semipermanent wetlands are typically dry by mid- to late summer. Water control schedules on the managed wetlands will be influenced by site-specific factors including wildlife habitat objectives, physical management constraints, annual environmental constraints, and regulatory constraints.

- **Controlled burns.** Burning can be an effective means of quickly replacing soil nutrients, removing undesirable seeds from the seed bank, removing excess plant material from the pond bottom to accelerate the decaying process, and controlling undesirable plant species such as saltgrass, Baltic rush, and Phragmites. Control of these species is best achieved if burned just prior to a flood-up period, and if the area is flooded over the unburned stalks to deprive the plants of oxygen and carbon dioxide.

- **Discing.** Discing aids in the preparation of seedbeds for artificial planting and natural succession. Discing can open up dense, monotypic stands of vegetation and change the vegetative composition of a pond. Following a burn, discing can kill roots of undesirable plants by exposing them to the sun and can increase the speed of nutrient cycling. Leaving the soil surface rough following discing can improve the effectiveness of leaching during the first year. Cross discing, which involves making one pass across a field and then a second pass at a 90 degree angle to the first, is thought to be the most effective discing method.

Discing should be selective and will be carefully monitored. Some plants, such as pepperweed and Phragmites, can reproduce from the chopped pieces of roots, so discing can increase production of these pest plants; such plants need to be sprayed with herbicide prior to discing. The managed wetlands should not be overdisced; overdiscing can break up the soil into fine particles that form impenetrable crusts when in contact with water. Overdiscing can also cause subsidence by increasing the exposure of soils to the atmosphere.

Discing has the potential to harm wildlife including salt marsh harvest mouse and Suisun shrew, and to temporarily remove cover for these species. To minimize adverse effects of discing on salt marsh harvest mouse and other native wildlife, no more than 20% of the managed wetlands in the reserve system will be disced each year (Suisun Resource Conservation District 1998).

- **Mowing.** Mowing is an effective method of creating open areas and setting back monocultures to allow formation of diverse plant communities. Mowing can also be an effective means for controlling invasive plants. Mowing should be performed by either cutting vegetation in strips or by clearing the entire area around a pond. Mowing should be done after August to prevent disturbance of ground-nesting birds.

#### 4.2.3.9.9 Recreation

Access to lands in the reserve system will be controlled in areas that are vulnerable to disturbance by humans and pets. In particular, human and pet access will be restricted to authorized personnel in vernal pool and alkali seasonal wetland complexes, nontidal marsh restored for giant garter snake, greater sandhill crane roost sites, and locations that support rare plant populations. Signs will be posted to inform the public of the access restrictions. Access to areas that support nesting covered bird species will be restricted during the nesting season.

In other portions of the reserve system, public access for recreational use will be authorized, subject to conditions discussed below.

## Public Access and Recreation in the Reserve System

The primary purpose of the reserve system is to protect and restore the biological values of the reserves, particularly for covered species. However, limited recreation can occur in some locations while still preserving these biological values. Limited public access and recreational use of the reserve system is permitted under the guidelines of this Plan (see Conditions, below) to the extent that the biological values of the sites are maintained.

The reserve system will allow recreation on approximately 61,000 acres of grassland, vernal pool complex, riparian, managed wetland, and aquatic natural community types. Over 170 miles of trail will provide recreational opportunities such as hiking, wildlife viewing, bicycling, equestrian use, hunting, fishing, and boating. One new boat launch facility will be constructed and one existing boating facility will be updated.

Although the reserve system will provide access to over 170 miles of recreational trail, only a subset of these trails will be new as existing infrastructure such as existing trails and minor roads will be used when and where possible. Many trails will be located on top of existing or newly created levees, further reducing the ground-disturbing activities associated with trail creation. Of the 170 miles of newly-accessible recreational trails, the construction of only 25 miles of new trails within the reserve system is assumed. Assuming trail width is 8 feet, ground disturbing activities associated the creation of 25 miles of new trail will result in approximately 25 acres of ground disturbance. The newly constructed boat launch facility will be constructed within the footprint of the North Delta diversion facilities and will not result in any additional ground disturbing activities.

One or more trailhead facilities will be needed at every new recreational location. Signage along the trails communicating rules, trail distances, geographic landmarks, and important warnings will also be required on all trails, existing or new. One new trailhead facility is assumed for approximately every 4,000 acres of newly acquired lands in the reserve system, resulting in 15 new trailhead facilities. Fourteen trailhead facilities are assumed to be 1 acre in size and one trailhead facility is expected to be up to 5 acres in size. The 5-acre trailhead facility will accommodate a staging area for equestrian use. New signage will affect approximately 0.05 acre per 1,000 acres of reserve system, resulting in 3 acres of ground disturbance. New trail, trailhead facility, and signage impacts total 50 acres of ground disturbing activities. All new recreation-related construction is expected to result in the permanent loss of grassland natural community. Table 4-5 summarizes the size, location, and natural community loss assumptions associated with recreation on BDCP reserve lands.

New trail construction will be limited to preserves within the grassland and upland transitional reserve. The construction of trailhead facilities, signs, staging areas, picnic areas, bathrooms, etc. will be placed on existing, disturbed areas when and where possible. If new ground disturbance is necessary, greater sandhill crane foraging habitat and covered plant species habitat will be avoided.

Recreational trails will be opened on preserved or restored grassland reserves in Conservation Zones 1, 8, and 11. The grassland reserve is expected to be 9,400 acres in size and include 45 miles of recreational trails, 15 of which are assumed to be newly created. The grassland reserve will also include two trailhead facilities, one of which is one-acre, the other of which is five acres. The grassland reserve will also include one picnic area. Recreational trails on grassland reserve lands will connect to recreational trails on adjacent open space areas when and where possible.

1 **Table 4-5. Extent of Recreational Activities in the Reserve System.**

<b>Dominant Natural Community Type</b>	<b>Potential Recreational Activities<sup>a</sup></b>	<b>Estimated Size (Acres)<sup>b</sup></b>	<b>Estimated Trails (Miles)</b>	<b>Assumed Facilities<sup>c</sup></b>	<b>Total Estimated Ground Disturbance (acres)<sup>d</sup></b>
Grassland	Hiking, wildlife viewing, biking, and equestrian use	9,400	45	15 miles of new trail; one 1-acre trailhead facility and one 5-acre trailhead facility; 1 acre for new signs; two 0.5-acre picnic facilities.	22
Valley/foothill riparian	Hiking and wildlife viewing, from levee	n/a	55	Trail and signs built on new setback levee; six 1-acre trailhead facilities; one 0.5-acre picnic facility.	6.5
Upland transitional habitat (restored tidal wetland edge)	Hiking and wildlife viewing	10,000	48	10 miles of new trail; two 1-acre trailhead facilities; 1 acre for new signs; one 0.5-acre picnic area.	13.5
Cultivated lands, greater sandhill crane reserve	Hiking and wildlife viewing	9,300	0	Assume creation of three 3-acre parking/viewing facilities and no new trails; two 0.5-acre picnic facilities.	4
Vernal pool/ alkali seasonal wetlands	Docent-led botanical and wildlife hikes	750	2	No new trails will be created in the vernal pool reserve; one 1-acre trailhead facility.	1
Managed seasonal and permanent wetlands	Fishing and hunting	6,600	20	No new trails, assume use of existing trails; one 1-acre trailhead facility; 1 acre of disturbance for signs.	2
Open Aquatic	Boat-based hunting and fishing	25,000	n/a	One new boat launch facility and contributions to updating one existing boat launch facility <sup>e</sup> .	0
<b>Totals</b>		<b>61,050</b>	<b>170</b>	<b>25 miles of new trail; 15 new trailhead facilities; four picnic areas; and two boat launch facilities.</b>	<b>50</b>
<b>Notes:</b> <sup>a</sup> Recreation within the reserve will be limited to those activities that do not conflict with the biological goals and objectives. <sup>b</sup> See Appendix 5.J, <i>Effects on Natural Communities, Wildlife, and Plants</i> . <sup>c</sup> Approximately one trailhead facility assumed for every 4,000 acres of reserve. Approximately 0.05 acre of new signs assumed for every 1,000 acres of reserve. Picnic facilities assigned based on number of trailhead facilities and assumed need. <sup>d</sup> Trail miles converted to acres of ground disturbance assuming a trail width of 8 feet. Appendix 5.J, <i>Effects on Natural Communities, Wildlife, and Plants</i> . <sup>e</sup> New boat facility will be built within new intake pump facility footprint; no associated ground disturbance.					

1 Approximately 750 acres of vernal pool and alkali seasonal wetland complex is expected to be  
2 within the reserve system in Conservation Zones 1, 8, and 11. Recreational use along two miles of  
3 trails is likely to be limited to one, larger parcel of protected vernal pool and alkali seasonal wetland  
4 complex. Recreational trails will be limited to existing trails and roads. Recreation within the vernal  
5 pool and alkali seasonal wetland reserve will be limited to docent-led wildlife and botanical tours.

6 Reserve lands will include approximately 10,000 acres of upland transition areas (edges around  
7 wetland restoration sites that allow for the accommodation of sea-level rise). These areas are  
8 expected to support 48 miles of trail, 10 of which are expected to be new. All new trail construction  
9 is expected to happen within the grassland natural community. This part of the reserve will also  
10 include two, one-acre trailhead facilities, and a 0.5-acre picnic facility.

11 There will be approximately 55 miles of levee-top trail along newly restored riparian and floodplain  
12 lands. Riparian restoration and protection and floodplain restoration will occur primarily in  
13 Conservation Zone 7 with some riparian and floodplain restoration potentially occurring in  
14 Conservation Zone 4. All trails are assumed to occur on newly created levees and thus are not  
15 expected to result in any additional loss of natural community. However, the construction of six new  
16 trailhead facilities and one new picnic area are expected to result in 7.5 acres of grassland natural  
17 community loss.

18 Approximately 9,300 acres of cultivated lands will be protected to provide roosting and foraging  
19 habitat for the greater sandhill crane. Recreation trails within the greater sandhill crane reserve will  
20 not be provided, however three, one-acre parking areas and one, 0.5-acre picnic area will be  
21 constructed. Parking areas will likely provide wildlife viewing areas and interpretive signs. The 3.5  
22 acres of construction are assumed to result in 3.5 acres of grassland natural community loss.

23 The reserve system will also include 6,600 acres of seasonal, semipermanent or permanent  
24 managed wetlands. The managed wetland reserve is also estimated to include 20 miles of levee-top  
25 trail. Hunting will be the primary recreational use of these lands. Outside the hunting season, hiking  
26 and fishing may be allowed. The construction of one new parking facility has potential to result in up  
27 to 1 acre of grassland natural community loss.

28 Approximately 25,000 acres of restored subtidal habitat are expected to increase hunting and  
29 fishing recreational opportunities throughout the Plan Area. To improve access to boat-based  
30 recreational opportunities, one new boat launch facility will be constructed and one existing boat  
31 launch facility will be improved. The new boat launch facility will be constructed within the  
32 construction footprint of the pump intake facilities on the main stem of the Sacramento River near  
33 the town of Hood. Construction is not expected to result in any additional natural community loss.  
34 The new boat launch facility will include two launch lanes, two boarding floats, a bathroom, and  
35 parking facilities. The existing boat launch facility to be improved will be chosen by the  
36 Implementation Office in coordination with the wildlife agencies.

37 Other covered recreational activities include the construction and maintenance of creek crossings,  
38 parking areas, gates, fencing, restrooms, wildlife observation platforms, and educational kiosks that  
39 are built and/or maintained in accordance with the guidelines in this Plan. All ground disturbing  
40 activities associated with the construction of these facilities will occur, when and where possible, on  
41 already disturbed areas. Recreation-related natural community loss shall not exceed take  
42 allowances for the grassland natural community. The Permittees<sup>15</sup> request coverage for incidental

<sup>15</sup> The *Permittees* are DWR and the participating state and federal water contractors.

take of covered species resulting from the construction, operation, and appropriate public use of trails and parking lots within the permit area, inside or outside of the designated reserve system, provided that usage is consistent with the guidelines in this Plan. Off-trail recreational activities or any type of activity prohibited by this Plan or by state or federal law are not covered activities.

#### 4.2.4 CM12 to CM21: Other Stressors

Activities to reduce contaminant loading, control or prevent infestation by invasive aquatic species, reduce predation on covered fish species, and address other stressors on aquatic life in the Plan Area comprise the substance of CM12 to CM20. Certain activities entailed in performance of these conservation measures have the potential to result in incidental take of covered species or to modify their habitat, and thus are covered activities under the BDCP. These include CM12, CM13, CM15 CM16, and CM21. CM14 and CM17 to CM20 are not expected to result in incidental take or adverse modification of habitat, and thus do not entail performance of covered activities.

##### 4.2.4.1 CM12 Methylmercury Management

Activities to reduce methylmercury contamination, which could result in incidental take, are covered activities under the BDCP. These activities are fully detailed in Chapter 3, *Conservation Strategy*. These include actions to minimize the methylation of inorganic mercury in habitat restoration areas. The Implementation Office will minimize, to the extent practicable, any increase in mercury methylation associated with habitat restoration conservation measures through the design and implementation of restoration projects. The Implementation Office will work with DWR and the Central Valley RWQCB to identify and implement methods for minimizing the methylation of mercury in restoration areas, and develop a programmatic quality assurance/quality control (QA/QC) program specifying sampling procedures, analytical methods, data review requirements, a QA/QC manager, and data management and reporting procedures. Each project-specific plan will be required to comply with these procedures to ensure consistency and a high level of data quality.

This program will be developed and implemented within the context of the Central Valley RWQCB methylmercury total maximum daily load (TMDL) and Mercury Basin Plan Amendment requirements. The timing and phasing of implementing CM12 will be contingent upon the timing and phasing of individual restoration projects developed under the BDCP, and will require the following actions.

- Define design elements that minimize conditions conducive to generation of methylmercury in restored areas.
- Define adaptive management strategies that can be implemented to monitor and minimize actual post-restoration creation and mobilization of methylmercury.
- Implement appropriate measures to monitor and minimize methylmercury in site-specific restoration designs.

The purpose of CM12, the methylmercury TMDL, and the Mercury Basin Plan Amendment is to coordinate research and inform future actions concerning mercury methylation and measures to reduce methylation. In particular, the control studies conducted as part of the Methylmercury TMDL will include a description of mercury management practices identified in Phase I, an evaluation of the effectiveness, costs, potential environmental effects, and overall feasibility of the control actions. At this time, there is no proven method to reduce methylation and mobilization of mercury into the

1 aquatic system resulting from inundation of restoration areas. The measures listed below are meant  
 2 to provide a list of current research that has indicated potential to mitigate mercury methylation.  
 3 This list will be updated as additional information is produced by the Phase I methylmercury TMDL  
 4 control studies and other related research.

- 5 • Characterize mercury concentrations in soil to inform restoration design, postrestoration  
 6 monitoring, and adaptive management strategies.
- 7 • Sequester methylmercury using low-intensity chemical dosing.
- 8 • Minimize microbial methylation through restoration design or management.
- 9 • Design restoration sites to maximize photodegradation, which removes methylmercury by  
 10 converting it to the biologically unavailable, inorganic form of mercury.
- 11 • Remediate sulfur-rich sediments with iron to reduce the activity of sulfide and the methylation  
 12 of mercury.
- 13 • Cap mercury-laden sediments to limit methylmercury flux into the water column and exposure  
 14 to biota.

15 Implementation of this conservation measure will be informed through compliance and  
 16 effectiveness monitoring, research actions, and adaptive management, as described in Chapter 3,  
 17 Section 3.4.12, *Conservation Measure 12 Methylmercury Management*. Key uncertainties associated  
 18 with CM12 include the effectiveness of the measure in minimizing production and mobilization of  
 19 methylmercury from lands in the reserve system and the foodweb and whether actions under CM12  
 20 interfere with the potential of a restoration project to meet its intended purpose. Compliance  
 21 monitoring will document completion and implementation of site-specific methylmercury  
 22 management plans for restoration sites. Effectiveness monitoring will assess how well CM12  
 23 minimizes production and mobilization of methylmercury from BDCP activities into the aquatic  
 24 system and the foodweb.

#### 25 **4.2.4.2 CM13 Invasive Aquatic Vegetation Control**

26 The Implementation Office will apply existing control methods tested and developed by the  
 27 California Division of Boating and Waterways (DBW) to control the growth of Brazilian waterweed  
 28 (*Egeria densa*), water hyacinth (*Eichhornia crassipes*), and other nonnative submerged aquatic  
 29 vegetation and floating aquatic vegetation throughout the Delta. The primary control methods  
 30 employed will be the application of herbicides<sup>16</sup> as specific as possible to these species and site  
 31 conditions. In addition, limited mechanical removal to control water hyacinth will be conducted.  
 32 Other methods of removal could be implemented as dictated by site-specific conditions, current  
 33 research, and intended outcome.

34 Initial implementation actions are expected to begin in year 2. In addition, ongoing research will  
 35 investigate potential biological control methods for *Egeria* and water hyacinth. This could minimize  
 36 or avoid the need for use of herbicides. Recognizing the potential threat of other IAV species, the  
 37 Implementation Office will implement an early detection and rapid response program to detect,  
 38 evaluate, and treat early invasions of other IAV species.

<sup>16</sup> Herbicide or pesticide use is not covered by the federal Section 10(a)(1)(B) permits due to on-going litigation with the EPA over pesticide certification. Therefore, the use of herbicides or pesticide must avoid take of federally listed wildlife species. This activity is covered by the state NCCP permit.



The Implementation Office will partner with existing programs operating in the Delta (including DBW, U.S. Department of Agriculture–Agriculture Research Service, University of California Cooperative Extension Weed Research and Information Center, California Department of Food and Agriculture (CDFA), local Weed Management Areas, Resource Conservation Districts, and the California Invasive Plant Council [Cal-IPC]) to perform risk assessment and subsequent prioritization of treatment areas to strategically and effectively reduce expansion of the multiple species of IAV in the Delta. This risk assessment will dictate where initial control efforts will occur to maximize the effectiveness of CM13. Additionally, avoidance and minimization measures will be adopted and likely be similar to those conditions identified in the existing DBW program (including the associated BiOp and EIR), which restrict where and when herbicide treatment may occur, establish allowable chemical concentrations in treated areas and adjacent water, and require extensive water quality monitoring. Uncertainties associated with this measure include questions regarding the most effective designs for tidal restoration sites that preclude invasive plants, effects of IAV on restored natural communities, and the feasibility of creating conditions that favor growth of native pondweeds rather than IAV. The Implementation Office will ensure that tidal natural communities restoration sites are designed to minimize the risk of IAV establishment and propagation. Such measures include manipulating water flow velocity, water depth, salinity, and other environmental conditions so as to reduce the risk of invasion and colonization by *Egeria* and other IAV. If IAV does invade and colonize restoration sites, additional control measures, as described above, may be necessary to protect restored aquatic habitat and maintain benefits for covered fish and other native aquatic organisms. In addition, the Implementation Office will work with DBW to prioritize control of established *Egeria* and water hyacinth source populations that are hydrologically connected to restoration sites in a way that could facilitate the spread of propagules from the source population to these sites.

Under CM4, marsh channels and levee breaches will be designed to maintain flow velocities that minimize conditions favorable to IAV establishment. In addition, restoration will be designed, within restoration site constraints, to produce sinuous, high-density, dendritic networks of tidal channels that promote effective tidal exchange. Effective tidal exchange will help to achieve flow velocities that can inhibit colonization by IAV. Channel orientation and shape will be designed to work with the prevailing wind direction to reduce or eliminate the risk that IAV fragments could disperse into the restoration sites.

Should IAV colonize and impair the functioning of a restoration area, control will be required. An example of a design feature to facilitate IAV control is incorporating sites where temporary barriers could be installed to isolate portions of restoration area channels for a duration sufficient to allow the long contact time required by fluridone (6 to 8 weeks), currently, the most effective herbicide used on *Egeria* in the Delta (California Department of Boating and Waterways 2006).

#### **4.2.4.2.1 Methods and Techniques**

Application of IAV control methods, primarily chemical treatment, but also mechanical or biological control where appropriate, will be used in implementing CM13.

The primary goal of CM13 is aggressive control, not eradication, of IAV in the Plan Area, because eradication of the major widespread IAV species in the Delta is not currently considered feasible. CM13 is intended to substantially reduce the IAV area and biomass to the level where it no longer causes substantial, ecosystem-scale adverse effects on water quality, aquatic habitats, covered fish, and other native fish and wildlife. However, eradication may be implemented where appropriate.

1 The decision process will be informed by implementation of a risk assessment protocol and will be  
2 based on a site-by-site evaluation of density, proximity, and extent, among other factors, by  
3 biologists familiar with the Delta ecosystem, local hydrological regime, and the ecology of the  
4 species.

## 5 **Control Methods**

### 6 ***Chemical Control***

7 Chemical control—application of herbicide—is the most feasible and effective control method.  
8 Herbicides can be used to rapidly control IAV over large areas (hundreds or thousands of acres at a  
9 time) and for extensive infestations.

10 As the lead agency for IAV control in the Delta, DBW has been using herbicide treatments to control  
11 *Egeria* since 2001 and water hyacinth since 1983, and has researched several different herbicides,  
12 adjuvants, and application protocols. All chemicals used were approved and labeled for aquatic use  
13 by the EPA. The herbicides studied and used were 2,4-D, glyphosate, diquat, and fluridone, and the  
14 adjuvant Agri-dex.

15 Based on DBW's research and field testing and observations, fluridone is currently considered the  
16 most effective treatment for *Egeria* in the Delta. It is slow-acting, requiring a residence time of 6 to 8  
17 weeks to be effective. Where flow rates do not allow long enough contact, multiple applications will  
18 be made. The concentration range of fluridone used in the *Egeria* control program is 10 to 20 parts  
19 per billion, which is at the low end of the labeled application rates.

### 20 ***Mechanical Control***

21 Mechanical treatment of IAV involves removal from the water by hand or machine and disposal on  
22 land or shredding in the water. Both hand and machine removal can be relatively successful at small  
23 scales. For example, physical removal has been successful in reducing or eliminating South American  
24 spongeplant in the early stages of infestation (Anderson and Akers 2011). Removal of small  
25 infestations of water hyacinth in the Delta has been achieved by "herding," in which small rafts of  
26 water hyacinth are pushed into a flowing channel to be washed downstream into saline water where  
27 they die (California Department of Boating and Waterways 2006).

28 Removal and disposal of large amounts of IAV become very problematic, because transportation is  
29 costly and suitable terrestrial disposal sites nearby are difficult to find.

### 30 ***Biological Control***

31 Biological control has been successful against water hyacinth, particularly in the southeast United  
32 States (Center et al. 2002). The CDFA released weevils (*Neochetina eichhorniae* and *N. bruchi*) and a  
33 moth (*Sameodes albiguttalis*) that eat water hyacinth at selected sites in the Delta. Only *N.*  
34 *eichhorniae* established but survived at densities too low to affect water hyacinth, in part, because of  
35 cool winter temperatures (California Department of Boating and Waterways 2003). Pathogens may  
36 have infected the weevils, but additional studies are needed to investigate this possibility. DBW  
37 recently began releasing the water hyacinth water hopper (*Megamelus scutellaris*) at three sites in  
38 the Delta (California Department of Food and Agriculture 2011).

39 Before release of a potential biocontrol organism in California, extensive evaluation is undertaken  
40 by the CDFA's Biological Control Program, which is a component of the Plant Health and Pest

Prevention Service's Pest Prevention Program. The evaluation process involves determining the host-specificity to assess risk to nontarget species; domestic quarantine if approved for import into California under state and federal regulation; small-scale field testing to determine effectiveness against the target species; and additional evaluation of risks to nontarget species and the environment. Once released, long-term monitoring and evaluation continue to assess efficacy and risk to nontarget organisms.

### Scale of Control Treatment

To control *Egeria*, the Implementation Office will fund treatment of between approximately 1,700 acres per year (low estimate) and 3,300 acres per year (high estimate). (See Chapter 8, Section 8.2.3.13, *CM13 Invasive Aquatic Vegetation Control*, for a discussion of these estimates). These figures are similar to the amount of *Egeria* treated by the DBW in 2007 and 2008 at Franks Tract. Comparison of the proposed treatment acreage with the estimated total acreage of *Egeria* across the Delta and results of DBW's large-scale *Egeria* control efforts at Franks Tract provide useful insight into the feasibility of this scale of treatment and the projected outcome in terms of the overall reduction in *Egeria* extent throughout the Delta.

In 2006, DBW estimated that *Egeria* occupied 11,500 to 14,000 acres in the Delta and was spreading at a rate of 10 to 20% per year (California Department of Boating and Waterways 2006). More recent measurements (2007), based on aerial imagery analysis, estimate *Egeria* occupied approximately 10,000 acres (Ustin 2008). The DBW (2006) and Ustin (2008) estimates of overall rate of increase were similar.

Prior to 2007, the *Egeria* control program treated 500 acres or less of *Egeria* with herbicide annually, and the acreage of *Egeria* continued to increase. However, in 2007 and 2008, the treatment of over 3,000 acres per year in Franks Tract produced significant results. *Egeria* cover was reduced by 1,500 acres (47%) in 2007 (Ustin 2008; Santos et al. 2009), and *Egeria* biovolume was significantly reduced (Ruch and California Department of Boating and Waterways 2006). Additional treatment in 2008 yielded a further 50% reduction (Santos et al. 2009). Similar results were achieved at Fourteenmile Slough, a smaller site (Santos et al. 2009). These results demonstrate that successful treatment of the order of a thousand acres annually can be achieved in the Delta.

Under CM13, the low estimate (1,700 acres per year) for proposed treatment is equivalent to approximately 12 to 15% of the total estimated area of *Egeria* in the Delta, and the high estimate (3,300 acres per year) is equivalent to approximately 24 to 29%. Projected changes in total acreage of *Egeria* Delta-wide (Figure 3.4-29, *Projected Changes in Delta-Wide Extent of Egeria under Low and High Treatment Amounts and Two Different Projected Rates of Egeria Increase* in Chapter 3, *Conservation Strategy*) for the low and high treatment amounts assume a 10 and 20% annual increase in *Egeria* extent. Based on the control efficiencies shown in Figure 3.4-29, the following inferences seem to be supported.

- With an initial high investment in treatment, it is feasible to bring *Egeria* under control within 5 to 11 years, a relatively short time period compared to the 50-year BDCP term.
- Thereafter, control would only be needed on a local basis to control any new *Egeria* infestations.

To treat new and emerging IAV species, the Implementation Office will respond at the appropriate scale and intensity in coordination with existing programs and cooperators, such as CDFA and USDA-ARS.

## Permit Conditions and Requirements: Avoidance and Minimization Measures

Currently, DBW is the only entity authorized to use herbicide to treat *Egeria* and water hyacinth, and more recently South American spongeplant, in the Delta, its tributaries, and Suisun Marsh. DBW was required to obtain three permits for each program.

Two BiOps were required under the ESA<sup>17</sup>. A USFWS BiOp was required for Sacramento splittail, giant garter snake, valley elderberry longhorn beetle, and delta smelt. An NMFS BiOp was required for winter-run Chinook salmon, spring-run Chinook salmon, steelhead, and green sturgeon. Also, the Central Valley Regional Water Quality Control Board (Central Valley Water Board) required an NPDES permit.

The BiOps identified possible direct and indirect adverse effects that the *Egeria* and water hyacinth control programs might have on federally listed species and specified requirements for avoidance and minimization of effects on federally listed species.

NPDES permits are required for all aquatic pesticide applications in California. The NPDES permit goals were to minimize the extent of potential impacts on water quality in the Delta and to create a water monitoring and reporting program.

The herbicides used, primarily Sonar formulations (active ingredient fluridone) for *Egeria* control and primarily Weedar 64 (active ingredient 2,4-D) and also Rodeo (active ingredient glyphosate) for water hyacinth control, are registered by the EPA and by the California Department of Pesticide Regulation for use in California. Registration of an herbicide involves many years of research and is considered the functional equivalent of an EIR.

The herbicide programs are obliged to follow the California Department of Pesticide Regulation procedures for pesticide application and to comply with all requirements of the Division 6 Pesticides and Pest Control Operations of the federal Food and Agriculture Code covering labeling, handling, transportation, mixing, and rinsing containers. Additional requirements include a memorandum of understanding between DBW and regional water agencies outlining application restrictions relating to drinking water intakes and filing a Notice of Intent with the County Agricultural Commissioner of each county where herbicide use occurs.

All of the applicable conditions adopted by DBW and imposed by USFWS, NMFS, and NPDES as part of its IAV control programs are also incorporated into CM13, except for the toxicity research, which is completed. Mandatory minimization and avoidance measures and monitoring and reporting requirements are provided in Table 4-6.

The Implementation Office will establish an early detection and rapid response program to monitor and detect potential IAV that can be targeted before becoming problematic. A good example of such a program is CDFA's Hydrilla Eradication Program. The program conducts an annual survey of the Delta to detect hydrilla before it can establish a foothold. CDFA works in cooperation with county agricultural commissioners and a variety of federal, state, and county agencies including DBW, DWR, and Reclamation. Other early detection programs in the Delta include those of CDFA's Integrated Pest Control Branch and the Bay Area Early Detection Network (Williams et al. 2009).

<sup>17</sup> The federal nexus for this activity is the USDA-ARS, which is responsible for conducting research and providing technical input into the control of nuisance weeds and agricultural pests.

1 **Table 4-6. Minimization and Avoidance Measures and Monitoring and Reporting Requirements for**  
 2 **Herbicide Programs in the Delta**

Type of Measure/ Condition	Measures/Conditions
Avoidance—site and timing restrictions	<ul style="list-style-type: none"> <li>• Timing restrictions based on outmigration of juvenile salmonids at specific sites (e.g., no treatment before June 1 at sites with juvenile outmigration, no treatment from October 16 to March 31)</li> <li>• Survey for elderberry shrubs and treat at low tide if any elderberry shrubs are within 100 feet of the water's edge</li> <li>• Application window restrictions on timing between repeat applications for water hyacinth</li> </ul>
Plans and Protocols	<ul style="list-style-type: none"> <li>• An aquatic pesticide application plan including BMPs.</li> <li>• A pesticide application log including specific information on each application</li> <li>• <i>The Water Hyacinth Control Program Protocol and Procedures Manual</i> and appendices that include requirements covering herbicide handling, treatment planning protocol, day of treatment protocols, and BMPs, plus the permit conditions of the two biological opinions and the NPDES permit (California Department of Boating and Waterways 2009)</li> </ul>
Fish Monitoring	<ul style="list-style-type: none"> <li>• Collection of dead fish resulting from treatment</li> <li>• Protocol for collecting information on each fish salvaged and environmental and water quality conditions</li> <li>• Fish passage protocol to ensure that operations have no impacts on fish</li> </ul>
Treatment Monitoring	<ul style="list-style-type: none"> <li>• Monitoring and monthly reporting of the following.</li> <li>• Pre- and posttreatment measurements of chemical residue, pH, turbidity levels, water temperature, and dissolved oxygen (DO) at selected sites</li> <li>• Water temperature and DO changes resulting from <i>Egeria</i> control activities</li> <li>• Amounts, types, and dates of herbicide application at each site</li> <li>• Visual assessment of pre- and posttreatment conditions of treated sites to determine efficacy of treatment and any effects of chemical drift</li> <li>• Operational status of equipment and vessels</li> </ul>
Surveillance and Treatment Efficacy Monitoring	<ul style="list-style-type: none"> <li>• Development of effective and efficient methods for mapping and monitoring <i>Egeria</i> and water hyacinth presence pre- and posttreatment, including:</li> <li>• Aerial mapping analyses,</li> <li>• Hyperspectral analyses of aerial imagery, and</li> <li>• Hydroacoustic analyses</li> </ul>
Environmental Monitoring	<ul style="list-style-type: none"> <li>• A water monitoring program requiring that a minimum of 10% of all treatment sites be sampled for each water type to collect and analyze Delta water quality data, and results of chemical residue and toxicity tests</li> <li>• An environmental monitoring plan</li> <li>• An approved monitoring protocol and sampling plan</li> <li>• A quality assurance project plan for chemical residue and toxicity monitoring, describing procedures and protocols for data collection and analysis</li> <li>• An annual report describing permit compliance and program findings and conclusions</li> <li>• An annual data validation package to confirm the quality of environmental monitoring data</li> </ul>
Water Quality Targets and Limits	<ul style="list-style-type: none"> <li>• Specific turbidity standards</li> <li>• pH limits</li> <li>• Residue concentrations</li> </ul>

Type of Measure/ Condition	Measures/Conditions
Dissolved Oxygen	<ul style="list-style-type: none"> <li>• No treatment if DO levels are between 4 to 6 parts per million in low-flow areas or below 5 parts per million in high-flow areas</li> <li>• Development of protocol for monitoring DO</li> <li>• Review committee to examine monitoring results</li> </ul>
Environmental Training	<ul style="list-style-type: none"> <li>• Environmental awareness training for all field crew members</li> <li>• Species identification and impact avoidance guidelines</li> <li>• Protocol for identification and protection of elderberry shrubs</li> <li>• Protocol for identification and protection of delta smelt, Chinook salmon, steelhead, green sturgeon, and associated protected habitats</li> <li>• Protocol for take of protected species</li> <li>• Use and calibration of equipment</li> </ul>

#### 4.2.4.3 CM14 Stockton Deep Water Ship Channel Dissolved Oxygen Levels

Under CM14 the Implementation Office will ensure that the Stockton Deep Water Ship Channel DWR Aeration Facility, which is currently operational, will continue to operate as needed during the BDCP permit term in order to maintain the concentrations of dissolved oxygen (DO) above target levels during the entire permit term. The Implementation Office will develop annual work plans in coordination with fish and wildlife agencies, the Central Valley Regional Water Quality Control Board (Central Valley Water Board), and the current aeration facility operating entities that specify the extent of DO improvements to be implemented and will monitor the effectiveness of measures intended to improve DO levels. The Implementation Office will make funding available for the continued long-term operation and maintenance of the aeration facility by year 1. The Implementation Office will also coordinate with the Central Valley Water Board to determine water quality standards to be met both as requirements of the San Joaquin River DO TMDL (U.S. Environmental Protection Agency 2007) and as part of the biological goals and objectives, as well as operational triggers related to when to initiate operations and what the duration of operations will be once implemented.

It is likely that, during the permit term, maintenance or repair of the aeration facility will require performance of in-water work. To the extent practicable, effects on covered fish will be minimized by conducting work during an approved in-water work window and adhering to relevant avoidance and minimization measures such as AMM5, *Spill Prevention, Containment, and Countermeasure Plan*.

#### 4.2.4.4 CM15 Localized Reduction of Predatory Fishes

The primary purpose of CM15 is to contribute to biological goals and objectives related to abundance and passage of covered salmonids by locally reducing nonnative predatory fishes, which it is hoped will increase the survival of migrating salmonids. Under CM15, the Implementation Office will reduce numbers of nonnative predatory fishes at specific locations and eliminate or modify holding habitat for nonnative predators (predators) at selected locations of high predation risk (i.e., predation hotspots).

CM15 will include the following two elements.

- Hotspot pilot program. Implement experimental treatment at priority hotspots, monitor effectiveness, assess outcomes, and revise operations with guidance from the Adaptive Management Team.
- Research actions. Via the adaptive management program, support focused studies to quantify the population level efficacy of the pilot program and any program expansion(s) intended to increase salmonid smolt survival through the Delta.

If demonstrably effective, the hotspot pilot program will be developed in three successive stages. During the first stage, a few treatment sites will be experimentally evaluated to test the general viability of various predator reduction methods. Secondary reduction actions, such as removal of abandoned vessels and other in-water structures, may be implemented to determine if they will be effective on a large scale. After the initial scoping stage is complete, and if shown to be effective, the second stage will consist of implementation of a pilot program with a larger range of treatment sites and refined techniques, incorporating what is learned from the first stage. The main focus at this stage is to study the efficacy of predator reduction on a larger scale to determine whether it is making a demonstrable difference and/or has any unintended ecological consequences (i.e., unexpected changes to food web dynamics that may have negative effects to covered fish species). The pilot program may include such activities as direct predator reduction at hotspots (e.g., Clifton Court Forebay, head of Old River scour hole, the Georgiana Slough sites, and SWP/CVP salvage release sites) and removal of old human-made structures (e.g., pier pilings, abandoned boats). The hotspots will also include those potentially produced by the BDCP (e.g., north Delta intakes, nonphysical barriers, and barge landings).

Because of the high degree of uncertainty regarding predation/competition dynamics for covered fish species and the feasibility and effectiveness of safely removing large fractions of existing predator populations, the proposed predator reduction program is envisioned as an experimental pilot program within an adaptive management framework.

The pilot program will be carefully monitored and refined to determine whether either of these practices are effective. If the pilot program shows that the main issues are resolvable, the third stage will consist of a defined predator reduction program (i.e., defined in terms of predator reduction techniques and the sites and/or areas of the Plan Area where techniques will be employed). Research and monitoring will continue throughout the duration of the program to address remaining uncertainties and ensure the measures are effective (i.e., that they reduce numbers and densities of predators and increase survival of covered salmonids).

The progress of the pilot program and research activities will be documented annually in the Adaptive Management and Monitoring Report. During year 1, the Implementation Office will evaluate the strategies for logistical issues, relative effectiveness, incidental impacts on covered fish, and cost-effectiveness. After year 1 of pilot program implementation, the Implementation Office will refine the scope and methodology of the pilot program—based on review and coordination with the fish and wildlife agencies—and continue with implementation for an additional 5 to 7 years. At the end of this pilot implementation period, program assessment will involve independent science review and publication of findings. After the reviews are considered, the Adaptive Management Team, in collaboration with the fish and wildlife agencies, will refine operations and decide whether and in what form predator reduction and further adaptive management will continue. Key uncertainties associated with this measure include determining where predation is likely to occur in

vicinity of new north Delta intakes, determining the best predator reduction techniques, determining predator density and distribution in vicinity of the north Delta intakes, prioritizing hotspots for localized predator reduction, and assessing the effects of localized predator reduction measures on covered fish salmonids.

The following sections provide an overview of management principles and key uncertainties, and details of the hotspot pilot program.

#### **4.2.4.4.1 Hotspot Pilot Program**

The hotspot pilot program will consist of discrete pilot projects and research actions coupled with an adaptive management and monitoring program to evaluate effectiveness. To minimize uncertainty about the efficacy of management regimes necessary to maintain and enhance survival of covered fishes, pilot program related experiments will be conducted to test the effects of predator reduction and structural habitat modifications or removal. The experiments will be designed to test a range of reasonable management alternatives at appropriate local spatial scales and river flows. All experiments and research work under the pilot program will be subject to review and approval by the Adaptive Management Team.

#### **Localized Reductions of Predatory Fish**

The first strategy involves direct reduction of predators from areas with high predator densities (predator hotspots). Pilot projects to reduce predatory fish at hotspots will incorporate study design principles similar to those used by Cavallo et al. (2012). A test program will incorporate a BACI study approach, analyzing the survival of covered fish like salmon with and without predator reduction treatments. This approach will be implemented in river reaches with known predator hotspots, including Georgiana Slough, Old and Middle Rivers, and the lower Sacramento River near Paintersville Bridge. The study design will compare treated and untreated (control) reaches, or above and below treated areas (e.g., scour hole at the head of Old River).

Before each predator reduction treatment, tagged salmon smolts will be released in the designated treatment and control reaches to determine the baseline level of reach-specific survival and predation loss. In some locations, longer-term monitoring of expected reach-specific survival can help solidify predictions of baseline survival. Flow rates during the release period will be measured in the reaches to account for the effect of stream velocity on the reach-specific survival rates of migrating juvenile salmonids. Hydroacoustic tracking and DIDSON cameras may also be employed to provide a general estimate of predator densities within the river reaches (e.g., the number of predators along the shore, within the main part of the channel, or around prominent in-channel vegetation or structures).

Once a location is selected, one of the reaches will receive predator reduction while the other one will represent the control reach. Experimental reaches will be relatively short (1 to 2 kilometers or less) to maximize the ability to effectively reduce the number of predators in the test reach. Multiple treatments of a given predator reduction strategy will be applied to the treated river reach to help develop an estimate of predator reduction effectiveness and an amount of time the treatment is effective. Following predator reduction, tagged salmon will be released daily to assess estimated predation loss, and to determine persistence of any change in local predator abundance or salmon survival rates. Tethered salmon may also be used to determine where elevated predation occurs (e.g., neashore, in the channel, near structures) in order to refine and target reduction techniques. Sustained reduction efforts will likely be necessary to maintain local reductions in predators.



To evaluate predation-related loss at the new north Delta intakes on the Sacramento River, it will be necessary to monitor the reach where the intakes will be located and potential predation loss within this reach. Studies are currently being designed to provide key baseline survival rates for emigrating covered salmonids, and presence/absence data for other covered and predatory fish species within the reach containing the new intakes. These studies will be implemented both to collect baseline data, and then again post installation of the north Delta intake facilities to document whether survival through this reach of the river changes as the BDCP is implemented.

Various techniques used to control fish populations are reviewed in Table 4-7; however, only physical reduction techniques will be considered for testing and implementation in the Delta. These include boat electrofishing, hook-and-line fishing, passive capture by net or trap (e.g., gillnetting, hoop net, fyke trap), and active capture by net (e.g., trawl seine, beach seine). Advantages of physical reduction include public acceptance of these known techniques, lack of impacts on water quality, low level of hazard to nontarget organisms, higher level of feasibility compared to dewatering or chemical treatment in the open Delta waterways, and lower level of risk of unintended ecological consequences. Limitations include high exploitation rates required to achieve meaningful and measurable benefits, potentially high expense and intense labor, and short-lived benefits (Finlayson et al. 2010). The predator control techniques implemented will be analyzed to identify capture efficiency of predatory fish, as well as rates of injurious by-catch of covered fish. Addressing the uncertainty associated with the implementation of reduction techniques will be evaluated and refined through the Adaptive Management Process, as described in Chapter 3, Section 3.6, *Adaptive Management and Monitoring Program*.

**Table 4-7. Potential Methods of Localized Reduction of Predatory Fish Populations**

Technique	Advantage	Limitation	Potential Application
<b>Methods Potentially Applicable for the Delta</b>			
Electrofishing	<ul style="list-style-type: none"> <li>• Can be used in areas with dense vegetation (SAV) or submerged structures</li> <li>• Can preferentially target larger predatory fish (which consume more and larger prey per capita)</li> </ul>	<ul style="list-style-type: none"> <li>• Incidental injury or mortality possible for covered fish species</li> <li>• Labor-intensive</li> <li>• Expertise required</li> <li>• May be less effective with smaller but more numerous juvenile predators</li> <li>• Does not work well in brackish water</li> <li>• Low efficiency for mobile predators</li> </ul>	<ul style="list-style-type: none"> <li>• Apply in shallow areas with submerged structures or SAV, regions where techniques such as netting are less effective</li> </ul>

Technique	Advantage	Limitation	Potential Application
Hook-and-line	<ul style="list-style-type: none"> <li>• Can be modified to target specific species</li> <li>• Low mortality of by-catch</li> <li>• Easy to implement</li> <li>• Could enlist voluntary (perhaps with incentives) help of anglers</li> <li>• Take of predators beyond legal bag limits could be covered by scientific collecting permits, if approved by CDFW</li> </ul>	<ul style="list-style-type: none"> <li>• Time-intensive</li> <li>• Skill, knowledge, and proper equipment are necessary to efficiently capture fish by hook and line</li> <li>• Participation of anglers limited by requirement for scientific collecting permit</li> <li>• Take of predators may be limited by scientific collecting permit</li> </ul>	<ul style="list-style-type: none"> <li>• Deploy paid fisherman (biologists or technicians) or volunteers to angle for predators in targeted areas.</li> <li>• Implement in hotspots such as Clifton Court Forebay or along portion of the mainstem San Joaquin River.</li> </ul>
Passive trapping (e.g., fyke nets, hoop net traps, baited traps)	<ul style="list-style-type: none"> <li>• Effective against sunfish and other centrarchids (except largemouth bass)</li> <li>• Hoop nets effective on catfish</li> <li>• Low mortality rates of by-catch</li> <li>• Can be deployed in areas too deep for beach seining</li> </ul>	<ul style="list-style-type: none"> <li>• Not effective for largemouth bass</li> <li>• Labor-intensive to maintain</li> <li>• Cannot be set in shallow areas</li> <li>• Must be periodically moved to maintain catch efficiency</li> </ul>	<ul style="list-style-type: none"> <li>• Effective for areas with high flow</li> </ul>
Gillnetting	<ul style="list-style-type: none"> <li>• Shown to be effective against striped bass and other mobile fish species</li> <li>• Works well in turbid waters</li> </ul>	<ul style="list-style-type: none"> <li>• High by-catch of splittail and for some mesh sizes, adult salmonids</li> </ul>	<ul style="list-style-type: none"> <li>• Use in areas of the Delta with turbid waters and lack of submerged vegetation or structures, e.g., the hole at Head of Old River</li> </ul>
Active capture (e.g., trawling or beach seines)	<ul style="list-style-type: none"> <li>• Mesh size of nets could be large enough to capture larger predators while achieving relatively low rates of incidental by-catch of juvenile salmonids and adult delta and longfin smelt.</li> </ul>	<ul style="list-style-type: none"> <li>• Labor-intensive</li> <li>• Ineffective in areas with a lot of submerged vegetation or structures</li> <li>• Need open beach areas to conduct beach seines</li> <li>• Limited to wadeable depths</li> </ul>	<ul style="list-style-type: none"> <li>• Use in areas lacking submerged structures or dense vegetation that may hinder or get entangled in the netting</li> <li>• Beach seining requires open beaches</li> </ul>
Predator lottery fishing tournaments	<ul style="list-style-type: none"> <li>• Can be designed to direct volunteer fishing effort to particular fish species, at specific times and locations</li> <li>• Low mortality of by-catch</li> <li>• Potential for good public relations</li> </ul>	<ul style="list-style-type: none"> <li>• Requires provision in fishing tournament regulations to allow participants to possess fish in excess of bag limits and outside of legal size limits (similar to provisions already provided for black bass tournaments in the Delta)</li> <li>• Requires targeting fish in identified, localized hotspots, and avoiding indiscriminately catching fish throughout the Plan Area</li> </ul>	<ul style="list-style-type: none"> <li>• Release predators with internal coded tags, and advertise the event and offer a prize for angler catching a specific tag coded fish</li> <li>• Implement in hotspots such as Clifton Court Forebay or along portion of the mainstem San Joaquin River</li> </ul>
Sources: Nielsen and Johnson 1983; Feyrer and Healey 2003; Finlayson et al. 2010; U.S. Army Corps of Engineers 2012; Cavallo pers. comm.			

Predator lottery fishing tournaments, a variant of the hook-and-line fishing technique, could be useful for reducing local abundance of predators at hotspots such as Clifton Court Forebay or along mainstem San Joaquin River (Cavallo pers. comm.). These tournaments will be designed to encourage intensive angling pressure at a particular location during a particular period of time (i.e., when covered prey species are present), and targeting specific predatory fish species (i.e., striped bass, largemouth bass). Such tournaments will be cost-effective, and potential by-catch will be minimized by requiring fisherman to use only particular hook-and-line methods that are known to be effective for the target predator(s). Following a tournament, tagged fish will be released and recaptured at these localized hotspots, using methods similar to those used to evaluate prescreen loss at Clifton Court Forebay or at other locations within the Delta. The results will be compared to survival studies of covered fish within localized hotspots prior to predator reduction efforts. The comparison will take into account flow rates through the area and water temperature, since these factors play a significant role in affecting predation losses as indexed by smolt survival (Cavallo et al. 2012).

#### **Habitat Modification to Reduce Predator Holding Areas**

The pilot program also will evaluate the modification or elimination of habitat features that provide holding habitat for predatory fish and/or increase capture efficiency by predators. Examples of such habitat features include submerged human-made structures (e.g., abandoned boats, derelict structures, bridge piers), water diversion facilities (e.g., intakes, forebays), channel features (e.g., scour hole at head of Old River), beds of invasive aquatic vegetation (IAV) (to be treated under CM13), and salvage release sites (California Department of Water Resources 2010b). One hypothesis is that removal of structures could have the benefit of reducing local aggregations of predators.

Reach-specific survival rates of tagged salmon smolts will be assessed using a before-and-after comparison study to evaluate the predation-related impact of removing predator hotspot structures. Survival assessments will take into account the role of flow rates and water temperature in comparing the before-and-after-removal survival results. Such a before-and-after comparison approach will also be implemented by targeting predators associated with the scour hole at the head of Old River, a known predator holding area. Another method for estimating the efficacy of predator control will be to sample predators at habitat locations and document predator density, then use bioenergetics models to estimate how much consumption of covered fish species may have been reduced (Cavallo pers. comm.). This method may be cost prohibitive however, due to the extensive data that will be required.

Another approach is to modify salvage release methods and vary or increase release locations to avoid unintentionally creating predator feeding stations at the release pipe. A pilot experiment will increase the number of release sites from four to eight, alternate the timing of releases between the eight sites to discourage predators from holding at release sites and remove debris near salvage release sites monthly from October through June to reduce the predation loss of salvaged splittails and other fish. Increasing the number of release sites, alternating the timing of releases between the sites and removing debris that may provide predator cover are expected to contribute to a reduction in predation of covered fish species.

#### **4.2.4.4.2 Program Timeline**

During year 1, the Implementation Office will evaluate the strategies for logistical issues, relative effectiveness, incidental impacts on covered fish, and cost-effectiveness. The initial year of

assessment will be used to improve understanding of the intricacies of implementing each strategy of predator reduction specifically in the Delta ecosystem. Initially, the implementation of the pilot program may be managed by Implementation Office staff, but eventually responsibility will transfer to CDFW and NMFS field staff.

After year 1 of pilot program implementation, the Implementation Office will refine the scope and methodology of the pilot program based on review by and coordination with the fish and wildlife agencies, and continue with implementation for an additional 5 to 7 years. Review and coordination with the fish and wildlife agencies will occur every other year thereafter for the duration of the implementation period. At the end of this pilot implementation period, program assessment will involve independent science review and publication of findings. After the reviews are considered, the Adaptive Management Team, in collaboration with the fish and wildlife agencies, will refine operations and decide whether and in what form predator reduction and further adaptive management will continue.

#### 4.2.4.5 CM16 Nonphysical Fish Barriers

Under CM16, the Implementation Office will use nonphysical barriers to redirect juvenile fish away from channels and river reaches in which survival is lower than in *alternate routes* (Figure 3.4-33, *Schematic of Nonphysical Fish Barrier*, in Chapter 3, *Conservation Strategy*). Nonphysical barriers may be installed and operated from October to June or when monitoring determines that salmonid smolts are present in the target areas. Nonphysical fish barriers have not been shown to be effective for other covered fish species; thus, this conservation measure is only expected to benefit salmonids.

The Implementation Office may install nonphysical barriers at the sites described below. These barriers will use a combination of sound, light, and bubbles, similar to the three-component nonphysical barrier used in the 2009 DWR Head of Old River Test Project (Bowen et al. 2009). Design and permitting for the initial barrier installations will take approximately 2 years, with installation and operation beginning in year 3. The cost estimate for this conservation measure (Chapter 8, *Implementation Costs and Funding Sources*) assumes that seven barriers will be constructed and operated during the permit term; however, fewer than seven barriers may be constructed if they are found to be less effective biologically and more expensive per barrier than the cost estimates. Similarly, more than seven barriers may be constructed if they are found to be biologically effective and less costly per barrier than estimated.

##### 4.2.4.5.1 Siting and Design Considerations

Siting and design considerations may include survival rates of juvenile salmonids along specific migration routes within the Plan Area; site-specific conditions such as flow, turbidity, substrate, and channel bathymetry; and predator interaction with nonphysical barriers. Currently, likely sites for nonphysical barrier placement include Head of Old River (Figure 3.4-34, *Potential Locations of Nonphysical Fish Barriers*, in Chapter 3, *Conservation Strategy*). Delta Cross Channel, Georgiana Slough, and possibly Turner Cut and Columbia Cut. Barriers at these locations have a high potential to deter juvenile salmonids from using specific channels/migration routes that may contribute to decreased survival resulting from increased predation and/or entrainment, or to direct juvenile salmonids to areas that may increase their survival such as Yolo Bypass. The Implementation Office may consider other locations in the future, if, for example, future research demonstrates differential rates of survival in Sutter and Steamboat Sloughs or in Yolo Bypass relative to the mainstem Sacramento River. The Implementation Office will be responsible for installation, operation,

1 maintenance, and removal of the nonphysical barriers. Nonphysical barrier placement may be  
 2 accompanied by actions to reduce local predator abundance, if monitoring finds that such barriers  
 3 attract predators or direct covered fish species away from potential entrainment hazards but  
 4 toward predator hotspots. Barriers will be removed and stored offsite while not in operation  
 5 (Holderman pers. comm.).

6 Site-specific conditions will drive the design of nonphysical barrier in terms of techniques to anchor  
 7 and secure the structure, measures to indicate the location of the structure for the safety of  
 8 waterway users (i.e., recreational boaters) and preferences for fish migration routes. As described in  
 9 Chapter 8, *Implementation Costs and Funding Sources*, the capital and operational costs of  
 10 nonphysical barriers increase dramatically in deep and wide sections of channels. Therefore, the  
 11 expected and measured benefits of the barrier at a particular location will be evaluated against its  
 12 biological benefits.

#### 13 **4.2.4.6 CM17 Illegal Harvest Reduction**

14 CM17 funds and provides equipment to support more game wardens to enforce fish and game  
 15 regulations in the Delta. Currently the activities of these staff have not been identified as having the  
 16 potential to result in take of covered species. The conservation measure does not propose any new  
 17 activities – only that the current activities be performed more frequently and consistently.  
 18 Accordingly, this conservation measure is not expected to result in take of covered species or  
 19 adverse modification of critical habitat.

#### 20 **4.2.4.7 CM18 Conservation Hatcheries**

21 Under CM18, the Implementation Office will establish new and expand existing conservation  
 22 propagation programs for delta and longfin smelt. The Implementation Office will support two  
 23 programs.

- 24 • The development of a delta and longfin smelt conservation hatchery by USFWS to house a delta  
 25 smelt refugial population and provide a continued source of delta and longfin smelt for  
 26 experimentation.
- 27 • The expansion of the refugial population of delta smelt and establishment of a refugial  
 28 population of longfin smelt at the University of California Davis Fish Conservation and Culture  
 29 Laboratory in Byron.

30 The principal purpose of CM18 is to ensure the existence of refugial captive populations of both  
 31 delta and longfin smelt, thereby helping to reduce risks of extinction for these species. The use of  
 32 two refugial facilities will decrease the likelihood of catastrophic loss of captive fish to disease. The  
 33 refugial populations will also constitute a source of animals for experimentation, as needed, to  
 34 address key uncertainties about delta and longfin smelt biology. This approach minimizes the need  
 35 to harvest wild stock for research purposes.

36 Depending on the site selected for hatchery construction, the hatchery may occupy already  
 37 developed areas or cultivated land. The size of the site needed for construction is estimated at 20  
 38 acres. Construction is expected to require limited in-water work to build small intakes and outflows.  
 39 Effects of this construction will be minimized by performing work during approved in-water  
 40 construction windows and through application of appropriate avoidance and minimization  
 41 measures, such as AMM5 *Spill Prevention, Containment, and Countermeasure Plan*, AMM8 *Fish Rescue*  
 42 *and Salvage Plan*, and AMM9 *Underwater Sound Control and Abatement Plan*, as applicable.

#### 4.2.4.8 CM19 Urban Stormwater Treatment

CM19 funds local projects that improve treatment of urban stormwater, but does not permit or authorize such projects. A project that requires in-water work is required to secure appropriate permits, including appropriate ESA consultation for any action with a federal nexus. Projects that do not require in-water work are expected to occur in developed areas that do not provide habitat for covered species. Accordingly, this conservation measure is not expected to result in incidental take of covered species or adverse modification of critical habitat.

#### 4.2.4.9 CM20 Recreational Users Invasive Species Programs

CM20 does not entail or require any in-water activity, or activity in areas that are not already developed. This conservation measure also does not entail or require any construction. Therefore, this conservation measure is not expected to result in take of covered species or adverse modification of critical habitat.

#### 4.2.4.10 CM21 Nonproject Diversions

##### 4.2.4.10.1 Purpose

For the purpose of the BDCP, nonproject diversions consist of infrastructure used to divert surface waters within the Plan Area and that is not associated with operations of the SWP or the CVP. This conservation measure has the potential to result in the remediation of an average estimated 100 cfs of diversion capacity per year, beginning in year 6 and continuing throughout the permit term. The level and extent of remediation that occur through this process will depend on the number of participating diverters and the diversion capacity of those participants' diversion facilities. The estimate of an average of 100 cfs diversion capacity per year remediated is based on an evaluation of the level of landowner participation to date in the existing CDFW and Reclamation fish screen programs, and the expected increase in participation with the availability of new funds and the opportunity to obtain take authorization through the BDCP.

Remediation will occur through remediation techniques detailed below, and in CM21. Remediated diversions could be located anywhere in the Plan Area. Most of the nonproject diversions that occur in the Plan Area serve to support agriculture or waterfowl production.

This remediation will be achieved by the installment of fish screens or other similar means, or by removal of diversions because of transfer of cultivated lands or managed wetlands into the reserve system. In-water work will occur during the months of June to October of each year.

Remediation is defined to include application of any of the following methods for treatment of unscreened diversions.

- Installation of screens.
- Consolidation of multiple unscreened diversions into a single or fewer screened diversions placed in lower-value habitat.
- Relocation of diversions with substantial effects on covered species from high-value to lower-value habitat, in conjunction with screening.

- Reconfiguration and screening of individual diversions in high-value habitat to take advantage of small-scale distribution patterns and behavior of covered fish species relative to the location of individual diversions in the channel.
- Voluntary alteration of the daily and seasonal timing of diversion operation.
- Removal of individual diversions that have relatively large effects on covered fish species, or as a consequence of transfer of cultivated lands or managed wetlands into the reserve system.

Additional methods may be implemented if the Implementation Office determines those methods to be appropriate.

#### **4.2.4.10.2 Actions to be Implemented**

The Implementation Office will form a technical team to inventory potential projects and rank those potential projects in order of priority. The technical team will include BDCP staff designated by the Science Manager, USFWS and Reclamation representatives from the a representative of Reclamation's Anadromous Fish Screen Program, and a representative of CDFW's Fish Screen and Passage Program. Although the existing Reclamation and CDFW programs focus on achieving benefits to anadromous salmonids, the technical team will be charged to develop and apply criteria that consider potential effects on all covered fish species and that assign highest priority to cost-effective projects that maximize expected entrainment reductions.

The Implementation Office will develop and publish criteria by which it will evaluate requests from landowners, on whose property nonproject diversions are located, for participation in this conservation measure. In its consideration of landowner requests, the Implementation Office will take into account, at a minimum, the following factors.

- Demonstration by the landowner of a valid water right.
- Use by the landowner of reasonable methods of diversion and water measurement.
- Efforts by the landowner, or by the entity that receives water diverted through the landowner's diversion facility, to implement appropriate irrigation efficiency programs.
- Demonstration by the landowner that the diverted water is being put to reasonable and beneficial use and not being wasted.
- Demonstration by the landowner that subsurface drain water and/or surface returns flow discharged into a Delta water way does not have an unreasonable impact on Delta water quality.

Landowners who operate diversions identified by the technical team as a high priority for remediation, and whose diversions have been evaluated favorably by the Implementation Office pursuant to the aforementioned criteria, will be invited to participate in CM21. Operators who choose to be part of the program will sign a certificate of compliance committing them to the process and terms of this conservation measure. Operators who have signed a certificate of compliance will receive authorization for incidental take associated with diversion operation or remediation and will be referred to as Other Authorized Entities (Chapter 7, Section 7.1.2.2, *Other Authorized Entities*). Participating landowners will be covered for take associated with the operation of these diversions, including take that may occur because of the following circumstances.

- Upon signing the certificate of compliance for the program, but prior to remediation, incidental take may occur due to entrainment to the existing diversion or impingement on the existing screens, if any.

- During the remediation process, incidental take may occur because of implementing the remedial measure. For instance, remediation that involves removing an existing diversion may result in take associated with in-water work required to remove screens, piping, and other materials related to the diversion, and potentially from incidental effects, such as temporary turbidity spikes associated with installation of earth or plant materials that may be required to restore the site. Remediation that involves consolidating multiple diversions and either installing a new diversion or refitting an existing one may cause take due to in-water work that potentially includes placement of temporary or permanent piling, temporary site dewatering, risk of hazardous material spills, and risk of turbidity or associated issues. These potential impacts will be minimized using techniques described in Appendix 3.C, *Avoidance and Minimization Measures*, including but not limited to development of temporary erosion and sedimentation control plans and fish rescue and salvage plans.
- Following remediation, incidental take may still occur through entrainment or impingement, although the risk of these impacts will be de minimus if the diversion were fitted with fish screens approved by the fish agencies. Remediation that entails altered timing of diversion operations will still entail a risk of incidental take, if individuals of covered species were present at times when diversions were operational.

Remediation actions will be fully funded through the BDCP. These actions will be completed within 5 years of the execution of a certificate of compliance by the Implementation Office and the participating landowner.

With regard to diversions selected for remediation, the Implementation Office will implement the remediation program consistent with all Anadromous Fish Screen Program and Fish Screen and Passage Program objectives.

The Implementation Office will prepare, either internally or in conjunction with the Anadromous Fish Screen Program and Fish Screen and Passage Program, annual summary reports describing prior year achievements of supported programs.

The remediation program, including the execution of associated interagency agreements creation of a technical team, development of selection criteria, and establishment of priorities, is expected to be in effect within 2 years and fully operational in year 3. Individual actions under the program are expected to take approximately 3 to 5 years to design, permit, and construct.

Based on performance of the Anadromous Fish Screen Program and Fish Screen and Passage Program during the past 20 years, the highest priority projects, at least initially, may address the larger nonproject diversions (more than 100 cfs) located along major channels in the Delta. It is also likely that priority may be given to some smaller diversions occurring in locations that support relatively large concentrations of covered fish, and that other diversions will be given higher priority because their timing of operations is conducive to high risk of take of covered species. For example, diversions operated during the winter have a higher risk of entraining outmigrant winter-run Chinook salmon than diversions operated only in the late spring and summer.

#### **4.2.4.10.3 Review and Adaptation Provisions**

Projects will be identified through the review process, and will then be subject to a multiyear process that includes a feasibility study, preliminary design, final design, and construction. Other regulatory requirements also must be met. Upon completion of the project, the diverter becomes the



owner of the constructed facilities and is solely responsible for the operation and maintenance of the fish screen, if one is installed.

The Implementation Office will defer, as appropriate, to the working procedures used in the existing Reclamation and CDFW programs. Work plans for diversions selected for remediation will be included in the Annual Work Plan and Budget.

The Implementation Office and Adaptive Management Team will review the reports prepared by Supporting Entities to assess program effectiveness including approaches to management and funding, and may recommend changes to the conservation measure. If program assessments indicate that the program is not effective in achieving its stated objectives of providing benefits to covered species or their habitats, the Implementation Office may recommend that the program be terminated. If the Authorized Entity Group approve such a recommendation, take coverage will remain in place for any diversions that have already been remediated under the program.

## 4.2.5 CM22 Avoidance and Minimization Measures

Certain activities described for CM22 in Chapter 3, Section 3.4, *Conservation Measures*, and in Appendix 3.C, *Avoidance and Minimization Measures* have the potential to cause incidental take and thus are covered activities. Although these measures are intended to identify presence of covered species or suitable habitat and to avoid impacts to these resources, there is a risk that these measures may not be fully effective and as a consequence may result in unintended, incidental take. The measures which may result in such outcomes all entail performance of activities within potentially suitable habitat for covered species, and are briefly described in Table 4-8.

**Table 4-8. Summary of the Covered Avoidance and Minimization Measures**

Number	Title	Summary
<b>Benefit All Natural Communities and Covered Species</b>		
1	Worker Awareness Training	Includes procedures and training requirements to educate construction personnel on the types of sensitive resources, including sensitive timing windows for covered species, in the project area, the applicable environmental rules and regulations, and specific training on the measures required to avoid and minimize effects on these resources.
2	Construction Best Management Practices and Monitoring	Standard practices and measures that will be implemented prior, during, and post-construction to avoid or minimize effects of construction activities on sensitive resources (e.g., species, habitat), and monitoring protocols for verifying the protection provided by the implemented measures.
<b>Primarily Benefit Covered Fishes</b>		
3	Stormwater Pollution Prevention Plan	Includes measures that will be implemented to minimize pollutants in stormwater discharges during and after construction related to covered activities, and that will be incorporated into a Stormwater Pollution Prevention Plan to prevent water quality degradation related to pollutant delivery from project area runoff to receiving waters.

Number	Title	Summary
4	Erosion and Sediment Control Plan	Includes measures that will be implemented for ground-disturbing activities, to control short-term and long-term erosion and sedimentation effects and to restore soils and vegetation in areas affected by construction activities, and that will be incorporated into plans developed and implemented as part of the National Pollutant Discharge Elimination System permitting process for covered activities. It is anticipated that multiple erosion and sediment control plans will be prepared and implemented for BDCP construction activities, each taking into account site-specific conditions such as proximity to surface water, erosion potential, drainage, etc.
5	Spill Prevention, Containment, and Countermeasure Plan	Includes site-specific plans and measures to prevent and respond to spills of hazardous material that could affect navigable waters, including actions used to prevent spills, in addition to specifying actions that will be taken should any spills occur, including emergency notification procedures and education on pollution control laws and regulations.
6	Disposal and Reuse of Spoils, Reusable Tunnel Material (RTM), and Dredged Material	Includes measures for handling, storing, beneficial reuse, and disposing of excavation or dredge spoils and RTM, including procedures for the chemical characterization of this material or the decant water to comply with permit requirements, and reduce potential effects on aquatic habitat, as well as specific measures to avoid and minimize effects to species in the areas where RTM will be used or disposed.
7	Barge Operations Plan	Includes measures to avoid or minimize effects on aquatic species and habitat related to barge operations, by establishing specific protocols for the operation of all project-related vessels at the construction and/or barge landing sites. The plan also includes monitoring protocols to verify compliance with the plan and procedures for contingency plans.
8	Fish Rescue and Salvage Plan	Includes measures that detail procedures for fish rescue and salvage to minimize the number of Chinook salmon, steelhead, green sturgeon, and other fish stranded during construction activities especially during the placement and removal of cofferdams at the intake construction sites.
9	Underwater Sound Control and Abatement Plan	Includes measures to minimize the effects of underwater construction noise on fish, particularly from impact-pile-driving activities. Potential effects of pile driving will be minimized by limiting pile driving to the approved in-water work window and by controlling or abating underwater sound levels generated during pile driving.
<b>Primarily Benefit Covered Plants, Wildlife, or Natural Communities</b>		
10	Restoration of Temporarily Affected Natural Communities	Restore and monitor natural communities in the Plan Area that are temporarily affected by covered activities. Measures in AMM10 <i>Restoration of Temporarily Affected Natural Communities</i> including methods for stockpiling and storing topsoil, restoring soil conditions, and revegetating disturbed areas; schedules for monitoring and maintenance; strategies for adaptive management; reporting requirements; and success criteria, will be incorporated into restoration monitoring plans.
11	Covered Plant Species	Conduct botanical surveys during the project planning phase and implement protective measures, as necessary. Redesign to avoid indirect effects on modeled habitat, and effects on core recovery areas.
12	Vernal Pool Crustaceans	Includes provisions to require project design to minimize indirect effects on modeled habitat, avoid effects on core recovery areas, minimize ground-disturbing activities or alterations to hydrology, conduct protocol-level surveys, and redesign projects to ensure that no suitable habitat within these areas is adversely affected.

Number	Title	Summary
13	California Tiger Salamander	During the project planning phase, identify suitable habitat within 1.3 miles of the project footprint, ash survey aquatic habitats in potential work areas for California tiger salamander. If California tiger salamander larvae or eggs are found, implement prescribed mitigation.
14	California Red-Legged Frog	During the project planning phase, identify suitable habitat within 1 mile of the project footprint, conduct a preconstruction survey, implement protective measures for areas where species presence is known or assumed, and establish appropriate buffer distances. If aquatic habitat cannot be avoided implement prescribed surveys and mitigation.
15	Valley Elderberry Longhorn Beetle	During the project planning phase, conduct surveys for elderberry shrubs within 100 feet of covered activities involving ground disturbance, design project to avoid effects within 100 feet of shrubs, if feasible. Implement additional protective measures, as stipulated in AMM2 <i>Construction Best Management Practices and Monitoring</i> . Elderberry shrubs identified within project footprints that cannot be avoided will be transplanted to previously approved conservation areas in the Plan Area.
16	Giant Garter Snake	During the project planning phase, identify suitable aquatic habitat (wetlands, ditches, canals) in the project footprint. Conduct preconstruction surveys and implement protective measures.
17	Western Pond Turtle	Identify suitable aquatic habitat and upland nesting and overwintering habitat in and within the project footprint. Conduct preconstruction surveys in suitable habitat twice including 1 week before and within 48 hours of construction. Implement protective measures as described.
18	Swainson's Hawk and White-Tailed Kite	Conduct preconstruction surveys of potentially occupied breeding habitat in and within 0.25 mile of the project footprint to locate active nest sites. Implement prescribed mitigation (tree planting) and monitoring to verify attainment of performance standards.
19	California Clapper Rail and California Black Rail	Identify suitable habitat in and within 500 feet of the project footprint. Perform surveys and implement prescribed protective measures in areas where species is present or assumed to be present.
20	Greater Sandhill Crane	Conduct preconstruction surveys to determine winter roost occupancy within 0.5 mile of the project footprint and determine related areas of foraging habitat. Implement protective measures in occupied areas.
21	Tricolored Blackbird	Conduct preconstruction surveys in breeding habitat in and within 1,300 feet of the project footprint, if the project is to occur during the breeding season. Avoid any construction activity within 250 feet from an active tricolored blackbird nesting colony, and minimize such activity within 1,300 feet.
22	Suisun Song Sparrow, Yellow-Breasted Chat, Least Bell's Vireo, Western Yellow-Billed Cuckoo	Conduct preconstruction surveys of potential breeding habitat in and within 500 feet of project activities. It may be necessary to conduct the breeding bird surveys during the preceding year depending on when construction is scheduled to start. Implement protective measures in occupied areas.
23	Western Burrowing Owl	Perform surveys where burrowing owl habitat (or sign) is encountered within 150 meters of a proposed construction area. If burrowing owls or suitable burrowing owl burrows are identified during the habitat survey, and if the project does not fully avoid direct and indirect impacts on the suitable habitat, perform preconstruction surveys and implement certain minimization measures

Number	Title	Summary
24	San Joaquin Kit Fox	Conduct habitat assessment in and within 250 feet of project footprint. If suitable habitat is present, conduct a preconstruction survey and implement U.S. Fish and Wildlife Service guidelines. Implement protective measures in occupied areas.
25	Riparian Woodrat and Riparian Brush Rabbit	Surveys will be conducted for projects occurring within suitable habitat as identified from habitat modeling and by additional assessments conducted during the planning phase of construction or restoration projects following U.S. Fish and Wildlife Service <i>Draft Habitat Assessment Guidelines and Survey Protocol for the Riparian Brush Rabbit and the Riparian Woodrat</i> . Implement protective measures in suitable habitat.
26	Salt Marsh Harvest Mouse and Suisun Shrew	Identify suitable habitat in and within 100 feet of the project footprint for projects in the species range. Ground disturbance will be limited to the period between May 1 and November 30, to avoid destroying nests with young. Prior to ground-disturbing activities, vegetation will first be removed with nonmechanized hand tools (e.g., goat or sheep grazing, or in limited cases where the biological monitor can confirm that there is no risk of harming salt marsh harvest mouse or Suisun shrew). Implement protective measures in suitable habitat.
27	Selenium Management	Develop a plan to evaluate site-specific restoration conditions and include design elements that minimize any conditions that could be conducive to increases of bioavailable selenium in restored areas. Before ground-breaking activities associated with site specific restoration occurs, identify and evaluate potentially feasible actions for the purpose of minimizing conditions that promote bioaccumulation of selenium in restored areas.
28	Geotechnical Studies	Conduct geotechnical investigations to identify the types of soil avoidance or soil stabilization measures that should be implemented to ensure that the facilities are constructed to withstand subsidence and settlement and to conform to applicable state and federal standards.
29	Design Standards and Building Codes	Ensure that the standards, guidelines, and codes, which establish minimum design criteria and construction requirements for project facilities, will be followed. Follow any other standards, guidelines, and code requirements that are promulgated during the detailed design and construction phases and during operation of the conveyance facilities.
30	Transmission Line Design and Alignment Guidelines	Design the alignment of proposed transmission lines to minimize impacts on sensitive terrestrial and aquatic habitats when siting poles and towers. Restore disturbed areas to preconstruction conditions. In agricultural areas, implement additional BMPs. Site transmission lines to avoid greater sandhill crane roost sites or, for temporary roost sites, by relocating roost sites prior to construction. Site transmission lines to minimize bird strike risk.
31	Noise Abatement	Develop and implement a plan to avoid or reduce potential construction-, maintenance-, and operation-related in-air noise impacts.
32	Hazardous Material Management	Develop and implement site specific plans that will provide detailed information on the types of hazardous materials used or stored at all sites associated with the water conveyance facilities and required emergency-response procedures in case of a spill. Before construction activities begin, establish a specific protocol for the proper handling and disposal of hazardous materials.

Number	Title	Summary
33	Mosquito Management	Consult with appropriate Mosquito and Vector Control Districts before the sedimentation basins, solids lagoons and the intermediate forebay inundation area become operational. Once these components are operational, consult again with the MVCDs to determine if mosquitoes are present in these facilities, and implement mosquito control techniques as applicable. Consult with MVCDs when designing and planning restoration sites.
34	Construction Site Security	Provide all security personnel environmental training similar to that of onsite construction workers so that they understand the environmental conditions and issues associated with the various areas for which they are responsible at a given time.
35	Fugitive Dust Control	Implement basic and enhanced control measures at all construction and staging areas to reduce construction-related fugitive dust and ensure the project commitments are appropriately implemented before and during construction, and that proper documentation procedures are followed.
36	Notification of Activities in Waterways	Before in-water construction or maintenance activities begin, notify appropriate agency representatives when these activities could affect water quality or aquatic species.

## 4.2.6 Monitoring Activities

Monitoring activities specific to the BDCP include compliance monitoring, which verifies BDCP compliance with terms of the Plan, and effectiveness monitoring, which tracks status of covered species and natural communities, and also tracks Plan progress toward achieving the biological objectives. As described in Chapter 3, Section 3.6.4.1.2, *Protocols*, monitoring protocols will be developed and proposed by the Adaptive Management Team and are subject to review and approval by the fish and wildlife agencies. Minimization of incidental take risk will be an objective when developing the protocols, but in some cases, it may not be practicable to avoid the risk entirely. All BDCP monitoring activities undertaken by the Implementation Office are covered activities. All covered monitoring activities will be carried out in a manner consistent with protocols recommended by the Adaptive Management Team and approved by the fish and wildlife agencies.

Monitoring activities currently proposed are detailed in Appendix 3.D, *Monitoring and Research Actions*. The following types of monitoring activities have the potential to result in incidental take:

*Species surveys:* Species surveys are needed for preconstruction surveys (Appendix 3.C, *Avoidance and Minimization Measures*) and to track status and trend of covered species in the Plan Area. Such surveys are needed for most covered species, both terrestrial and aquatic. Some of these surveys require capture and release of individuals of covered species; others entail activities in occupied habitat. Such surveys have the potential to result in incidental take by harassment, temporary modification of fundamental behaviors (e.g., foraging, reproduction), or incidental injury or mortality.

*Sample collection:* Sampling is needed to plan construction work (e.g., sampling for methylmercury in sediments) verify effectiveness of conservation actions intended to increase production of food organisms, control IAV, locally reduce piscivorous predator abundance, and achieve other changes in ecosystem condition. Such sampling typically requires disturbance of habitat, in-water net trawls, or similar activities that have the potential to entrain, harass, or injure individuals of covered species in the area.

*Ambient environmental monitoring in habitat:* Ambient environmental monitoring includes all monitoring requiring field work, not described above. Examples include water quality monitoring, monitoring to verify function of created or restored habitat, and various types of construction compliance monitoring. If the habitat is occupied by covered species, there is a risk that monitoring activities may cause incidental harassment, primarily by temporary disruption of activities such as foraging, although effects up to and including mortality are possible.

#### **4.2.7 Transfers and other Voluntary Water Market Transactions**

State and federal laws governing water use in California promote the use of water transfers to manage water resources, particularly during water shortages, provided that certain conditions associated with the transfers are adopted to protect source areas, the environment and other users of the water. Transfers of water requiring export from the Delta are conducted at times when pumping and conveyance capacity at the SWP or CVP export facilities is available to move the water. Additionally, operations to accomplish these transfers must be carried out in coordination with SWP and CVP operations, such that the capabilities of the projects to exercise their own water rights or to meet their legal and regulatory requirements are not diminished or limited in any way. Water conveyed under DWR's water right permits between or among its SWP water contractors is not a water transfer.

In addition to the water transfer transactions described above, there is a potential for other voluntary water market transactions that involve water that could be conveyed through the Delta for water supply or environmental purposes. These transactions could include acquisitions of water rights, exchanges of water, or coordinated or integrated operations of projects other than the SWP or CVP, that could be used to supplement water supplies, increase in-stream flows, or increase Delta inflow. These other types of transactions will most likely come from some of the same source areas and have similar constraints and in-Delta impacts as water transfers.

Under the BDCP, there is no quantified maximum amount of water that could be delivered through SWP and CVP facilities in the Delta, including SWP and CVP project water and water from voluntary water market transactions, provided SWP and CVP operations are consistent with the operational criteria described in CM1, and these operations are not limited by other factors including hydrologic, regulatory and contractual conditions. Water transfers, exchanges of SWP or CVP project water among SWP or CVP contractors and other voluntary water market transactions are covered activities if the transactions are consistent with the operational criteria described in CM1 and the effects analysis described in Chapter 5, *Effects Analysis*. However, the actions involved in obtaining water for these voluntary water market transactions that affect the source area are outside the scope of the covered activities. Consequently, separate environmental review and possibly take authorizations may need to be obtained that cover impacts to listed species or critical habitat that may result from the effects of such transactions on the source area. It is the responsibility of the seller or buyer of water in such transactions to secure any such take authorizations.

### **4.3 Federal Actions Associated with the BDCP**

The activities described in this section have been designated as federal actions associated with the BDCP. These actions consist of CVP-related activities in the Delta that are primarily carried out by

Reclamation. Reclamation has authority to act consistent with current authorizations, regulatory commitments, or future new authorizations. At this time no new activities have been authorized for performance of BDCP actions, and Reclamation does not represent an intent to participate in BDCP actions except within the scope of their current authorizations. Federal actions described in the BDCP are subject to the ESA Section 7 consultation process; as such, Reclamation will consult with USFWS and NMFS regarding the effect of these actions on listed species and designated critical habitat. For the federal actions set out in this section, the BDCP is intended to provide the basis for a biological assessment to support Section 7 consultations with the federal fish and wildlife agencies.

The CVP's Delta Division<sup>18</sup> facilities in the Plan Area consist of the Delta Cross Channel, the eastern portion of the Contra Costa Canal, including the Contra Costa Water District (CCWD) diversion facility at Rock Slough; the Jones Pumping Plant (formerly Tracy Pumping Plant), the Tracy Fish Collection Facility, the northern portion of the Delta Mendota Canal (Figure 1-1, *Plan Area Location*, in Chapter 1, *Introduction*, and Figure 4-1), the joint point of diversion facilities to be constructed in the north Delta, and the associated conveyance to export facilities in the south Delta. These facilities are used to convey water from the Sacramento River in the north Delta to the south Delta and to export that water from the Delta into canals and pipelines that carry it to agricultural and municipal and industrial contractors to the south and west of the Delta. These facilities are integral components of the CVP and contribute to the functional capacity of the overall system. This section describes the existing facilities, their operational requirements, and the actions necessary to maintain their viability. (Section 4.2.1, *CM1 Water Facilities and Operation*, describes the new facilities proposed for the north Delta, and the associated conveyance facilities.) The operation and maintenance of these facilities are not only integral to the water supply system, but are also important to the conservation strategy and the protection and conservation of the aquatic ecosystem and covered fish species.

Once the new north Delta diversions become operational, the existing CVP facilities described in this section will be operated under the water operations criteria described in CM1. All operations and maintenance of CVP facilities described in this section are federal actions associated with the BDCP and the effects of those actions are addressed by the conservation strategy (Chapter 3, *Conservation Strategy* and Chapter 5, *Effects Analysis*). Take authorizations, however, will be provided to Reclamation through the Section 7 consultation process.

### 4.3.1 Delta Cross Channel

The Delta Cross Channel is a gated diversion channel between the Sacramento River, near Walnut Grove, and Snodgrass Slough (Figure 1-1, *Plan Area Location*, in Chapter 1, *Introduction*). Flows into the Delta Cross Channel from the Sacramento River are controlled by two 60-foot-by-30-foot radial gates. When the gates are open<sup>19</sup>, water flows from the Sacramento River through the cross channel to Snodgrass Slough and from there to channels of the lower Mokelumne River and into the central Delta. Once in the central Delta, the water is conveyed primarily via Old and Middle Rivers to the Jones Pumping Plant by the draw of the pumps. The Delta Cross Channel operation improves water

<sup>18</sup> The Delta Division is one of several CVP divisions covering various geographical areas and facilities of the CVP including the American River, Friant, East Side, Sacramento River, San Felipe, West San Joaquin, and Shasta/Trinity River divisions. The CVP Delta Division includes facilities within the Plan Area (described in this chapter) and facilities outside the Plan Area (not included in this chapter).

<sup>19</sup> The Delta Cross Channel gates are open on holiday weekends (Memorial Day, Fourth of July, and Labor Day) to allow the passage of recreational boats.

quality in the interior Delta by improving circulation patterns of good quality water from the Sacramento River towards Delta diversion facilities.

Reclamation operates the Delta Cross Channel in the open position to achieve the following benefits.

- Increase the transfer of water from the Sacramento River to the export facilities at the Banks (SWP) and Jones (CVP) Pumping Plants.
- Improve water quality in the southern Delta by increasing deliveries of fresh water from the Sacramento River to the south Delta.
- Reduce saltwater intrusion rates in the western Delta.

During the late fall, winter, and spring, the gates are often periodically closed to protect out-migrating salmonids from entering the interior Delta experience lower rates of survival due to a longer less direct migration route with higher levels of predation and greater potential for entrainment at the CVP and SWP south Delta export facilities. When flows in the Sacramento River at Sacramento reach 20,000 to 25,000 cfs (on a sustained basis) the gates are closed to reduce potential scouring and flooding that might occur in the channels on the downstream side of the gates.

See Chapter 3, *Conservation Strategy*, for a description of operations of the Delta Cross Channel gates under the BDCP to provide for protection of salmon in conjunction with water conveyance.

Reclamation is seeking ESA Section 7 authorization for all operations and maintenance of the Delta Cross Channel consistent with conservation measures.

### 4.3.2 C. W. “Bill” Jones Pumping Plant

The CVP and SWP use the Sacramento River, San Joaquin River, and Delta channels to transport water to pumping plants located in the south Delta (Figure 1-1, *Plan Area Location*, in Chapter 1, *Introduction*, and Figure 4-1). The CVP’s Jones Pumping Plant, about 5 miles northwest of Tracy, consists of six available pumps. The Jones Pumping Plant is located at the end of an earth-lined intake channel about 2.5 miles in length. The Jones Pumping Plant has a physical capacity of 5,100 cfs and the State Water Board-permitted diversion capacity of 4,600 cfs.

See Chapter 3, *Conservation Strategy*, for description of south Delta operations of the SWP and CVP under the BDCP to provide for protection of covered fish species in conjunction with water conveyance and diversion. Reclamation’s actions that are outside the scope of the BDCP will be addressed as part of their Section 7 consultation with the fish and wildlife services.

### 4.3.3 Tracy Fish Collection Facility

At the head of the intake channel leading to the Jones Pumping Plant, Tracy Fish Collection Facility louver screens intercept fish that are then collected, held, and transported by tanker truck to Delta release sites away from the south Delta facilities. The Tracy Fish Collection Facility uses behavioral barriers consisting of primary and secondary louvers to guide entrained fish into holding tanks. The primary louvers are located in the primary channel just downstream of the trash rack. The secondary louvers are located in the secondary channel just downstream of the traveling water screen. The louvers allow water to pass into the Jones Pumping Plant but the openings between the slats are tight enough and angled against the flow of water in such a way as to prevent most fish from passing between them and instead enter one of four bypass entrances along the louver arrays.



The holding tanks on hauling trucks used to transport salvaged fish to release sites are injected with oxygen and contain an eight parts per thousand salt solution to reduce stress on fish. The CVP uses two release sites, one on the Sacramento River near Horseshoe Bend and the other on the San Joaquin River immediately upstream of the Antioch Bridge.

Reclamation is seeking ESA Section 7 authorization for all operations and maintenance of the Tracy Fish Collection Facility consistent with the BDCP operating criteria.

#### 4.3.4 Central Valley Project Diversions

The volume of water delivered by the CVP is and will continue to be variable, but in any year will be equal to the amount of water that is hydrologically available and that can be diverted under current water rights consistent with the terms and conditions of the conservation strategy and then-existing permits and regulations. Reclamation delivers water transported through facilities in the Delta to senior water rights contractors, long-term CVP water service contractors, refuges and waterfowl areas, and temporary water service contractors south of the Delta. The total volume under contract, including Level 2 refuge supplies, is approximately 3.3 million acre-feet. The CVP provides Level 4 refuge water totaling approximately 100,000 acre-feet. In addition, as part of the San Joaquin River Restoration Program, Reclamation anticipates submitting a petition to add a point of diversion to the State Water Board to allow redirection of the restoration flows either upstream of or in the Delta. Moreover, in wet hydrologic conditions when CVP storage is not available and the Delta is in excess conditions, water is made available under temporary contracts for direct delivery. The volume of water available for conveyance through the Delta is a result of hydrologic conditions, upstream reservoir operations, upstream demands, regulatory constraints on CVP operations, and from transfers of water from upstream water users to south of Delta water users.

See Chapter 3, Conservation Strategy, for description of long-term operations and adaptive range of CVP and SWP under the BDCP to provide for protection of covered fish species in conjunction with water conveyance and diversion. Reclamation's conveyance and diversion actions associated with the BDCP will be covered in the Section 7 consultation. All other conveyance and diversion actions associated with the BDCP by DWR and participating contractors are covered activities for which permits under Section 10 and the NCCPA are sought.

Although DWR will own and operate the new intake and conveyance facilities and their operations will be covered activities as described in Section 4.2, *Covered Activities*, an agreement to wheel CVP water through the new conveyance facility will be executed by DWR, and this action by DWR will be a covered activity.

#### 4.3.5 Associated Maintenance Activities

Maintenance and replacement means those activities that maintain the capacity and operational features of the existing CVP water diversion and conveyance facilities described above including the Delta Cross Channel, Jones Pumping Plant, Tracy Fish Collection Facility, and Contra Costa Diversion Facilities. Maintenance activities include maintenance of electrical power supply facilities; maintenance as needed to ensure continued operations and replacement of facility or system components when necessary to maintain system capacity and operational capabilities; and upgrades and technological improvements of facilities to maintain system capacity and operational capabilities. Levee systems must also be maintained to provide reasonable assurance of protection from floods, and in accordance with an officially adopted maintenance plan.

All CVP maintenance described in this section is a federal action associated with the BDCP and will be covered in the Section 7 consultation.

## 4.4 References Cited

### 4.4.1 Literature Cited

- Alexander, B. S., G. H. Mendell, and G. Davidson. 1874. *Report of the Board of Commissioners on the Irrigation of the San Joaquin, Tulare, and Sacramento Valleys of the State of California*. Washington, DC: Government Printing Office.
- Anderson, L., and P. Akers. 2011. Spongeplant: A New Aquatic Weed Threat in the Delta. *Cal-IPC News* 19:1–4.
- Baraona, M., T. Ippolito, and W. Renz. 2007. *Post-Project Appraisals of Constructed Vernal Pools in Solano, County, California*. Water Resources Center Archives, Berkeley, CA: University of California.
- Bay Delta Oversight Council. 2002. *Delta Levee and Channel Repair and Maintenance Issues*. Available: <[http://www.calwater.ca.gov/Admin\\_Record/D-000742.pdf](http://www.calwater.ca.gov/Admin_Record/D-000742.pdf)>.
- Bowen, M. D., S. Hiebert, C. Hueth, and V. Maisonneuve. 2009. *Effectiveness of a Non-Physical Fish Barrier at the Divergence of the Old and San Joaquin Rivers (CA)*. Technical Memorandum 86-68290-09-05. Denver, CO: Department of the Interior, Bureau of Reclamation, Technical Service Center.
- Bureau of Reclamation. 2008. *Central Valley Project and State Water Project Operations Criteria and Plan Biological Assessment*. May.
- Bureau of Reclamation. 2010. *Central Valley Project Improvement Act*. Last revised: June 29, 2010. Available: <<http://www.usbr.gov/mp/cvpia/index.html>>. Accessed: November 6, 2011.
- Bureau of Reclamation. 2011. *Central Valley Project*. Last revised: April 11, 2011. Available: <[http://www.usbr.gov/projects/Project.jsp?proj\\_Name=Central%20Valley%20Project](http://www.usbr.gov/projects/Project.jsp?proj_Name=Central%20Valley%20Project)>. Accessed: November 6, 2011.
- California Department of Boating and Waterways. 2003. *Aquatic Pest Control: Water Hyacinth and Egeria Densa*. Available: <<http://www.dbw.ca.gov/aquatic.htm>>.
- California Department of Boating and Waterways. 2006. *Egeria densa Control Program Second Addendum to 2001 Environmental Impact Report with Five-Year Program Review and Future Operations Plan*. Sacramento, CA: U.S. Department of Agriculture.
- California Department of Boating and Waterways 2009. *Water Hyacinth Control Program Operations Management Plan 2009 Updated Manual*. Available: <[http://www.agriculturedefensecoalition.org/sites/default/files/file/contra\\_costa\\_wh\\_73/73X\\_2009\\_CA\\_Boating\\_Waterways\\_Department\\_WHCP\\_Operations\\_Management\\_Plan\\_Manual\\_2009\\_04\\_Appx\\_C\\_WHCP\\_OMP.pdf](http://www.agriculturedefensecoalition.org/sites/default/files/file/contra_costa_wh_73/73X_2009_CA_Boating_Waterways_Department_WHCP_Operations_Management_Plan_Manual_2009_04_Appx_C_WHCP_OMP.pdf)>.

- 1 California Department of Fish and Game. 2010. *The Vegetation Classification and Mapping Program.*  
2 *Natural Communities List. Forest and Woodlands Alliances and Stands.* September. Available:  
3 <<http://www.dfg.ca.gov/biogeodata/vegcamp/pdfs/natcomlist.pdf>>.
- 4 California Department of Food and Agriculture. 2011. *Beneficial Bugs in the Delta: CDFA Begins*  
5 *Releasing Insects that Feed on Invasive Water Hyacinth.* July 28. News Release #11-041.  
6 Sacramento, CA. Available:  
7 <[http://www.cdfa.ca.gov/egov/Press\\_Releases/Press\\_Release.asp?PRnum=11-041](http://www.cdfa.ca.gov/egov/Press_Releases/Press_Release.asp?PRnum=11-041)>. Accessed  
8 June 2012.
- 9 California Department of Water Resources. 2008. *California State Water Project and the Central*  
10 *Valley Project.* Last revised: April 29, 2008. Available: <<http://www.water.ca.gov/swp/cvp.cfm>>.  
11 Accessed: November 6, 2011.
- 12 California Department of Water Resources. 2010. *California State Water Project Overview.* Last  
13 revised: August 11, 2010. Available: <<http://www.water.ca.gov/swp/>>. Accessed: November 6,  
14 2011.
- 15 California Department of Water Resources. 2010b. *Release Site Predation Study.* Technical Report.  
16 Principle Investigators: J. Miranda and R. Padilla, Fishery Improvements Section, Bay-Delta  
17 Office. Sacramento, CA.
- 18 Castillo, G., J. Morinaka, J. Lindberg, R. Fujimura, B. Baskerville-Bridges, J. Hobbs, G. Tigan, and L.  
19 Ellison. In press. Pre-Screen Loss and Fish Facility Efficiency for Delta Smelt at the South Delta's  
20 State Water Project, California. *San Francisco Estuary and Watershed Science.* Available:  
21 <<http://www.fws.gov/stockton/jfmp/docs/DRAFT-Delta-Smelt-Pre-Screen-Losses-SWP.pdf>>.  
22 Accessed: April 2, 2012.
- 23 Cavallo, B., J. Merz, and J. Setka. 2012. Effects of Predator and Flow Manipulation on Chinook Salmon  
24 (*Oncorhynchus tshawytscha*): Survival in an Imperiled Estuary. *Environmental Biology of Fishes.*  
25 Netherlands: Springer.
- 26 Center for Plant Conservation. 1991. Appendix. Genetic Sampling Guidelines for Conservation  
27 Collections of Endangered Plants. Pages 225–238 in D. A. Falk and K. E. Holsinger (eds.), *Genetics*  
28 *and Conservation of Rare Plants.* New York: Oxford University Press.
- 29 Central Valley Joint Venture. 2006. *Central Valley Joint Venture Implementation Plan—Conserving*  
30 *Bird Habitat.* Sacramento, CA: U.S. Fish and Wildlife Service.
- 31 Department of Public Works. 1930. *The State Water Plan. Public Works Bulletin No. 25. A Report to*  
32 *the Legislature of 1931.* Sacramento, CA.
- 33 Feyrer, F., and M. P. Healey. 2003. Fish Community Structure and Environmental Correlates in the  
34 Highly Altered Southern Sacramento–San Joaquin Delta. *Environmental Biology of Fishes*  
35 66(2):123–132.
- 36 Finlayson, B., R. Schnick, D. Skaar, J. Anderson, L. Demong, D. Duffield, W. Horton, and J. Steinkjer.  
37 2010. *Planning and Standard Operating Procedures for the Use of Rotenone in Fish Management –*  
38 *Rotenone SOP Manual.* Bethesda, MD: American Fisheries Society.
- 39 Hays, D. W., K. R. McAllister, S. A. Richardson, and D. W. Stinson. 1999. *Washington State Recovery*  
40 *Plan for the Western Pond Turtle.* August. Olympia, WA: Washington Department of Fish and

1 Wildlife. Available:

2 <<http://www.wdfr.wa.gov/wlm/diversty/soc/recovery/pondturt/wptfinal.pdf>>.

3 Hoffman Black, S., M. Shepard, M. Vaughan, C. LaBar, and N. Hodges. 2009. *Yolo Natural Heritage*  
4 *Program (HCP/NCCP) Pollinator Conservation Strategy*. November. Sacramento, CA: The Xerces  
5 Society for Invertebrate Conservation.

6 Keeley, J. E. 1993. Assessing Suitable Sites for Grassland Restoration. Pages 277–281 in J. E. Keeley  
7 (ed.), *Interface Between Ecology and Land Development in California*. Los Angeles, CA: Southern  
8 California Academy of Sciences.

9 Lund, J., E. Hanak, W. Fleenor, R. Howitt, J. Mount, P. Moyle. 2007. *Envisioning Futures for the*  
10 *Sacramento-San Joaquin Delta*. San Francisco, CA: Public Policy Institute of California.

11 Nielsen, L. A., and D. L. Johnson (eds.) 1983. *Fisheries Techniques*. Bethesda, MD: American Fisheries  
12 Society.

13 Riparian Habitat Joint Venture. 2004. *The Riparian Bird Conservation Plan: A Strategy for Reversing*  
14 *the Decline of Riparian-associated Birds in California*. Version 2.0. California Partners in Flight.  
15 Available: <<http://www.prbo.org/calpif/pdfs/riparian.v-2.pdf>>.

16 Ruch, S. A., and Aquatic Weed Unit, California Department of Boating and Waterways. 2006. *Utilizing*  
17 *Differential Quantitative Mapping Technologies and Traditional Botanical Knowledge to Assist*  
18 *Brazilian Waterweed Management in the Sacramento-San Joaquin Delta: An Example from*  
19 *Frank's Tract*. Berkeley and Sacramento, CA.

20 Santos, M. J., S. Khanna, E. L. Hestir, M. E. Andrew, S. S. Rajapakse, J. A. Greenberg, L. W. J. Anderson,  
21 and S. L. Ustin. 2009. Use of Hyperspectral Remote Sensing to Evaluate Efficacy of Aquatic Plant  
22 Management in the Sacramento-San Joaquin River Delta, California. *Invasive Plant Science and*  
23 *Management* 2:216–229.

24 Singleton, P., H. Gaines, L. William, and J. F. Lehmkuhl. 2002. Landscape Permeability for Large  
25 Carnivores in Washington: a Geographic Information System Weighted-Distance and Least-Cost  
26 Corridor Assessment. Res. Pap. PNW-RP-549. Portland, OR: U.S. Department of Agriculture,  
27 Forest Service, Pacific Northwest Research Station.

28 Solano County Water Agency. 2011. *N11. Cache Slough Ag Intakes Excel File*. September 30. Provided  
29 by David Okita via email.

30 Stromberg, M. R., and P. Kephart. 1996. Restoring Native Grasses in California Old Fields. *Restoration*  
31 *and Management Notes* 14:102-111.

32 The Nature Conservancy. 1998. *Ecoregional Assessment Status Tool (EAST)*. Version 2.01.04.  
33 Available: <<http://east.tnc.org>>.

34 U.S. Army Corps of Engineers. 2012. *Fact Sheet: Acoustic Fish Deterrents*. Issued by the Great Lakes  
35 and Mississippi River Interbasin Study. April. Available:  
36 <<http://www.glmris.anl.gov/documents/docs/anscontrol/AcousticFishDeterrents.pdf>>.

37 U.S. Environmental Protection Agency. 2007. *TMDL Review Checklist for Stockton Deep Water Ship*  
38 *Channel Dissolved Oxygen and Approval Letter*. February 27. San Francisco, CA.

1 U. S. Fish and Wildlife Service. 2010. *Draft Recovery Plan for Tidal Marsh Ecosystems of Northern and*  
2 *Central California*. Sacramento, CA.

3 Ustin, S. L. 2008. *Mapping Invasive Plant Species in the Sacramento-San Joaquin River Delta Using*  
4 *Hyperspectral Imagery*. Final report. June. Center for Spatial Technologies and Remote Sensing  
5 (CSTARS), University of California, Davis. Submitted to Aquatic Weed Control, California  
6 Department of Boating and Waterways, Sacramento, CA.

7 Williams, A. E., S. O'Neil, E. Speith, and J. Rodgers. 2009. *Early Detection of Invasive Plant Species in*  
8 *the San Francisco Bay Area Network: A Volunteer-Based Approach*. Natural Resource Report  
9 NPS/SFAN/NRR—2009/136. Fort Collins, CO: National Park Service.

10 Williams, P., and P. M. Faber. 2004. *Design Guidelines for Tidal Wetland Restoration in San Francisco*  
11 *Bay*. December 29. Prepared for The Bay Institute.

## 12 **4.4.2 Personal Communications**

13 Cavallo, Brad. Senior scientist. Cramer Fish Sciences, Auburn, CA. June 21 and 28, 2012—phone  
14 conversation with Ramona Swenson, Cardno ENTRIX, and email communication regarding fish  
15 removal techniques and experiments such as electrofishing, targeted predator fishing  
16 tournament, and orally delivered piscicide.

17 Chappell, S. Executive Director, Suisun Resource Conservation District. July 22, 2010—telephone  
18 conversation with J-L Cartron regarding functioning of salinity gates and patterns of land use at  
19 Suisun Marsh, and development and release of the Suisun Marsh Habitat Management,  
20 Preservation, and Restoration Plan.

21 Holderman, M. Chief, Temporary Barriers Project and Lower San Joaquin. California Department of  
22 Water Resources. June 10, 2009—telephone conversation with R. Wilder regarding the 2009  
23 DWR Head of Old River Non-Physical Barrier Test Project.  
24





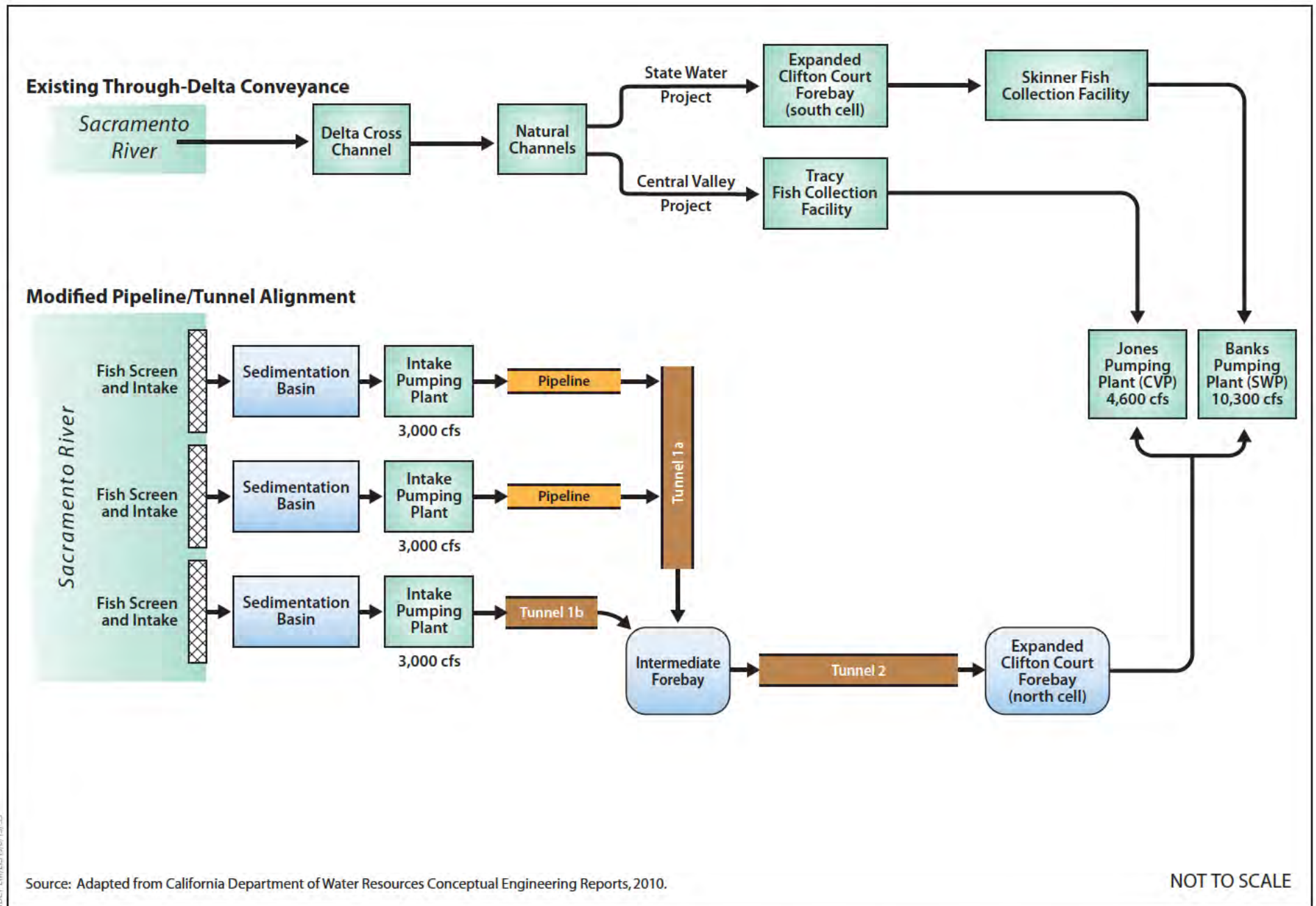


K:\Projects\_1\DW\000000\_00\_BDCP\mapdoc\Public Draft\DW\Screencheck\Chapter 4\Fig 04\_01\_Major Components SWP\_CVP\_20130903.mxd Date: 9/4/2013 Time: 5:08:44 PM 29301

GIS Data Source: Dams/Pumps, DWR 1994; SWPCVP Lakes, HDR 2011; SWPCVP Canals/Aqueducts, HDR 2011.

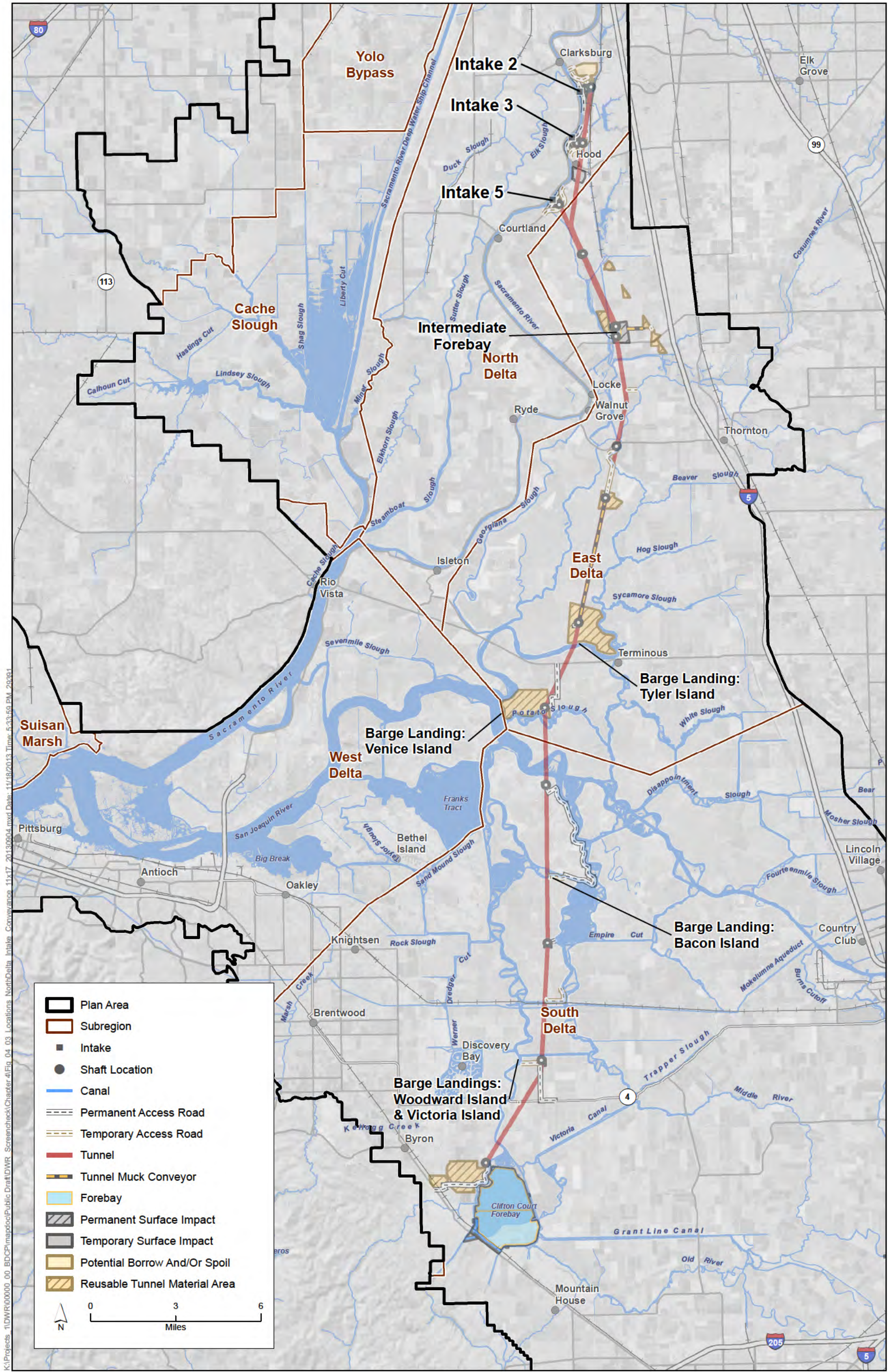
**Figure 4-1**  
**Major Components of the State Water Project (SWP)**  
**and Central Valley Project (CVP)**





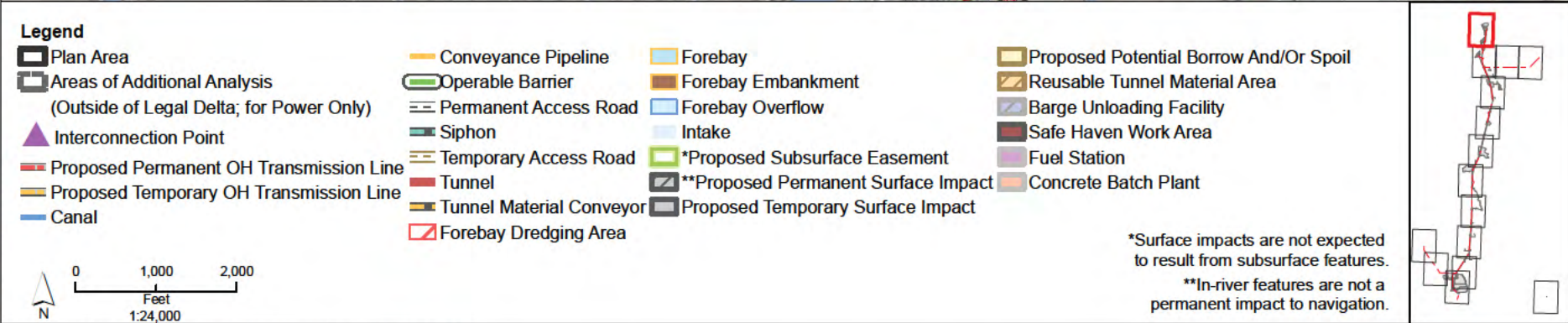
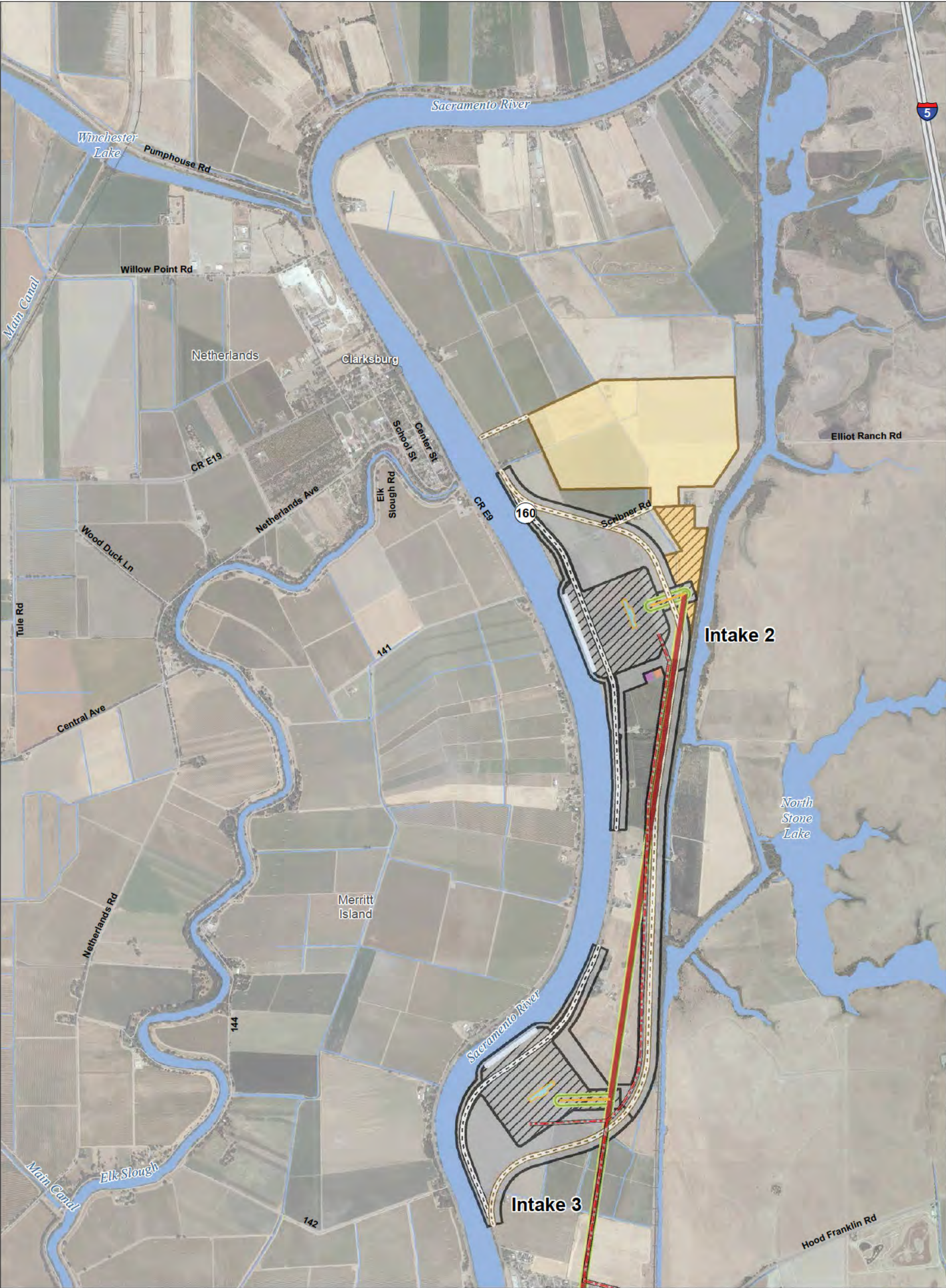
**Figure 4-2**  
**Schematic Diagram of the Proposed North Delta Intake and Conveyance Facilities**





**Figure 4-3**  
**Locations of the Proposed North Delta**  
**Intake and Conveyance Facilities**

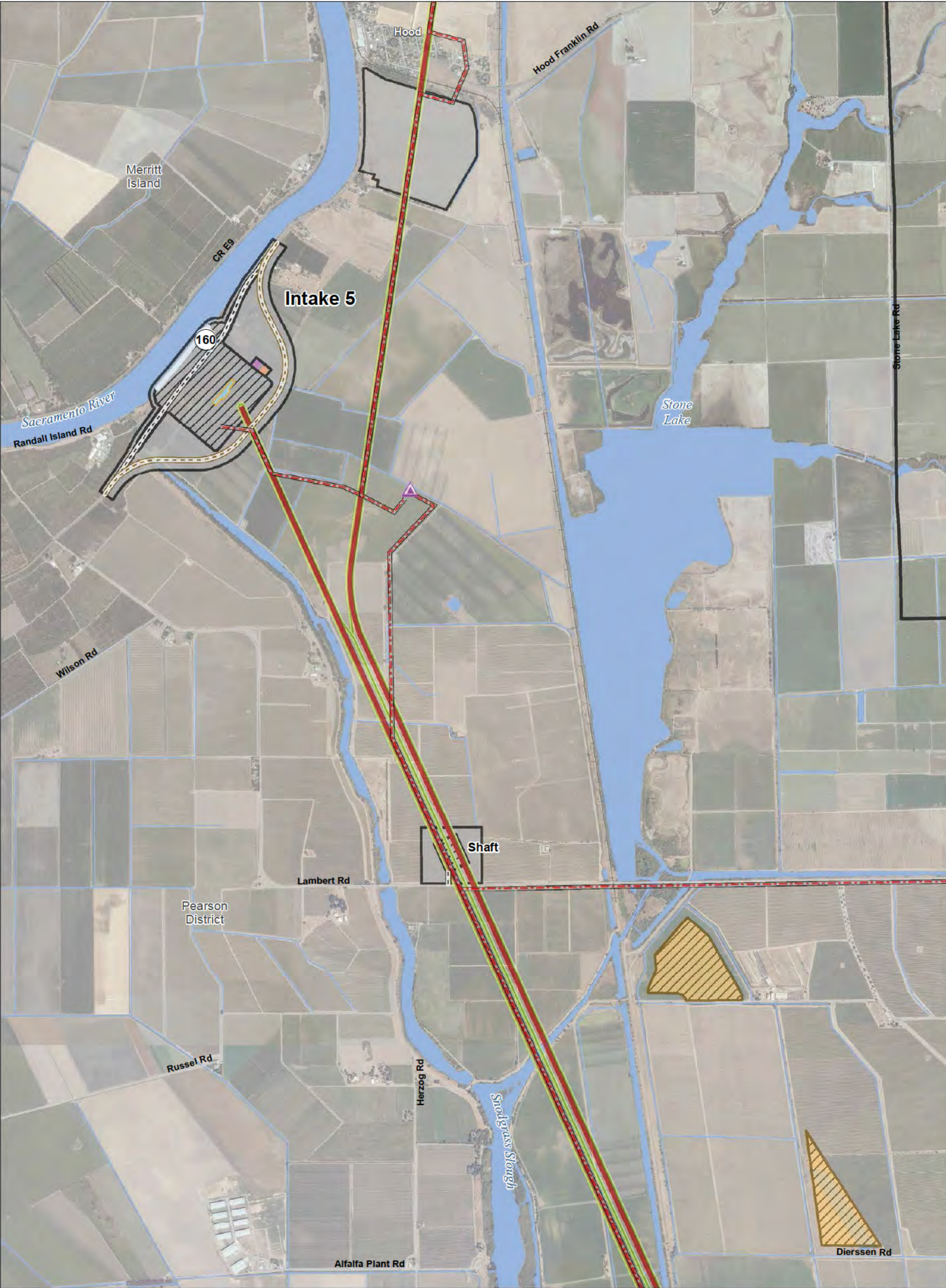




Sources: Plan Area, SAIC 2010; DWR DHCCP Engineering (rev 2b); NAIP 2012

**Figure 4-4**  
**Facilities Associated with Intakes 2 and 3**

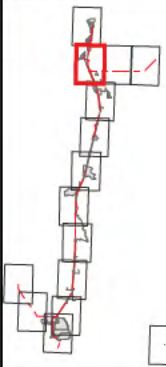




**Legend**

- |   |                          |                                     |  |
|---|--------------------------|-------------------------------------|--|
| Plan Area   | Conveyance Pipeline      | Forebay                             | Proposed Potential Borrow And/Or Spoil |
| Areas of Additional Analysis (Outside of Legal Delta; for Power Only) | Operable Barrier         | Forebay Embankment                  | Reusable Tunnel Material Area          |
| Interconnection Point   | Permanent Access Road    | Forebay Overflow                    | Barge Unloading Facility               |
| Proposed Permanent OH Transmission Line                               | Siphon                   | Intake                              | Safe Haven Work Area                   |
| Proposed Temporary OH Transmission Line                               | Temporary Access Road    | *Proposed Subsurface Easement       | Fuel Station                           |
| Canal   | Tunnel                   | **Proposed Permanent Surface Impact | Concrete Batch Plant                   |
|   | Tunnel Material Conveyor | Proposed Temporary Surface Impact   |  |
|   | Forebay Dredging Area    |                                     |  |

\*Surface impacts are not expected to result from subsurface features.  
\*\*In-river features are not a permanent impact to navigation.

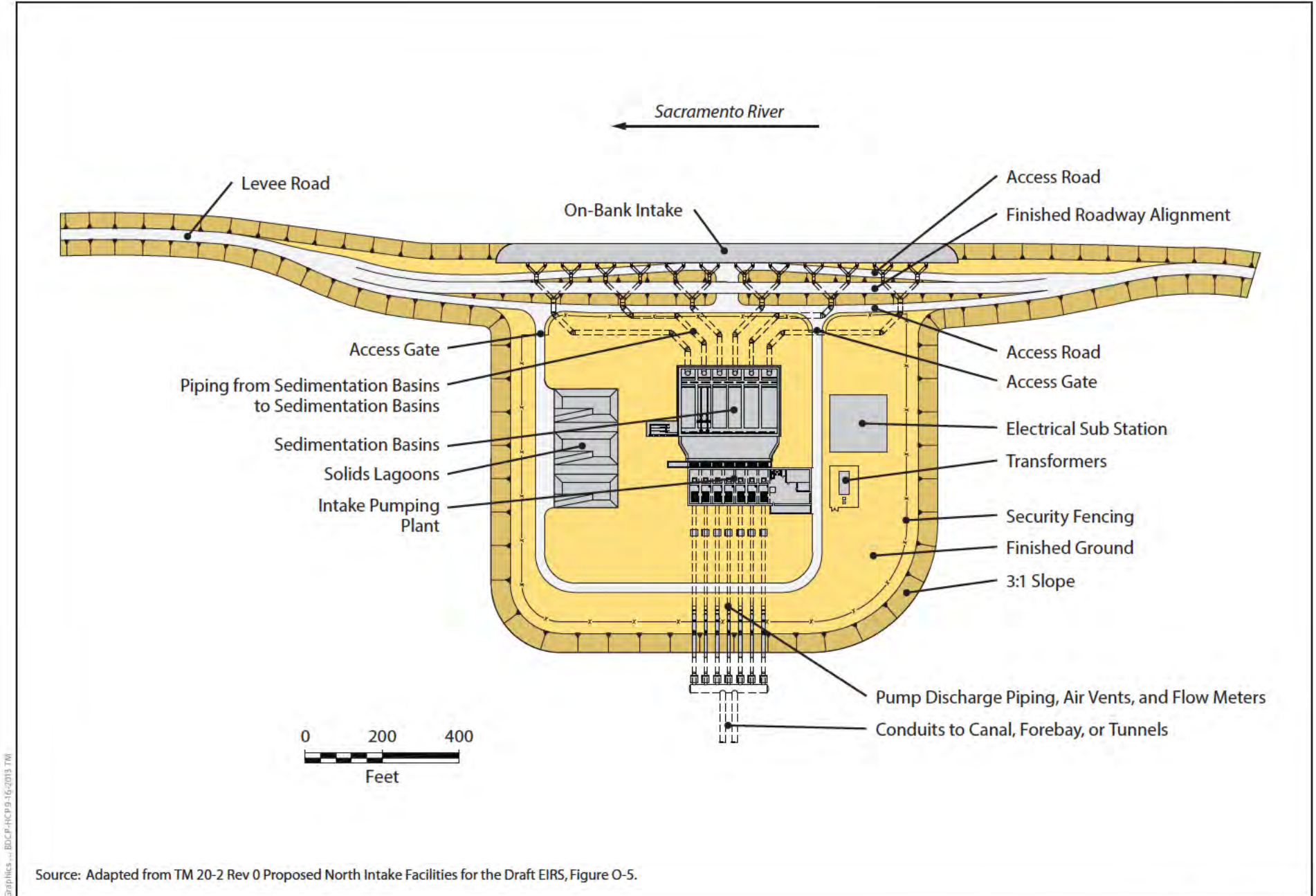


Graphics ... BDCP-HCP-9-16-2013.TM

Sources: Plan Area, SAIC 2010; DWR DHCCP Engineering (rev 2b); NAIP 2012

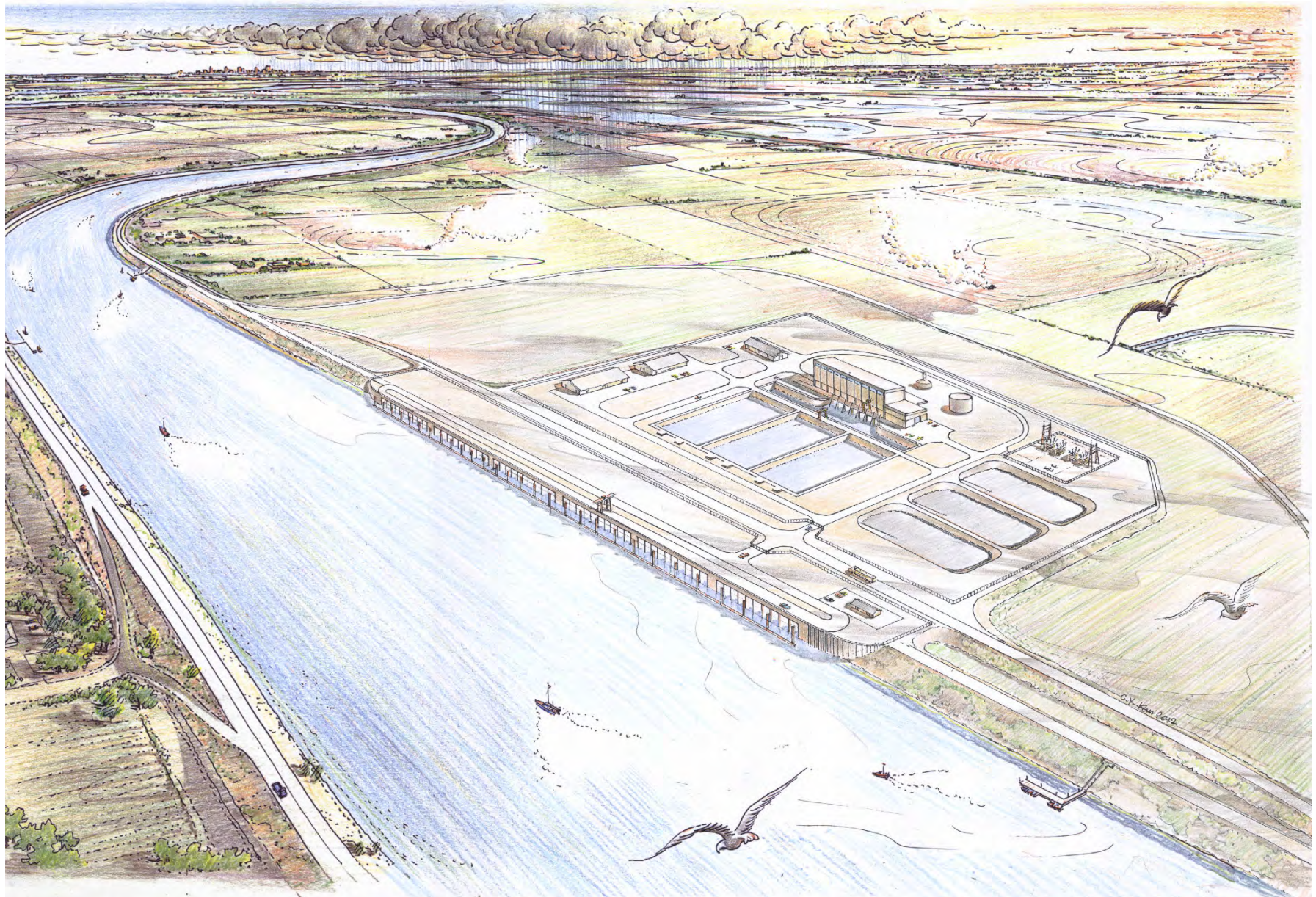
**Figure 4-5**  
**Facilities Associated with Intake 5**





**Figure 4-6**  
**Schematic Diagram of an Intake Structure**

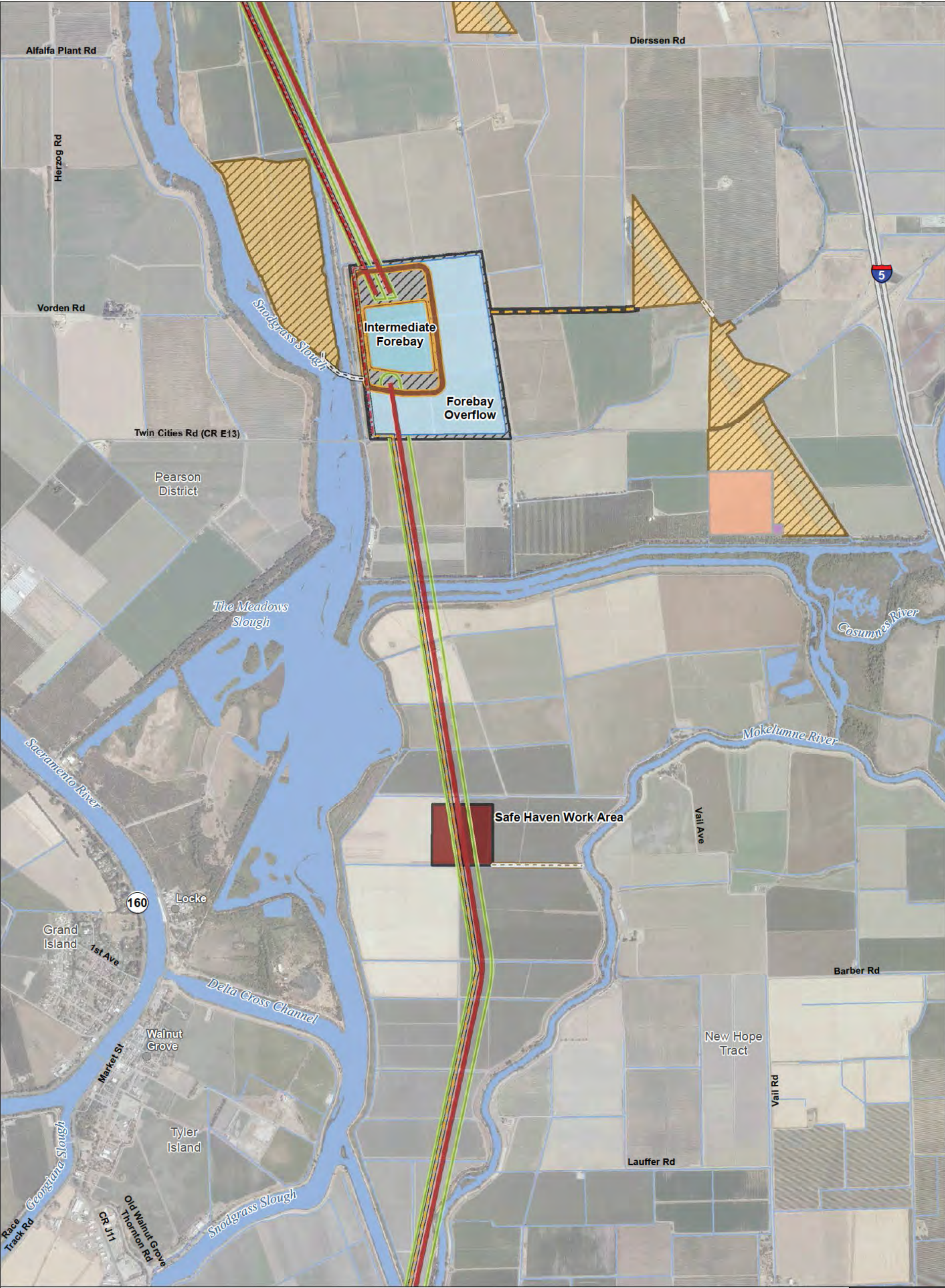




Source: Conceptual Engineering Report, Modified Pipeline/Tunnel Option.

**Figure 4-7**  
**Conceptual Rendering of an Intake Structure**



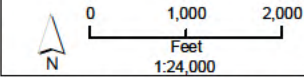
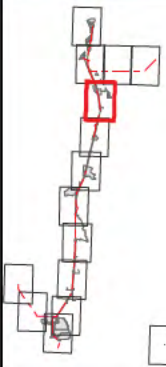


**Legend**

- |  |                          |                                     |
|--|--------------------------|-------------------------------------|
| Plan Area  | Conveyance Pipeline      | Forebay                             |
| Areas of Additional Analysis<br>(Outside of Legal Delta; for Power Only) | Operable Barrier         | Forebay Embankment                  |
| Interconnection Point  | Permanent Access Road    | Forebay Overflow                    |
| Proposed Permanent OH Transmission Line                                  | Siphon                   | Intake                              |
| Proposed Temporary OH Transmission Line                                  | Temporary Access Road    | *Proposed Subsurface Easement       |
| Canal  | Tunnel                   | **Proposed Permanent Surface Impact |
|  | Tunnel Material Conveyor | Proposed Temporary Surface Impact   |
|  | Forebay Dredging Area    |                                     |

- |  |
|--|
| Proposed Potential Borrow And/Or Spoil |
| Reusable Tunnel Material Area          |
| Barge Unloading Facility               |
| Safe Haven Work Area                   |
| Fuel Station                           |
| Concrete Batch Plant                   |

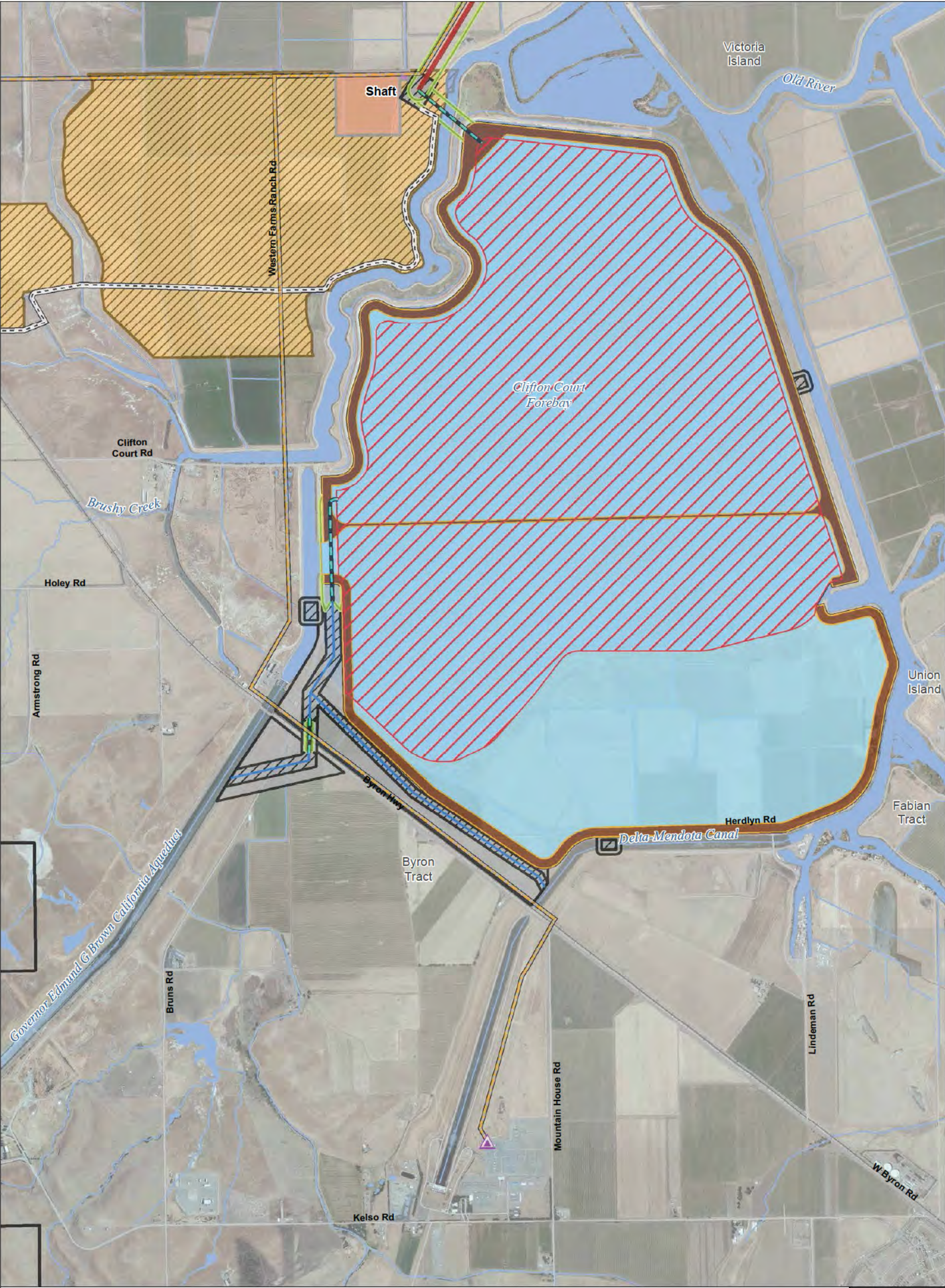
\*Surface impacts are not expected to result from subsurface features.  
\*\*In-river features are not a permanent impact to navigation.



Sources: Plan Area, SAIC 2010; DWR DHCCP Engineering (rev 2b); NAIP 2012

**Figure 4-8**  
**Facilities Associated with the Intermediate Forebay**





**Legend**

- Plan Area
- Areas of Additional Analysis (Outside of Legal Delta; for Power Only)
- Interconnection Point
- Proposed Permanent OH Transmission Line
- Proposed Temporary OH Transmission Line
- Canal

- Conveyance Pipeline
- Operable Barrier
- Permanent Access Road
- Siphon
- Temporary Access Road
- Tunnel
- Tunnel Material Conveyor
- Forebay Dredging Area

- Forebay
- Forebay Embankment
- Forebay Overflow
- Intake
- \*Proposed Subsurface Easement
- \*\*Proposed Permanent Surface Impact
- Proposed Temporary Surface Impact

- Proposed Potential Borrow And/Or Spoil
- Reusable Tunnel Material Area
- Barge Unloading Facility
- Safe Haven Work Area
- Fuel Station
- Concrete Batch Plant

\*Surface impacts are not expected to result from subsurface features.  
\*\*In-river features are not a permanent impact to navigation.

0 1,000 2,000  
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1:24,000

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Sources: Plan Area, SAIC 2010; DWR DHCCP Engineering (rev 2b); NAIP 2012

**Figure 4-9**  
**Facilities Associated with the Clifton Court Forebay**