DEPARTMENT OF WATER RESOURCES
AGREEMENT # 4600009291

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Prospect Island Tidal Habitat Restoration Project:
Admin Final Restoration Plan

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ABREVIATIONS

Acronym	Definition
ac	acre
ACHP	Advisory Council on Historic Preservation
APE	area of potential effects
BDCP	Bay Delta Conservation Plan
BiOps	Biological Opinions
CALFED	CALFED Bay-Delta Program
Cal-IPC	California Invasive Plant Council
CDFW	California Department of Fish and Wildlife
CDTSC	California Department of Toxic Substances Control
CESA	California Endangered Species Act
cfs	cubic feet per second
Cm	Columbia fine sandy loam
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
CSC	Cache Slough Complex
CVP	Central Valley Project
CVRWQCB	Central Valley Regional Water Quality Control Board
DOC	dissolved organic carbon
DPR	California Department of Pesticide Regulation
DPS	distinct population segments
DRERIP	Delta Ecosystem Restoration Implementation Plan
DWR	Department of Water Resources
DWSC	Sacramento Deep Water Ship Channel
EIR	Environmental Impact Report
ERP	Ecosystem Restoration Program
ESA	Endangered Species Act
ETM	estuarine turbidity maximum
°F	Fahrenheit
FAST	Fish Agency Strategy Team
FEMA	Federal Emergency Management Agency
FRP	Fish Restoration Plan
FRPA	Fish Restoration Program Agreement
ft	feet
IBA	Important Bird Area
IEP	Interagency Ecological Program
ITP	Incidental Take Permit

Acronym	Definition
LGP	low ground pressure
MCY	Million cubic yards
MHHW	Mean higher high water
MHW	Mean higher water
MLLW	Mean lower low water
MLW	Mean lower water
NAHC	Native American Heritage Commission
NAVD88	North American Vertical Datum of 1988
NCCPA	Natural Communities Conservation Planning Act
NMFS	National Marine Fisheries Service
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NTU	nephelometric turbidity units
NWIC	Northwest Information Center
OHP	Office of Historic Preservation
PCI	Parus Consulting, Inc.
PG&E	Pacific Gas & Electric Company
PRC	Public Resources Code
RD	Reclamation District
ROD	Record of Decision
RPA	Reasonable and Prudent Alternative
Ry	Ryde clay loam
Sa	Sacramento silty clay loam
SAV	Submerged aquatic vegetation
Sd	Sacramento Clay
SRFCP	Sacramento River Flood Control Project
SSC	Suspended solids concentration
SWP	State Water Project
Tu	Tujunga fine sand
USACE	U.S. Army Corps of Engineers
USBR	U.S. Bureau of Reclamation
USC	United States Code
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Society
Va	Valdez silt loam
WWR	Wetlands and Water Resources

1 INTRODUCTION

This Prospect Island Tidal Habitat Restoration Project (Project) Draft Restoration Plan (Plan) describes the proposed actions needed to restore up to 1,600 acres (ac) of diked lands to tidal wetlands.

1.1 Project Site

The Project site is located in Solano County, in the northern Sacramento-San Joaquin River Delta (Delta) (Figure 1-1). Prospect Island falls under two ownerships: the approximately 1,300-ac northern property is owned by the California Department of Water Resources (DWR), and the southern, approximately 300-ac portion is owned by the Port of West Sacramento (Port). There are three privately owned properties contiguous to the site: the Stringer property, a small peninsula connected to the southeast margin of the DWR property; the Hall property, a small peninsula connected to the southeast margin of the Port property; and the Fahn property, actively farmed land north of the Project boundary. A privately operated marina, Arrowhead Harbor, is located at the northeastern corner of the site (Figure 1-2).

With the exception of discussion of site topography (Section 4.3.3), three areal extents are used for the purposes of this Restoration Plan and interrelated environmental analyses of the Project. The ***Tidal Restoration Footprint*** is the area internal to the levees that would be subject to tidal action following restoration. The ***Diked Lands Project Area*** represents all diked lands that would be restored and potentially used to construct the Project, and extends outward to the high tide line on the exterior side of the levees. The ***Construction Project Area*** represents the Diked Lands Project Area plus all potential exterior in-water work areas (Table 1-1).

Table 1-1. Project Areas

Boundary Description	Area (acres)		
	North (DWR) Property	South (Port) Property	Total
Tidal restoration footprint[1]	1,250	275	1,525
Diked Lands Project Area[2]	1,373	301	1,674
Construction Project Area[2]	1,376	309	1,685

[1] *North and south split as each side of internal cross levee*
[2] *North and south split at property line just south of internal cross levee*

Prospect Island is part of the Sacramento River Flood Control Project (SRFCP). It was separated from the southern end of the 59,000-ac Yolo Bypass by the Sacramento Deep Water Ship Channel (DWSC), constructed by the U.S. Army Corps of Engineers (USACE) in the 1960s. The entire site is enclosed by a levee system with lower ('restricted') heights, designed to allow overtopping in large flood events. The Project site has one internal cross levee that separates the DWR (north) property and the Port (south) property (Figure 1-2). The Project site is bounded on the east by Miner Slough, on the west by the DWSC, on the south by the 37-ac Miner Slough Wildlife Area, managed by the California Department of Fish and Wildlife (CDFW), and on the north by a levee that runs from Arrowhead Harbor to the DWSC (Figure 1-2).

1.2 Restoration Actions

The Project will consist of a suite of actions necessary for site preparation, restoration, minimizing or avoiding potential adverse impacts, post-restoration monitoring, and maintenance. Some activities are incorporated in the Proposed Project description, while others may be incorporated into the Project and/or alternatives depending on results of the EIR analyses. These elements are listed below and described in detail in Chapter 6.

Actions that will be included in the Proposed Project description

1. Pre-construction site preparation, including repairing the leak in the south property levee, dewatering, clearing and grubbing, constructing access roads and ramps, and preparing staging areas, for the purpose of implementing all of the actions listed below.
2. Invasive species control, for the purpose of reducing the potential for ecological or other invasive species impairments within the restoration site and surrounding areas.
3. Debris removal, to reduce non-native fish predator habitat on the restored site.
4. Excavation of tidal slough channels, for the purpose of facilitating internal tidal circulation and external connectivity.
5. Placement of excavated soils into selected remnant agricultural ditches, for the purpose of promoting target tidal circulation and tidal channel formation.
6. Placement of excavated soils into the site interior, for the purpose of creating internal topographic features and thus ecological variability.

7. Placement of excavated soils to construct a gently sloped eastern toe berm on the interior side of the eastern levee, for the purpose of improving levee erosion protection.
8. Placement of excavated soils to construct an eastern intertidal bench in areas interior to the Miner Slough levee and adjacent to subtidal areas, for the purpose of improving levee erosion protection.
9. Removal of a portion of the internal cross levee, for the purpose of connecting the north and south properties hydrologically, and promoting tidal circulation and external connectivity.
10. Excavation of one or more levee breach(es) to Miner Slough, for the purpose of restoring tidal connectivity.
11. Placement of excavated soils into the site interior at levee breach locations, for the purpose of reducing velocity gradients at levee breaches.
12. Dredging of the spur channel between Miner Slough and the south property and placement of dredged material within Prospect Island (if it meets sediment quality standards), for the purpose of providing unimpeded tidal exchange.

Actions that may be included in the Proposed Project description and/or restoration alternatives

1. Installation of a fixed-height, high-stage overflow weir connecting to Miner Slough in the northeast corner of the Project site, for the purpose of providing winter high-flow connectivity to Miner Slough and upstream sloughs that connect to the Sacramento River.
2. Measures to maintain access to private properties.

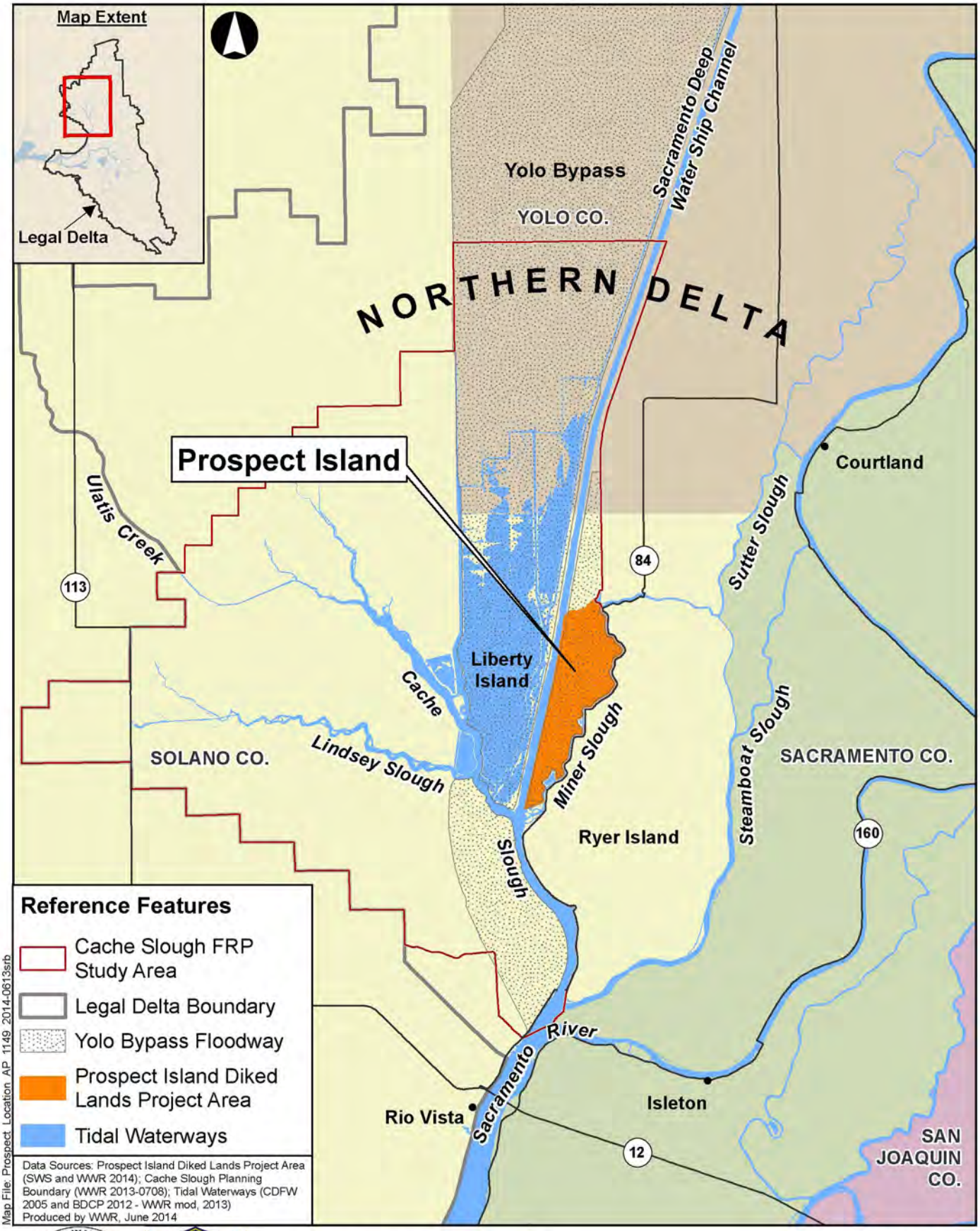
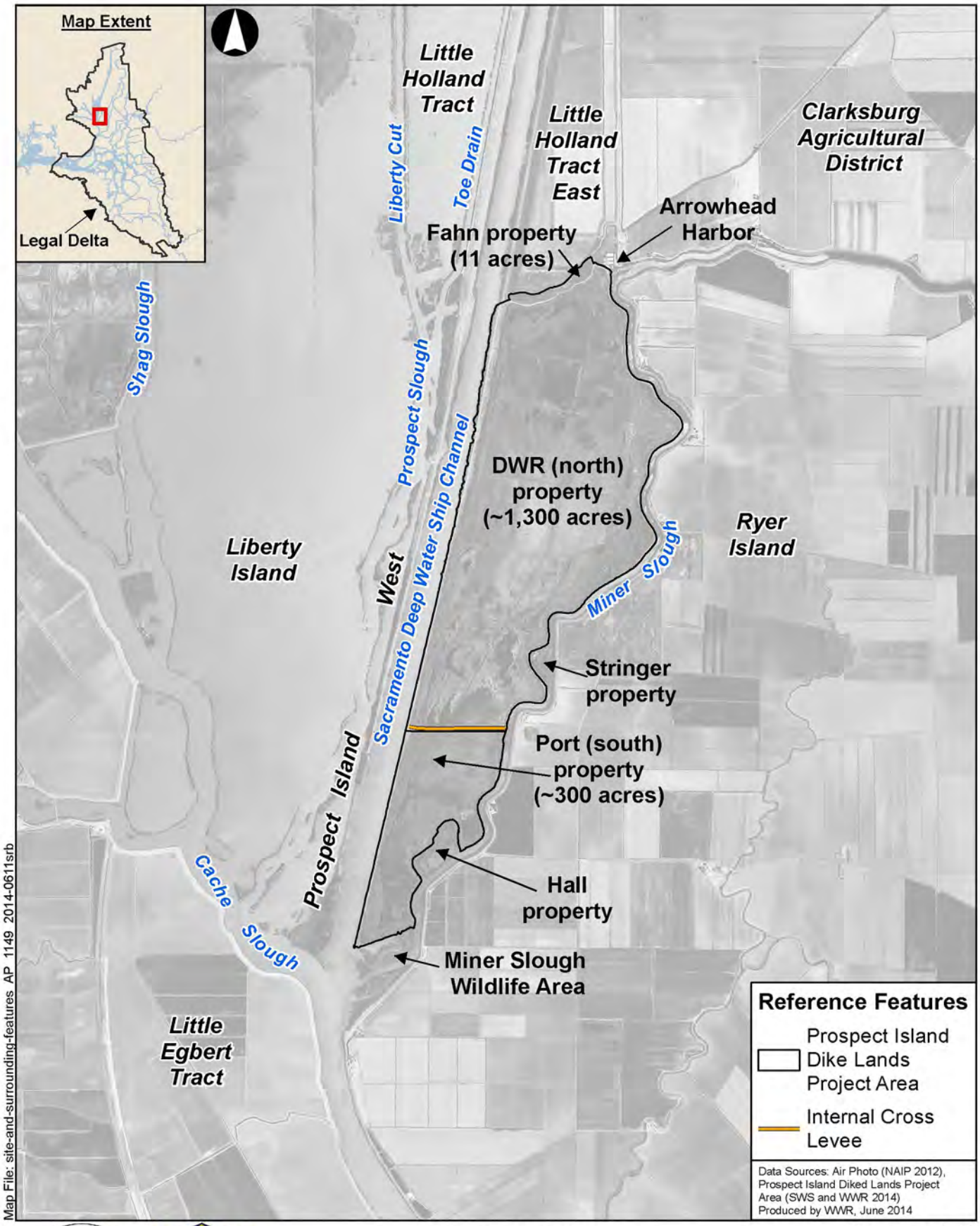


Figure 1-1

Project Location

PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT



Map File: site-and-surrounding-features_AP_1149_2014-0611srb

Figure 1-2
Prospect Island Site and Surrounding Features

PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT

2 PROJECT PURPOSE, GOAL, AND OBJECTIVES

The Project is intended to partially fulfill the 8,000-ac tidal habitat restoration obligations of California Department of Water Resources (DWR), contained within Reasonable and Prudent Alternative (RPA) 4 of the U.S. Fish and Wildlife Service Delta Smelt Biological Opinion (BiOp) (USFWS 2008) and referenced in RPA I.6.1 of the National Marine Fisheries Service Salmonid BiOp (NMFS 2009), for long-term coordinated operations of the State Water Project and the federal Central Valley Project. The Project could also serve towards fulfillment of tidal restoration objectives under the proposed Bay Delta Conservation Plan (BDCP), upon its approval.

2.1 Purpose

The BiOps underlying the Fish Restoration Program (FRP) establish the problem statement, and identify tidal and associated subtidal restoration as a component of the larger strategy for protection and potential recovery of the covered species. The BiOps thus establish the Project purpose. The broader policy efforts driving restoration in the Delta—the Delta Plan, the Ecosystem Restoration Program (ERP) Stage 2 Conservation Strategy, and the pending BDCP—provide secondary guidance on how Prospect Island tidal wetland restoration is carried out. In addition, DWR's Environmental Stewardship Policy mandates the inclusion of ecosystem and species restoration in DWR activities.

The BiOps identify fundamental impairments to Delta Smelt and juvenile salmonids within the tidal reaches of the Delta, for which tidal and subtidal Delta/Suisun Marsh restoration is an intended remedy:

Delta Smelt

- Food limited (USFWS 2008, p.189–190)
- Water quality inhibited (USFWS 2008, p.189–190)

Juvenile Salmon

- Floodplain rearing habitat limited (NMFS 2009, p.49)
- Water quality inhibited (NMFS 2009, p.49)

The premise for tidal and subtidal restoration, thus, is that it can reduce these limitations through restoration of aquatic food webs, water quality, and rearing

habitat, or through indirect effects that contribute to such improvements external to a restoration site.

2.2 Project Goal

The Project goal is to restore intertidal and associated subtidal habitat to the interior of Prospect Island. This includes the restoration of processes, structures, and functions that: (1) promote primary and secondary productivity to support delta smelt; and (2) enhance migratory pathways for salmonids by increasing the amount and quality of rearing habitat.

2.3 Project Objectives

Project objectives are measureable actions that collectively describe what must be accomplished in order to meet the Project goal. Our understanding of how restoration is expected to yield benefits to Delta Smelt and juvenile salmonids—the science relating covered species' life history requirements to functions that restored tidal lands can provide, and the mechanisms by which those functions are provided—drives the details of fulfilling the restoration obligations of the BiOps. This science drives decisions about where restoration efforts are located, specifics of the restoration design, and how the effectiveness of restoration efforts is assessed.

The six Project objectives (DWR 2013) are to:

1. Enhance primary and secondary productivity and food availability for Delta Smelt and other native fishes within Prospect Island and surrounding Delta waterways.
2. Increase the quantity and quality of salmonid rearing habitat within and in the areas surrounding Prospect Island.
3. Increase the amount and quality of habitats to support other listed species, to the extent they can be supported by site conditions and natural processes.
4. Provide other ecosystem benefits associated with increased Delta freshwater tidal marsh habitat, including water quality enhancement, recreation, and carbon sequestration.
5. To the greatest extent practical, promote habitat resiliency to changes in future Delta conditions, such as land use conversions, climate change, sea level rise, and invasive species.

6. Avoid promoting conditions adverse to Project biological objectives, such as those which would favor establishment or spread of invasive exotic species.

3 REGIONAL SETTING

This chapter describes the regional setting of the Project within its landscape context in the northern Delta. This context contributes to defining the specific restoration alternatives (Chapter 6) to meet the Project goal and objectives (Chapter 2), including both the target ecological benefits and the range of impact minimization and avoidance measures. Topics covered in this chapter begin with the importance of Prospect Island's landscape position.

3.1 Landscape Position

Prospect Island is located at a unique landscape position in the northern Delta. The Project site sits between the Cache Slough Complex (CSC) to the west at the downstream end of the Yolo Bypass, and the Sacramento River to the east via its distributary channel, Miner Slough (Figure 1-1). The CSC is a 53,000-ac region in the northern Delta composed of extensive diked lands mostly in agricultural use; two large and four small flooded islands that now contain tidal marsh and shallow tidal open waters; tidal sloughs, many of which support tidal marsh and riparian margins and in-channel islands; and the southern end of the Yolo Bypass (Figure 3-1). Turbidity levels in portions of the CSC are often the highest observed in the Delta, providing an important habitat benefit (cover from predators) to native fishes (Morgan-King and Schoellhamer 2013). The CSC has been identified as important spawning and rearing grounds for migratory Delta Smelt, in addition to supporting a year-round non-migratory population of Delta Smelt (Sommer and Mejia 2013). This is thought to be due to a combination of factors, including locally high turbidity, abundance of productive tidal marsh and shallow tidal aquatic habitats, connectivity to the Yolo Bypass, and the hydrodynamic influence of the large, shallow flooded islands creating a wide range of hydraulic residence times (the duration of time that a particle of water in the water column stays in one area) in various parts of the CSC.

Miner Slough connects the Sacramento River to the habitats in the CSC, and is a migration corridor for Sacramento River adult and juvenile Chinook salmon populations (Perry and Skalski 2009, Perry et al. 2013). Tidal restoration along this corridor will offer directly accessible habitats for migratory salmonids. The net downstream flow in Miner Slough creates a local setting where tidal influence diminishes rapidly over a short distance, reflecting the transition from the tidal Delta to the riverine Sacramento River. This hydrodynamic setting affords opportunities for variable aquatic residence times and tidal mixing with reconnection of Prospect Island.

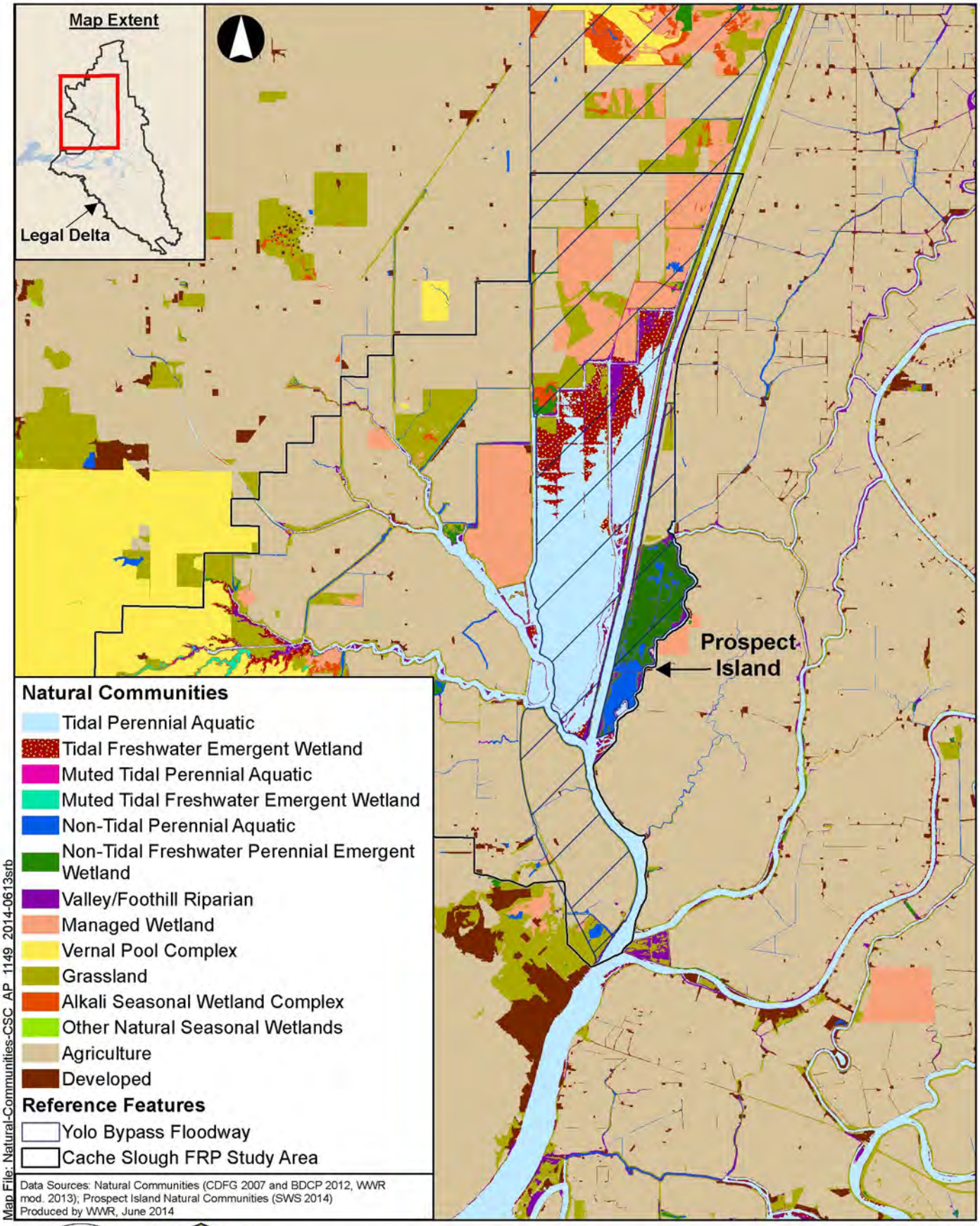


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Figure 3-1
Natural Communities in the Project Vicinity

PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT

3.2 Regional Ecosystem Restoration Efforts

The landscape position and identified ecological functions of the CSC, in combination with its sparse urban development and infrastructure, relatively intact hydrologic connections to tidal influence, and little land subsidence as compared with the central Delta, have made the region a focus for ecosystem restoration since the early development of the CALFED ERP in the 1990s. Several other ecosystem restoration efforts are planned in the CSC and on the Yolo Bypass upstream of the CSC. In addition, this region has seen a number of previous restoration actions, some planned and others initiated by unintended levee failures (Figure 3-2 and Table 3-1).

Table 3-1. Natural, Constructed, and Planned Ecosystem Restoration Efforts in the Cache-Yolo Region.

Name	Size (ac) [1]	Hydrology	Year
NATURAL RESTORATIONS (flooded islands)			
Prospect Island West	310	Tidal	~1963
Little Holland Tract	1,456	Tidal	1983, 1992
Little Hastings Tract	160	Tidal	~1992
Liberty Island	4,340	Tidal	1998
Hall Island	14	Tidal	Sometime between 1993 and 2002
CONSTRUCTED RESTORATIONS			
Cache Slough Mitigation Area (Liberty Farms Tip) (DWR)	170	Tidal	1991
Liberty Island Conservation Bank (Wildlands)	185	Tidal and floodplain	2010
PLANNED RESTORATIONS			
Lower Yolo (SFCWA)	1,749	Tidal and floodplain	
Prospect Island (DWR)	1,525	Tidal	
Calhoun Cut (also referred to as Lindsey Slough) Enhancement (DFW)	160	Tidal	
Putah Creek Realignment (DFW)	648	Fluvial and floodplain	
Yolo Bypass Wildlife Area Tidal Marsh Enhancement (DFW)	758	Tidal and floodplain	
NRCS WETLAND RESERVE PROGRAM NON-TIDAL WETLAND ENHANCEMENTS			
Liberty Farms	1,634	Non-tidal	2003
Peter's Pocket	101	Non-tidal	2005
Los Rios Unit	153	Non-tidal	2005
Ryer Island	175	Non-tidal	2006
Mound Farms	689	Non-tidal	2013
Other WRP Sites	1,537	Non-tidal	Unknown

Name	Size (ac) [1]	Hydrology	Year
PROJECTS BEING CONSIDERED			
Liberty Island Enhancement		Tidal	
Little Holland Tract Enhancement		Tidal	
BDCP Conservation Measure 2 Yolo Bypass Floodplain Enhancement		Floodplain	

Notes:

[1] Acreage values tentative and may change depending on specific restoration designs of each property. Values reflect currently known extent of diked lands at intertidal elevations.

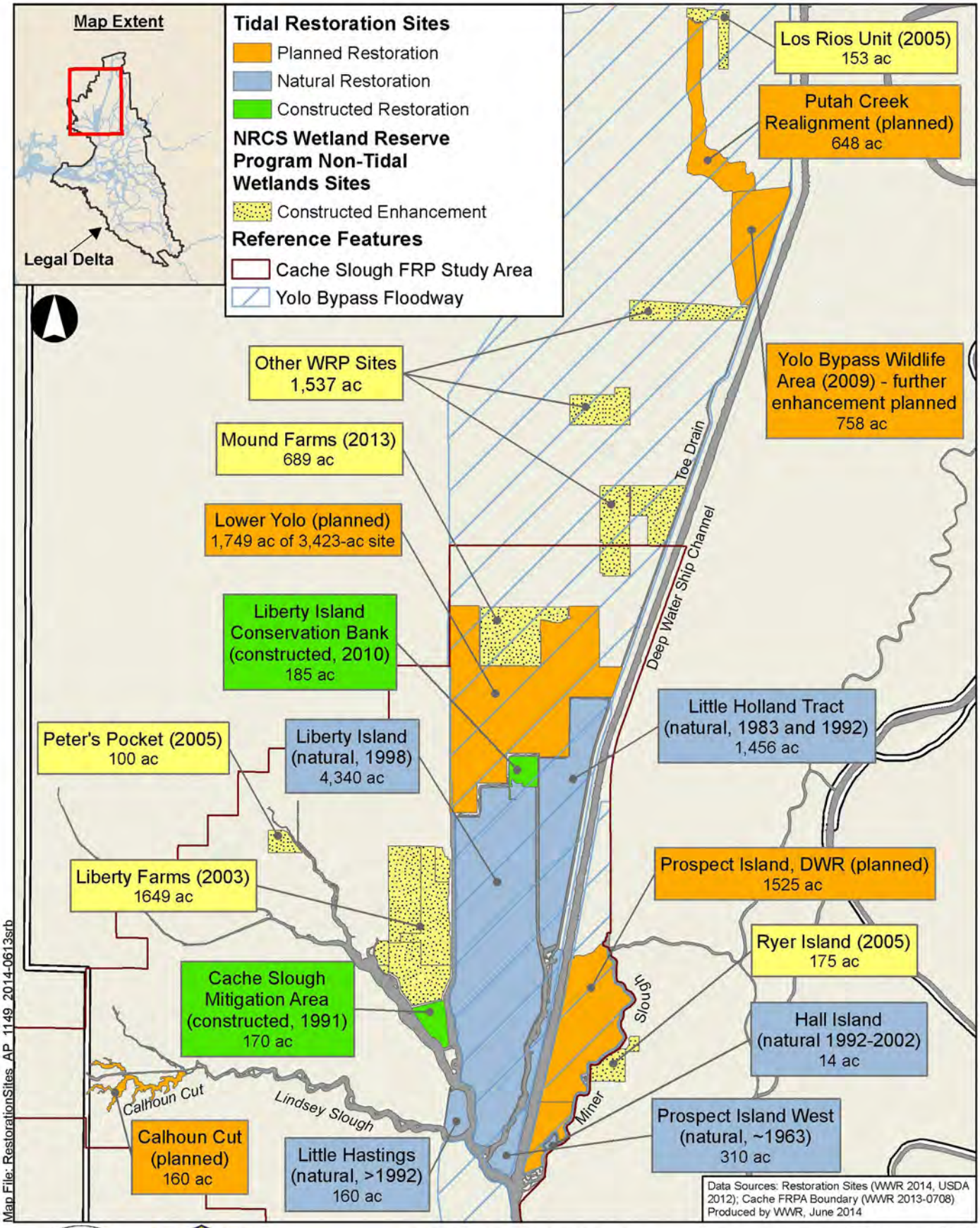


Figure 3-2
Restoration Efforts in the Cache - Yolo Region

PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT

4 EXISTING SITE CONDITIONS

After a brief discussion of the Project site history (Section 4.1), this chapter describes the existing site conditions occurring at Prospect Island since its acquisition by DWR in 2010, including: current land use (Section 4.2), a discussion of physical resources (Section 4.3), biological resources (Section 4.4), cultural resources (Section 4.5), and potential hazards and hazardous materials (Section 4.6).

4.1 Site History

Levees around Prospect Island were first constructed during the late nineteenth century. At that time, the tidal slough that formed the northern boundary of the island was diked as well, connecting Prospect Island to other reclaimed lands to the north. A cross levee was constructed and has been maintained to keep Prospect Island hydrologically separated from the lands to the north. The first ownership claims of the island date back to 1860.

Prospect Island was made part of the Sacramento River Flood Control Project when that project was constructed in the early twentieth century. Like other lands at the southern end of the Yolo Bypass (Little Holland Tract, Liberty Island, Little Egbert Tract), all of the Prospect Island levees were constructed and maintained as “restricted height levees”, designed to overtop during larger floods to provide additional flood storage capacity. By design, therefore, agricultural operations on the island were subject to interruption and damage during flood events. According to Hopf (2011), there were levee breaches and/or flooding on Prospect Island in 1919, 1938, 1940, 1962, 1963, 1980, 1981, 1983 (twice), and 1986. Following these events, the levees were repaired and the island was pumped dry to return the land to agricultural use.

The Port purchased the island around the early 1950s for construction of the DWSC (R. Toft, pers. comm. 2014). All levees surrounding Prospect Island were kept at the restricted height elevations, including the western levee, which forms the eastern side of the DWSC and, with construction of the DWSC, became designated as a federal navigation levee. The south property was used as a receiving site for dredge material during construction. The Port maintained ownership of the 300-ac south property after construction of the DWSC. The property has not been used for dredged material placement since construction of the DWSC, and may have been farmed between 1963 and 1997, although crop records are not available. The Port currently holds the land as mitigation for

dredging activities, and leases the property for duck hunting. (R. Toft, pers. comm. 2014).

After the DWSC was constructed in 1963, the 1,300-ac north property was sold by the Port to the Sakata brothers, and Reclamation District (RD) 1667 was activated to maintain the north property as farmland (R. Toft, pers. comm. 2014). The Sakata brothers maintained ownership until the U.S. Bureau of Reclamation (USBR) acquired the site in 1995 (DWR 2012). During the final year of agricultural production, wheat, corn, and safflower were grown on the site (USACE and DWR 2001).

The USBR purchased the north property in 1995 as part of a multi-agency effort to restore wetland and riparian habitats in the Delta. Prospect Island and two others purchased with public funds (Liberty Island and Little Holland Tract) were to be part of a proposed North Delta National Wildlife Refuge and to be managed by the USFWS, but efforts to establish a refuge did not move ahead.

In March 1995, flooding caused two levee breaches at the site, one in the Miner Slough levee on the south property and a second at the internal cross levee separating the south property from the north property. The levee breaches were repaired and the north property was pumped dry in July 1996; however, the site was again flooded in 1997 before farming could resume. Levee repairs were completed in 1999; farming activities were not resumed following these repairs (USACE and DWR 2001). The levees breached again in 2006, including a failure of the internal cross levee. These repeated levee failures were eventually repaired (at great expense), but lands remained flooded for extended periods following each breaching event before the island was again pumped dry.

Following the early 2008 repair of the 2006 levee breach, pumping flood water off of the north property was discontinued. During this time, the flap gate on the small drainage culvert on Miner Slough was damaged, allowing inundation and very limited but regular water exchange between Prospect Island and Miner Slough (see Section 4.3.4 below).

DWR acquired the northern portion of Prospect Island from USBR in January 2010 and reactivated the Prospect Island Reclamation District (RD 1667) in January 2014 to facilitate regular maintenance of Prospect Island levees.The Miner Slough culvert flap gate was repaired in February 2014.

4.2 Current Land Use and Ownership

The Project site (including both the north property and south property) is currently flooded, uncultivated land. The south property has a very "porous" breach repair consisting of large boulders (a few feet in diameter) with little to no soils in between them. Though no measurements have been made, field observations suggest that the south property experiences a limited tidal exchange with Miner Slough. The interior of the south property is largely shallow aquatic habitat with portions invaded by aquatic weeds and fringed by emergent marsh and riparian vegetation. During the winter waterfowl season, the Port leases out its property for waterfowl hunting.

The north property has roughly 0.05 ft of daily tidal exchange immediately next to a small culvert when the flap gate is open (see Section 4.3.4). The interior of the north property consists of a mixture of shallow aquatic habitat and emergent marsh, with a fringe of emergent marsh and riparian vegetation around the edges. Invasive aquatic plants are found in much of the aquatic habitat. Section 4.4.1 provides a more detailed description of current natural communities.

Ownership is shown in Figure 4-1. DWR owns most of the lands comprising the northern portion of Prospect Island, north of the internal cross levee. The Port owns most of the lands south of the internal cross levee. The Port owns the DWSC, and those parcels extend east into the interior of Prospect Island along its entire western side. Along Miner Slough within the south property is one small private inholding and a second piece of land with no assigned County Assessor's parcel. The unassigned land appears to be an old meander bend from the time before Miner Slough was straightened, and the private inholding appears to be the meander cutoff.

The adjacent DWSC allows cargo vessels to access the Port of West Sacramento. Recreational vessels use the DWSC and Miner Slough, including the two small side channels, for fishing and recreational boating. The Solano County General Plan designates both the north and south properties as intensive agriculture, a non-essential agricultural land-use designation, with a "Resource Conservation Overlay" (R. Glass, Solano County Department of Environmental Management, pers. comm., 2001, as cited in USACE and DWR 2001; PCI 2012).

4.2.1 Surrounding properties

Prospect Island is flanked by the DWSC to the west and Miner Slough to the east (Figure 1-2). On the western side of the DWSC lies the flooded Liberty Island,

and to the east, across Miner Slough, is Ryer Island. The Fahn property and Arrowhead Harbor are located just north of Prospect Island.

There are three small additional properties adjacent or connected to Prospect Island. These include the Miner Slough Wildlife Area to the south, Hall Island along the Miner Slough side of the south property, and the Stringer property adjacent to Miner Slough in the central part of the DWR-owned north parcel (Figure 1-2). Additional information on the ownership and land use of the surrounding properties is detailed below.

Miner Slough Wildlife Area

Located adjacent to the south end of Prospect Island is the Miner Slough Wildlife Area. Managed by CDFW, the Miner Slough Wildlife Area is a 37-ac tidal and riparian reserve. With only 10 ac above the high tide water elevation, the Miner Slough Wildlife Area is composed of one small island and a narrow peninsula extending from Prospect Island. The Miner Slough Wildlife Area is home to willows, cottonwoods, tules, blackberries, and other plant species, and supports a variety of wildlife species, including beaver (*Castor canadensis*), black-crowned night heron (*Nycticorax nycticorax*), and other waterfowl (CDFG 2009).

Ryer Island

To the east across Miner Slough is Ryer Island. With the exceptions of the Snug Harbor Resort residential area on the southeastern portion of the island, a marina on the southern tip, and a Wetland Reserve Program managed wetland near Miner Slough, the vast majority of Ryer Island is actively farmed.

Hall Island

Hall Island is a privately owned island almost completely enclosed by Prospect Island on Miner Slough. The 21-ac property was once connected by a road to Prospect Island and supported multiple residences. The island flooded sometime between 1993 and 2002 and has since reverted mainly to open water with a fringe of tidal marsh and riparian vegetation. Currently, the only infrastructure remaining is a small, decrepit boat dock and associated development on the southern tip. Legal access to Hall Island is via Prospect Island levees. The restoration planning process will have to determine whether the access easement must be maintained or if it can be extinguished now that the island is abandoned.

Stringer property

The Stringer property is a small, privately owned parcel of land connected to the DWR-owned northern portion of Prospect Island bordering Miner Slough. Most of the small parcel has flooded and reverted to a mixture of open water, tidal marsh, and riparian vegetation. The Stringer family maintains a single family residence on the northern portion. Legal access to the Stringer property is via Prospect Island levees. Ongoing access, or negotiated extinguishment of the access easement, will have to be provided in some manner as part of the Project.

Fahn property

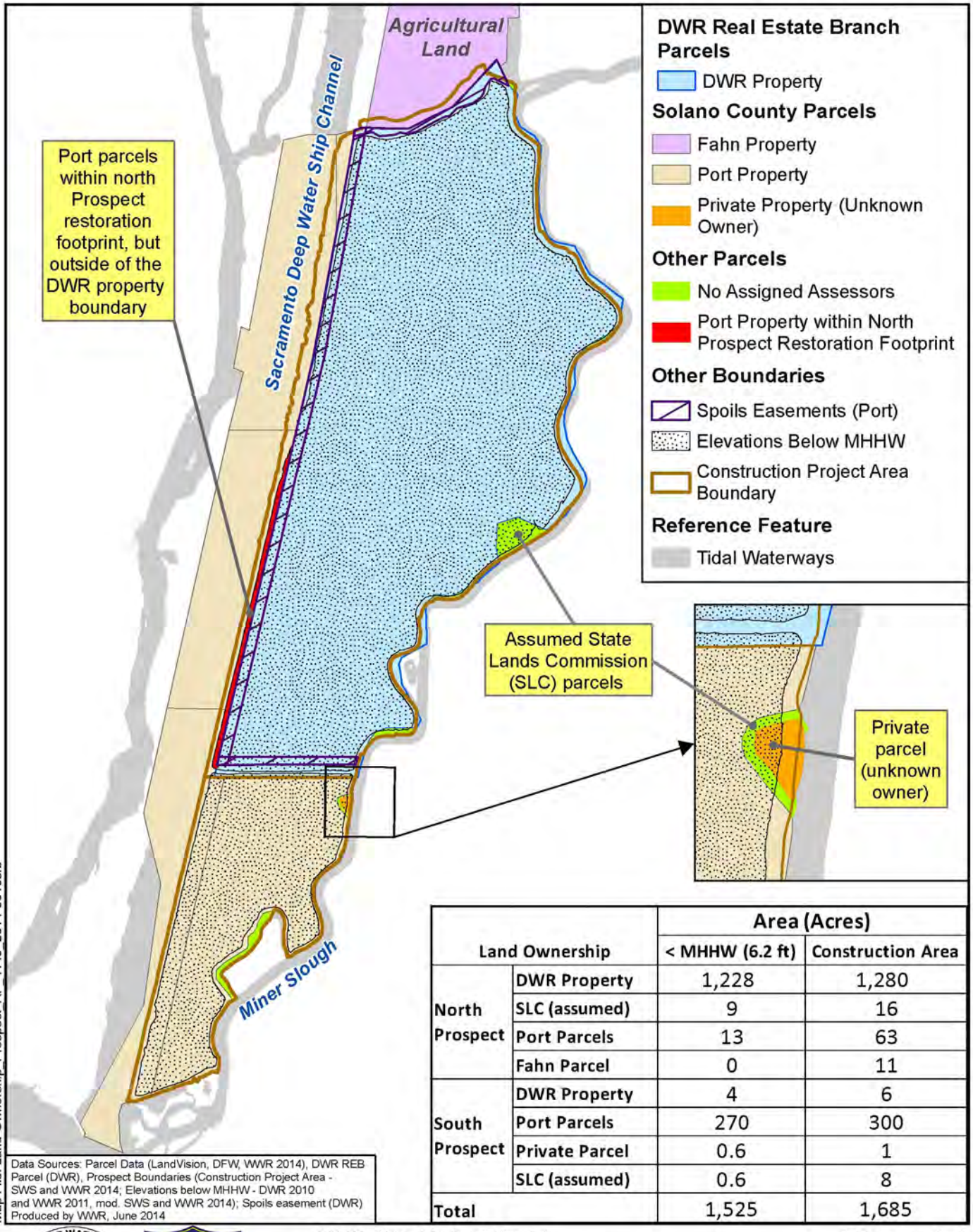
The Fahn property is agricultural land just north of Prospect Island. It is a remnant of Little Holland Tract, which was bisected by construction of the DWSC. The Fahn property is separated from Prospect Island by a northern cross levee extending from Arrowhead Harbor to the DWSC.

Arrowhead Harbor

Arrowhead Harbor is located just north of Prospect Island across Miner Slough, at the southwestern tip of the Clarksburg Agricultural District. This small 5-ac harbor is the closest marina to the Project site, and the only one currently operational on Miner Slough.

4.2.2 Nearby municipal areas

The City of Rio Vista and the Rio Vista Municipal Airport are located approximately 3 miles southwest of Prospect Island (Figure 1-1). The largest major metropolitan area in the vicinity, Sacramento, is located 30 miles to the northeast.



Land Ownership		Area (Acres)	
		< MHHW (6.2 ft)	Construction Area
North Prospect	DWR Property	1,228	1,280
	SLC (assumed)	9	16
	Port Parcels	13	63
	Fahn Parcel	0	11
South Prospect	DWR Property	4	6
	Port Parcels	270	300
	Private Parcel	0.6	1
	SLC (assumed)	0.6	8
Total		1,525	1,685

Data Sources: Parcel Data (LandVision, DFW, WWR 2014), DWR REB Parcel (DWR), Prospect Boundaries (Construction Project Area - SWS and WWR 2014; Elevations below MHHW - DWR 2010 and WWR 2011, mod. SWS and WWR 2014); Spoils easement (DWR)
Produced by WWR, June 2014

Map File: Land-Ownership_Prospect_AP_1149_2014-0616srb

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0 0.5 1 Km

Figure 4-1
Land Ownership at Prospect Island

PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT

4.3 Physical Resources

4.3.1 Levees

Levees encompassing Prospect Island were constructed during the late 19th century. Prospect Island levees were constructed and have been maintained as restricted height levees, designed to overtop during larger floods to provide additional flood storage capacity. Levee heights around Prospect Island range from 12 to 16 ft (NAVD88) along the DWSC, above 18 ft along the site's northern edge, 12 to 18 ft along Miner Slough (not including the degraded breach repair on the south property's eastern levee), and 12 to 14 ft along the internal cross levee (DWR 2012b) (Figure 4-2). Currently, the Prospect Island levee system is in relatively poor condition. A February 2013 inspection of the Miner Slough levee on the north property, the internal cross levee, and the northern levee of the north property found that significant areas of each of these levees are at risk of failure (MBK 2013).

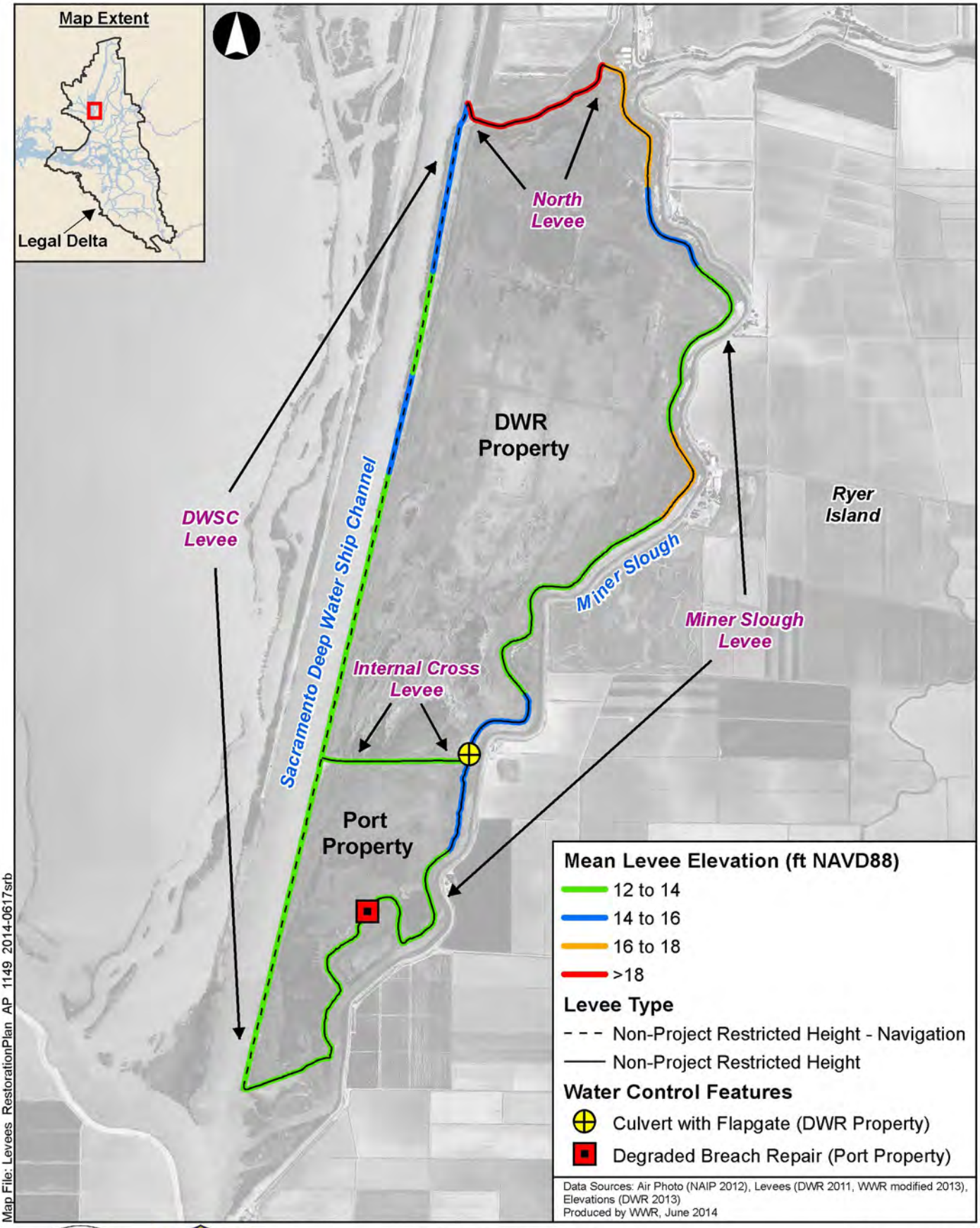

Figure 4-2
Levees at Prospect Island

PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT

4.3.2 Soils

Soils in the Delta range from a variety of alluvial fan deposits to organic peat (USACE and DWR 2001). Delta soils have high to very high shrink/swell potential and low strength for supporting the loads of embankments, dikes, and levees. Six soil units have been mapped within the Project site. Three comprise the bulk of the site: Sacramento silty clay loam (Sa) in the northern third, Ryde clay loam (Ry) in the central third, and Tujunga fine sand (Tu) in the southern third (Figure 4-3). The other three soils units are located around some of the Project margins: Columbia fine sandy loam (Cm) along Miner Slough, Valdez silt loam (Va) along Miner Slough and the DWSC and internal cross levee, and Sacramento Clay (Sd) on the northern levee (NRCS 2007). Additionally, unmapped dredged spoils are present within the south property and possibly within the north property.

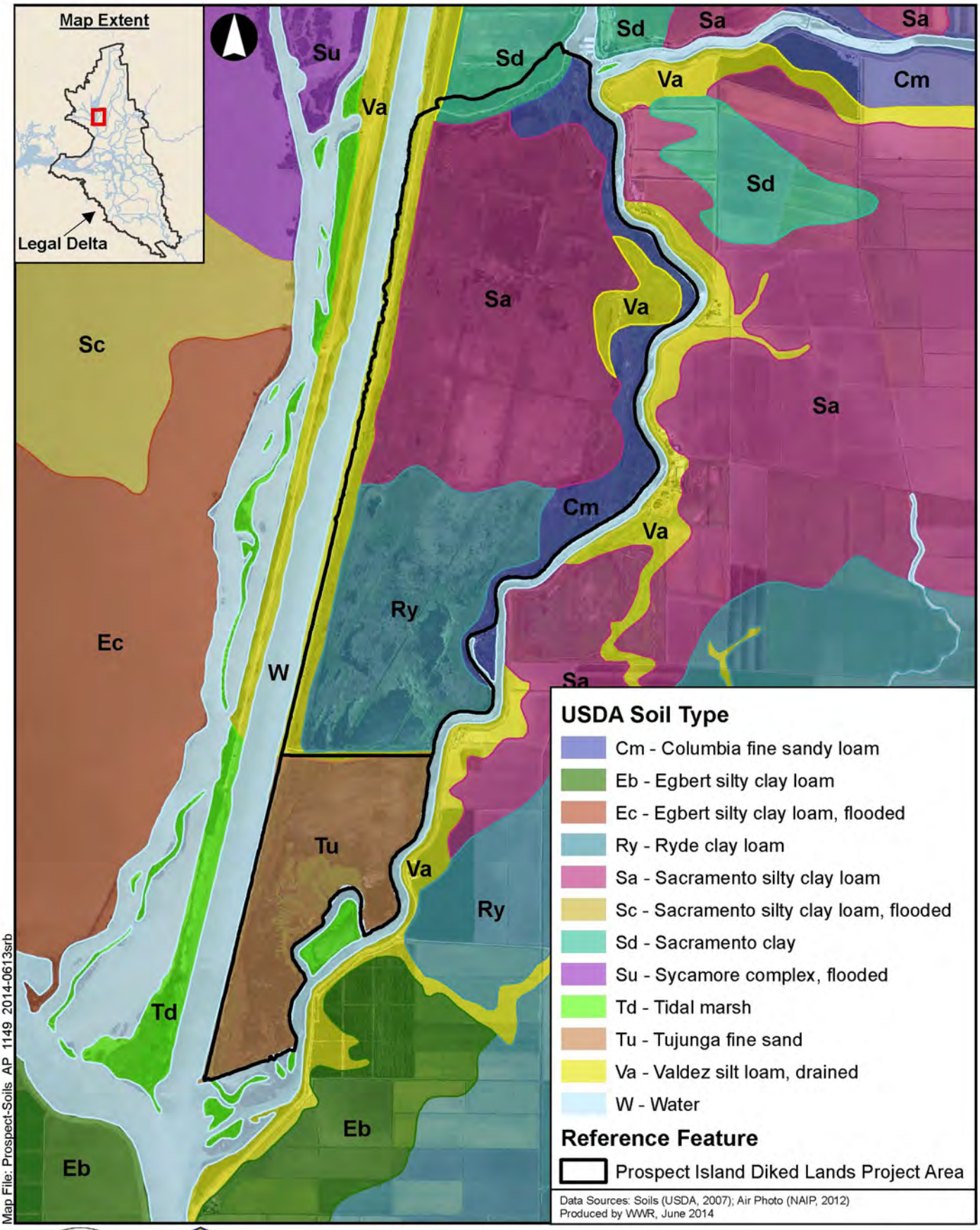

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Figure 4-3

Soils at Prospect Island

PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT

4.3.3 Topography

The north property is subsided to predominantly subtidal elevations, with about 40 percent of the land at shallow subtidal elevations (0 to 2 ft below mean lower low water [MLLW]) and 41 percent at moderate to deep subtidal elevations (moderate subtidal is defined in this report as 2 to 5 ft below MLLW, deep subtidal as greater than 5 ft below MLLW) (Figure 4-4). About 15 percent of the north property is at intertidal elevations (MLLW to mean higher high water [MHHW]). The remaining lands of the property consist of the perimeter levees and uplands (3%), and a minor amount of wetland-upland transition (1%) (Table 4-1, Figure 4-4). The south property lands are slightly higher, with about 61 percent at shallow subtidal and 33 percent at intertidal elevations, less than 1 percent at moderate subtidal, and limited wetland-upland transitional (1%) and upland areas (5%) (Table 4-1).

Figure 4-4 illustrates the dominance of subtidal elevations and the comparatively higher average elevations of the south property. The accommodation space of Prospect Island, the volume between current ground surface and high tide elevations, is roughly 12 million cubic yards.

Table 4-1. Elevations of DWR and Port Prospect Island Properties

Class	Elevation[1]		Area by class (ac, % of total area)[2]					
	Elevation range (ft MLLW)	Elevation range (ft NAVD88)	North Property		South Property		Total Prospect Island	
			(ac)	%	(ac)	%	(ac)	%
Upland	> 6	>8	46	3%	14	5%	60	4%
Transition	5.5 to 4	6.5 - 8	14	1%	4	1%	18	1%
Intertidal	4 to 0	2.5 - 6.5	191	15%	96	33%	287	18%
Shallow subtidal	0 to -2	0.5 - 2.5	522	40%	179	61%	701	44%
Moderate subtidal	-2 to -5	<-2.5 - 0.5	527	40%	1	0%	528	33%
Deep subtidal	< - 5	< -2.5	12	1%	0	0%	12	1%
Total			**1,312**		**294**		**1,606**	

[1] *Elevation ranges are approximate and rounded to the half foot.*

[2] *Total acres align with the Prospect Island 2011 DEM extent which includes the area within the levee crest. Rounding results in inexact mathematical sums.*

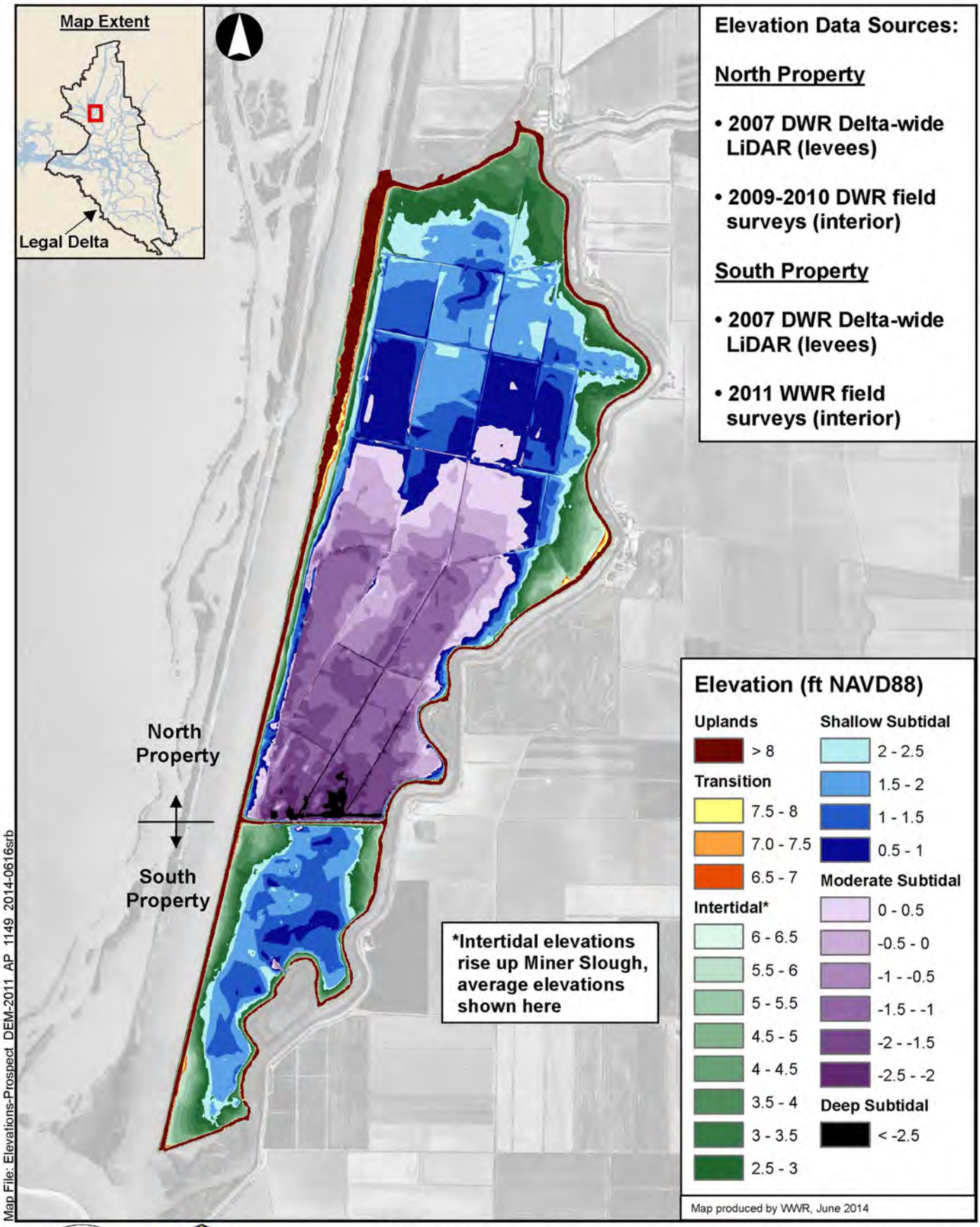


Figure 4-4

Elevations at Prospect Island

PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT

4.3.4 Site hydrology

North Property

The north property receives water from three sources: rainfall, groundwater seepage (DWR 2014a), and Miner Slough via a 4-ft diameter culvert, 50–75 ft in length, located in the southeast corner of the property. The culvert flap gate was vandalized not long after the 2008 levee breach repair, resulting in the property being inundated. DWR repaired and reinstalled this flap gate in February 2014.

Recent water level monitoring, conducted prior to the DWR flap gate repair, indicated a fairly uniform water surface elevation of around 3.4 ft NAVD88 (somewhat below local mean tide level) with a daily fluctuation of roughly 0.05 ft that aligns with the daily tidal cycle. Corresponding water depths across the site are up to 0.9 ft in the intertidal areas, 2.9 in the shallow subtidal areas, and 5.9 ft and deeper in the moderate to deep subtidal areas (see elevation intervals on Figure 4-4). The property was holding approximately 3,500 acre-feet of water at this stage.

The north property has retained its network of remnant agricultural drainage ditches, as indicated by the greater depths of these rectilinear features (Figure 4-4). These remnant agricultural ditches appear to be relatively shallow, on the order of a few feet in depth.

South Property

The south property does not appear to have retained any of its former agricultural drainage ditches (Figure 4-4), as presumably they have been buried by dredged materials. The property receives water from three sources: rainfall, groundwater seepage, and Miner Slough (via gaps in the large rocks of the levee breach repair on the side channel to Miner Slough, (Figure 4-2). Much of the property is submerged. The south property experiences limited tidal exchange, but no water level measurements have been made to establish the magnitude.

Tidal Datums Surrounding Project Site

Relevance of tidal datums. Tidal datums describe the elevations of the tides relative to a geodetic (earth surface) datum and are among the most fundamental drivers of estuarine ecology. Tidal datums are calculated by averaging conditions over the 18.6-year tidal epoch cycle (NOS 2003). The National Ocean Service (NOS) updates tidal datums about every 25 years nationally, to adjust for long-term sea level rise. The most recent NOS update was in 2005. The relationship

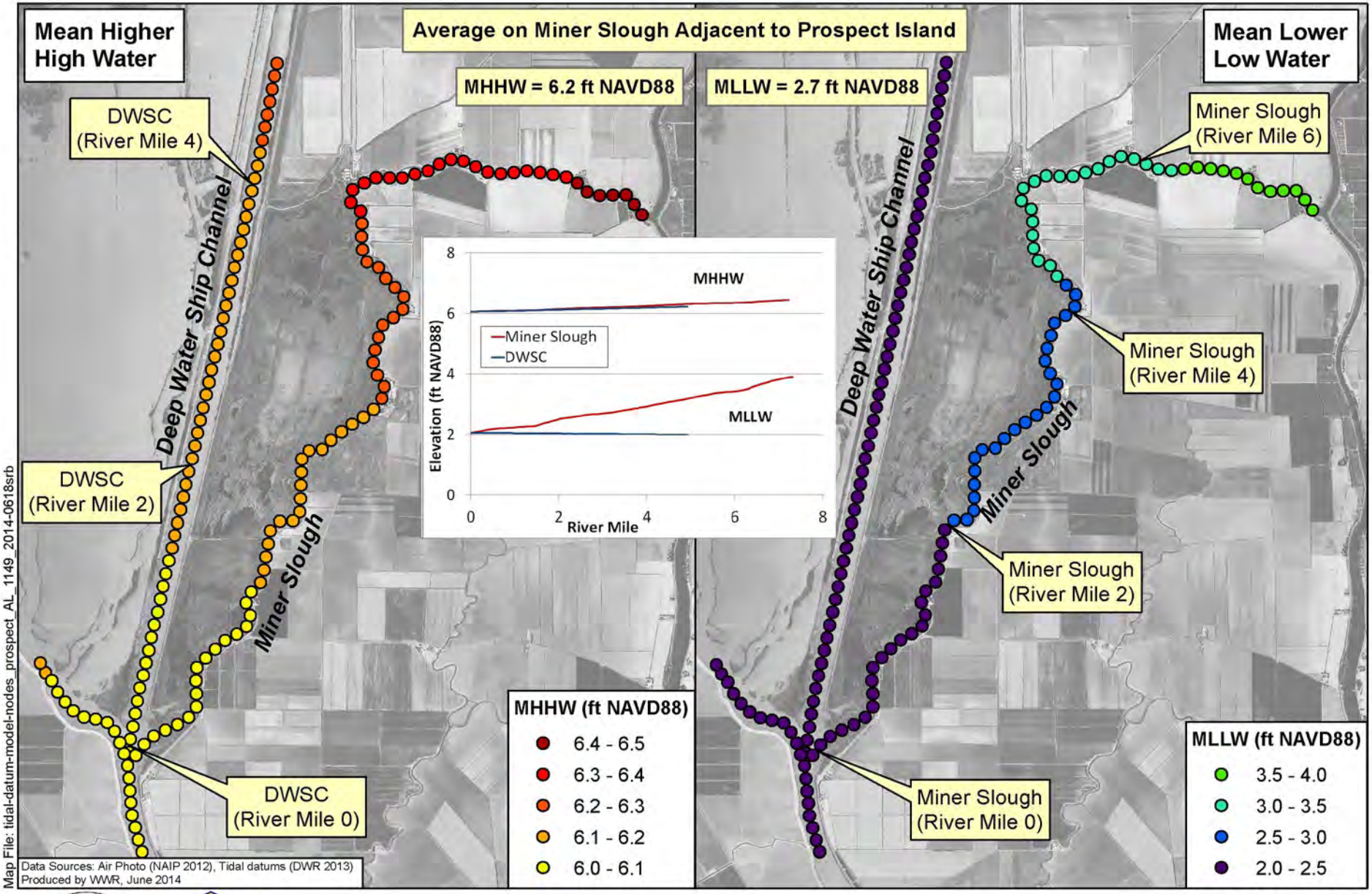
between tidal datums and the topography of a proposed restoration site will determine the design of restoration features, such as tidal channel dimensions, levee breach locations and geometry, grading extent, and suitable locations for vegetation establishment and natural colonization.

Method of tidal datum calculation for Prospect Island. For the Delta Vision Strategic Plan (DVBRTF 2008), DWR staff in collaboration with Wetlands and Water Resources undertook a Delta-wide tidal datum computation (Siegel et al. in prep). DWR staff calculated tidal datums at approximately 75 long-term DWR tide stations in the Delta, using data collected over a 10-year period. Computations followed standard NOS (2003) methods. DWR then applied these data to calibrate and verify a hydrodynamic model configured to calculate tidal datums at over 135,000 model nodes throughout the Delta and up each contributing river channel. For each node, DWR modeled four tidal datum "scenarios" to reflect the effects of Delta Cross Channel and South Delta Temporary Barriers seasonally varying operational schedules on tidal datums.

Prospect Island Tidal Datums and Tide Range. Table 4-2 shows tidal datums for the Prospect Island vicinity. These tidal datums reflect 162 of the model output nodes immediately adjacent to Prospect Island on Miner Slough, Cache Slough, and the Sacramento DWSC (Figure 4-5). Modeling results showed minor datum variations with Delta Cross Channel and South Delta Temporary Barriers operations, so datums in Table 4-2 represent the "all data" scenario. Miner Slough along its Prospect Island reach exhibits a small rise in high tide (MHHW) upstream, by 0.2 ft. Low tides (MLLW) on this reach exhibit a significant rise, of 1.1 ft. Tide range (MLLW to MHHW) decreases by 0.9 ft between the confluence of Miner Slough with Cache Slough upstream to Arrowhead Harbor, from about 4 ft to about 3 ft. Actual tidal datums and tide range within restored Prospect Island would consequently depend on levee breach location(s).

Table 4-2. Tidal Datums in the Vicinity of Prospect Island.

Tidal datum	Elevation (ft NAVD88)			
	Miner Slough			Deep Water Ship Channel (DWSC)
	South: confluence with Cache Slough	North: Arrowhead Harbor	Average	
Mean higher high water (MHHW)	6.1	6.3	6.2	6.1
Mean high water (MHW)	5.5	5.8	5.7	5.6
Mean low water (MLW)	2.7	3.7	3.2	2.6
Mean lower low water (MLLW)	2.1	3.2	2.7	2.0
Tide Range (ft)				
MLLW to MHHW	4	3.1	3.5	4.1



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0 0.5 1 Mi

0 1 2 Km

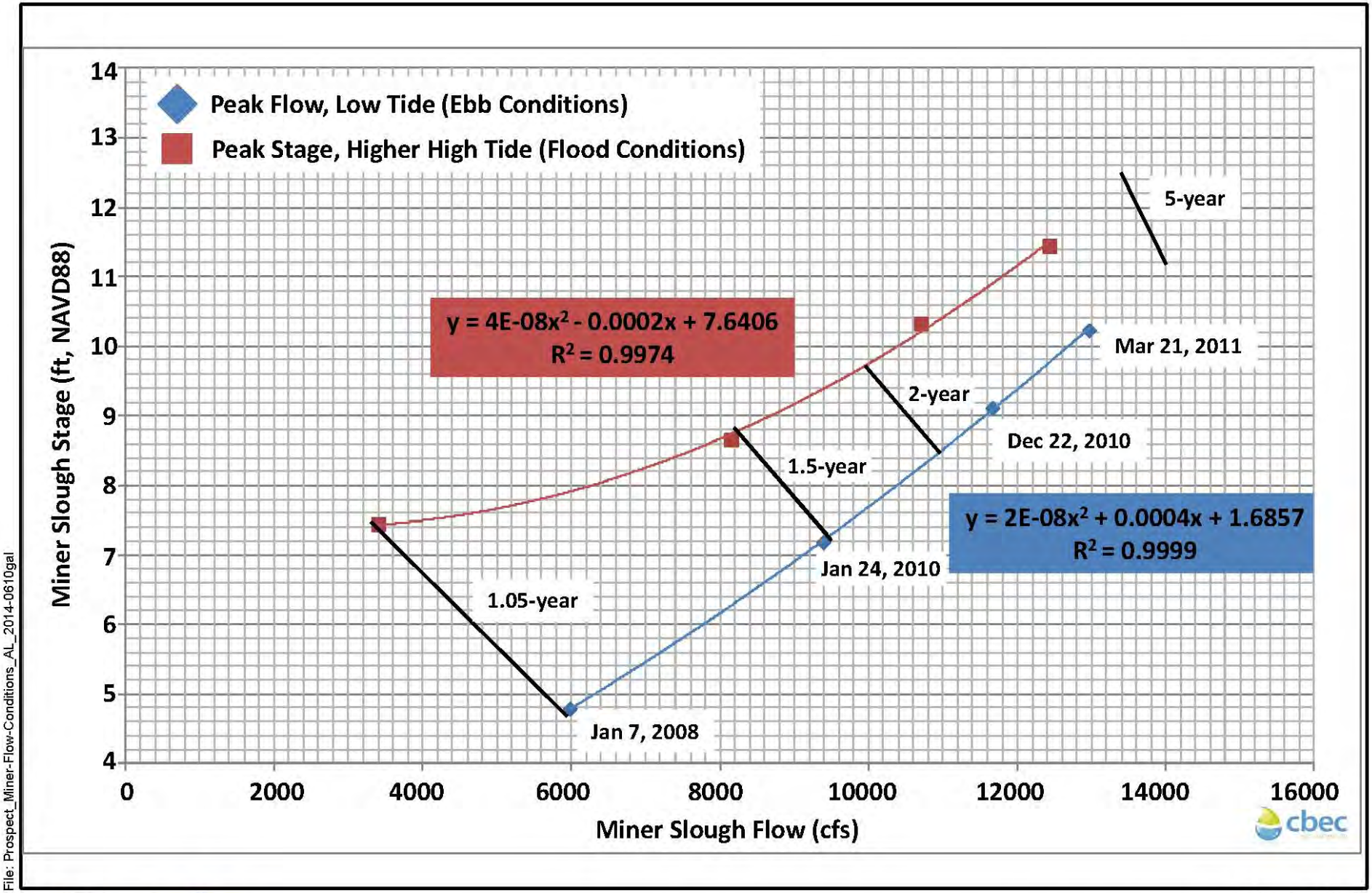
Figure 4-5

Tidal Datum Variation in Prospect Island Vicinity

PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT

4.3.5 Adjacent channels and sloughs

Miner Slough and the small tributary side channels adjacent to Prospect Island are relatively shallow, with depths mainly in the 8- to 12-ft range, although depths of up to 17 ft occur near the confluence with Cache Slough. The design flow of Miner Slough, as part of the SRFCP, is 10,000 cubic feet per second (cfs) (USACE 2006). During storm events, river flows dominate Miner Slough, overwhelming the tidal exchange and can result in unidirectional flow and higher stage for days to several weeks depending on the duration of upstream storm flows (CDEC 2013). Larger storm flows, which occur less frequently, raise Miner Slough “high tide” stage by several feet: by about 6 ft for a 5-year recurrence interval and by about 1 ft with a 1-year recurrence interval flow (Figure 4-6). These stage variations would exert considerable influence over the hydrology of a restored Prospect Island.



File: Prospect_Miner-Flow-Conditions_AL_2014-0610gal

Figure 4-6

Miner Slough Stage versus Flow for the 1- to 5-Year Recurrence Interval Storm Flow

The tidal exchange varies with both river flow and Delta Cross Channel operation. In general, when river flow in Miner Slough is higher (when the Delta Cross Channel is closed), the sloughs are river-dominated and the flood tide flow is lower. When the Delta Cross Channel is open, the system is still river-dominated. For example, when the Delta Cross Channel is open and Miner Slough river flow is at 1,000 cfs, tidal exchange is +5,000/-3,000 cfs. When river flow increases to 2,500 cfs, tidal exchange becomes even more ebb (river) flow-dominated with +5,250/-500 cfs.

The Sacramento DWSC, a terminal tidal slough to the Port of West Sacramento, is routinely dredged to 30-ft depth by the USACE to maintain maritime navigation. Originally authorized by the River and Harbor Act on July 24, 1946, construction of the channel was completed in 1963. The DWSC alongside Prospect Island is owned and managed by the Port. Shallow shoals of the DWSC comprise about two-thirds of the channel width, and provide shallow subtidal, intertidal, and emergent marsh habitat. The DWSC functions as a dead-end slough, and is dominated by tidal flow year-round.

4.3.6 Sediment Regime in Miner Slough

Erosion and deposition within post-restoration Prospect Island would be driven predominantly by the interaction of hydrodynamic processes (velocity, inundation duration, tidal and riverine influences), sediment concentrations, sediment grain size, presence of vegetation (emergent, floating, and submerged), water depth, wind energy, and site morphology (Schoellhamer et al. 2012, Siegel et al. 2010). Because Prospect Island is located at the junction of riverine flows of Miner Slough with tides from Cache Slough and moderated by flood flows down the Yolo Bypass in some years, its hydrodynamics and sediment transport setting are comparatively complex. The specific location of levee breach(es) relative to these hydrologic sources and their differing sediment supplies, and the extent of vegetation and channels within Prospect Island, will have a large effect on internal hydrodynamics and thus sedimentation processes. Riverine sediment supply will arrive at Prospect Island in a few pulses with early winter flows (the “first flush” sediment transport). Sediment from downstream sources has the potential for more year-round supply, with the magnitudes driven by sediment resuspension processes in the CSC.

The CSC has the highest year-round suspended solids concentration in the Delta because of its position within the highest sediment load region of the entire Delta (Morgan-King and Schoellhamer 2013, Schoellhamer et al. 2012). There are five sources of external sediment inputs into the CSC: the Yolo Bypass, the

Sacramento River, Steamboat Slough (distributary channel of the Sacramento River), Miner Slough (distributary channel of the Sacramento River), and the Ulatis Creek flood control channel. The Sacramento River (including its two distributary channels) is the dominant sediment source. Miner Slough captures approximately 20% of the water and sediment load from the Sacramento River (Morgan-King and Schoellhamer 2013), making it a slightly smaller sediment source than the Yolo Bypass but active in all years at some magnitude, whereas the Yolo Bypass supplies sediment predominantly when the floodplain is activated. Most of the sediment in Miner Slough (approximately 65%) is typically supplied during the first runoff event of the season (Morgan-King and Schoellhamer 2013). As the size of the first flush pulse increases, sediment supply increases, but erosive forces also increase, reducing the amount of sediment deposition, and increasing turbidity.

4.3.7 Utilities, gas wells, mineral rights, infrastructure, easements

Utilities

Other than utility poles, there are no other known utilities (potable water, sewer, transmission lines, etc.) present on the north Prospect Island property. Research into potential utilities on the south property has not yet been undertaken.

Gas Wells

There are six plugged, exploratory natural gas wells located within the north property on Prospect Island (Figure 4-7) (DOGGR 2013). Five of the wells were non-productive/dry and were capped shortly after drilling. One of the wells was in production/open from 1956 until 1965, at which point it was capped and abandoned. The most recent exploratory drilling on Prospect Island occurred in 2002, during which one of the five dry wells was explored, found to be dry, and subsequently capped and abandoned (DOGGR 2013).

Mineral Rights

Mineral rights on the north property are owned by the federal government. Mineral rights on the south property are owned by a suite of former owners prior to its condemnation by the Port (A. Lockhart, DWR, pers. comm., 2013).

Infrastructure

Prospect Island is currently undeveloped. The remains of buildings and structures are present on the island, and attest to its former agricultural use. Three houses, a bunkhouse, and at least three outbuildings (a pump house, wash/bath house, and a collapsed structure) were still present in 1997 on the eastern edge of the north property (on the western edge of Miner Slough) (PCI 2012). As of 2012, only the pump house and the remnants of the bunkhouse remained (PCI 2012). A dilapidated house is also present on the south property (Figure 4-7). A well-maintained travel trailer, located on the northwest corner of the south property and present only during waterfowl hunting season, is the only sign of recent human use of the island.

Easements

Pacific Gas & Electric Company (PG&E) maintains easements on the north property for electrical and communication purposes (Figure 4-7). Additional easements, deeded to the Port, are in place for the following: deposit and removal of spoil material, ingress and egress, and levee maintenance. An easement is also held by the Sacramento San Joaquin Drainage District for passage of the floodwaters of the Yolo Bypass across the site.

Ingress and egress easements are also held by private parties including an easement deeded to Jerry and Susan Hall and another deeded to John Stringer both for passage across the levee on the north side of the property, along the east DWSC levee, across the internal cross levee, and over a portion of the Miner Slough levee (Figure 4-7).

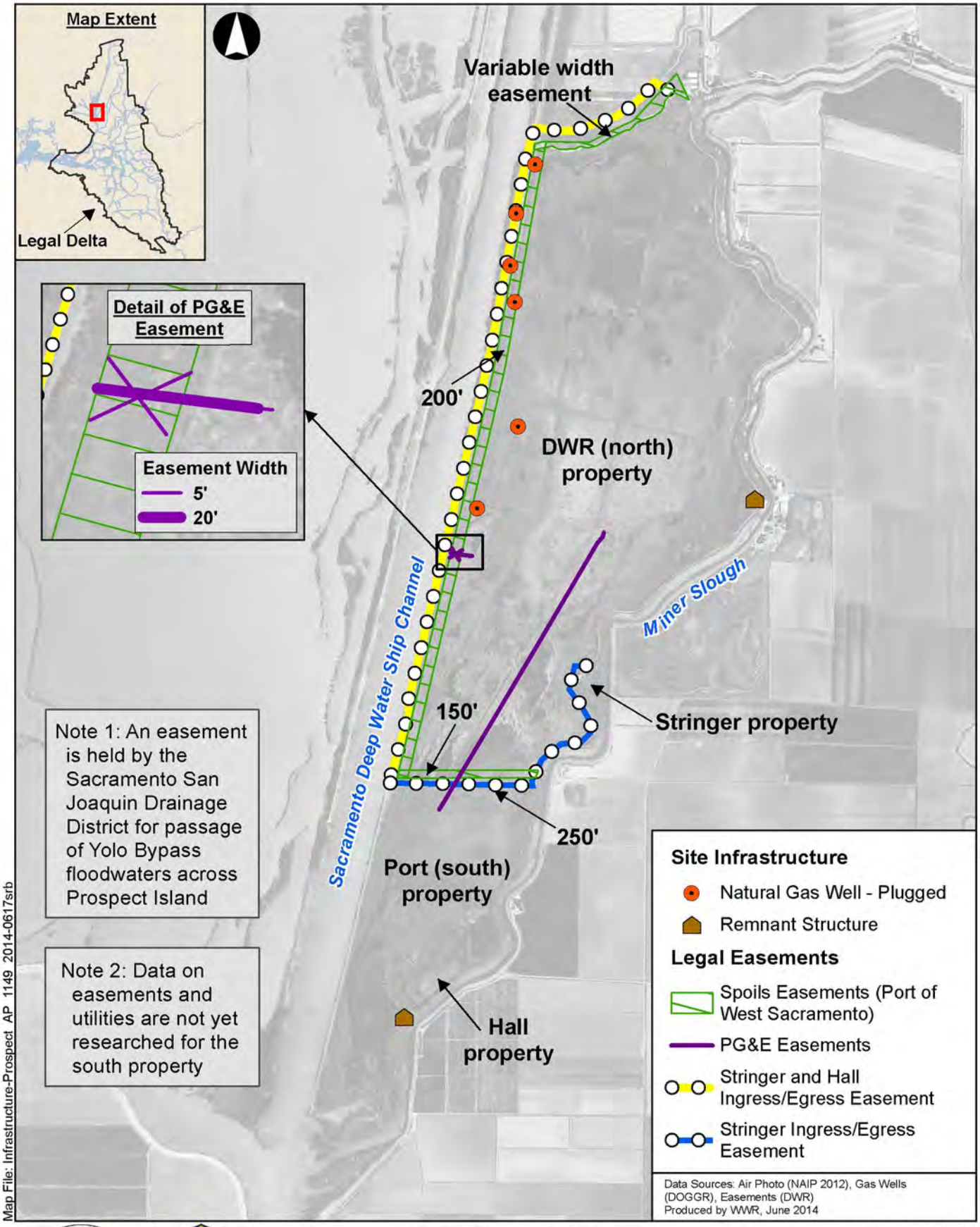


Figure 4-7
Infrastructure and Easements at Prospect Island

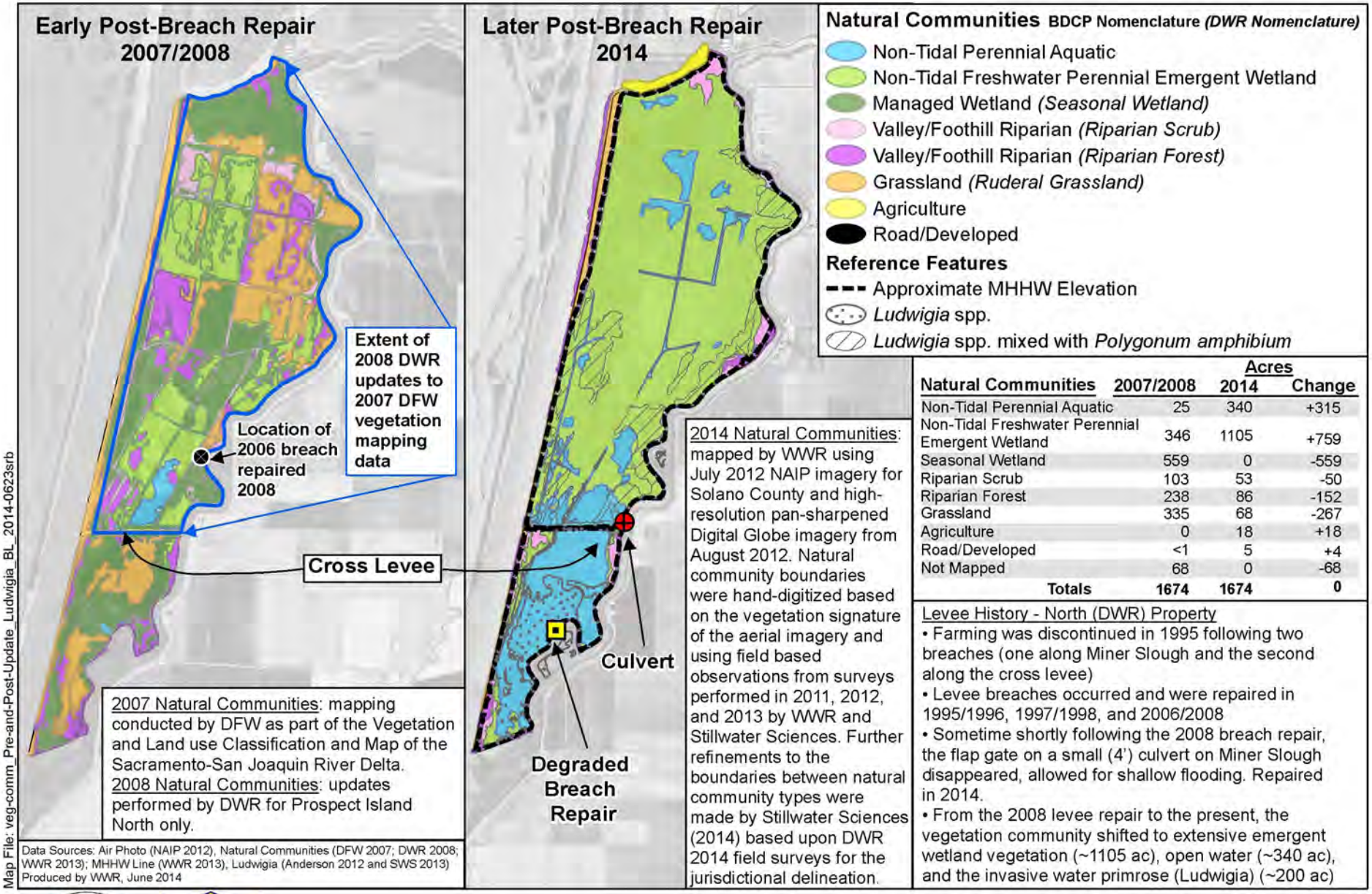
PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT

4.4 Biological Resources

The biology of the site has been transformed over time in response to changes in land use and hydrology. Given the unmanaged condition of the site, continual changes are assumed to be occurring.

4.4.1 Natural communities

Figure 4-8 illustrates the evolution of vegetation types on the island from conditions as mapped in 2007–2008, shortly after repair of the 2006 levee breach, to current conditions mapped in 2014, about six years after breach repair. The Project site currently supports a predominance of emergent wetland vegetation on the site interior with a mix of vegetation types around the margins, composed of native and non-native species. This natural community composition reflects the more stable inundation regime following breach repair and vandalism of the culvert flap gate.



Natural Communities	Acres 2007/2008	2014	Change
Non-Tidal Perennial Aquatic	25	340	+315
Non-Tidal Freshwater Perennial Emergent Wetland	346	1105	+759
Seasonal Wetland	559	0	-559
Riparian Scrub	103	53	-50
Riparian Forest	238	86	-152
Grassland	335	68	-267
Agriculture	0	18	+18
Road/Developed	<1	5	+4
Not Mapped	68	0	-68
Totals	**1674**	**1674**	**0**

Levee History - North (DWR) Property

- Farming was discontinued in 1995 following two breaches (one along Miner Slough and the second along the cross levee)
- Levee breaches occurred and were repaired in 1995/1996, 1997/1998, and 2006/2008
- Sometime shortly following the 2008 breach repair, the flap gate on a small (4') culvert on Miner Slough disappeared, allowed for shallow flooding. Repaired in 2014.
- From the 2008 levee repair to the present, the vegetation community shifted to extensive emergent wetland vegetation (~1105 ac), open water (~340 ac), and the invasive water primrose (Ludwigia) (~200 ac)

1:48,149 (1 in = 0.8 mile at letter size)

0 0.4 0.8 Mi

0 0.6 1.2 Km

Figure 4-8

Vegetation Communities 2007/2008 and 2014 at Prospect Island

PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT

Wetland communities

Non-Tidal Freshwater Perennial Emergent Wetland

Non-tidal freshwater perennial emergent wetlands occur in the interior of Prospect Island in areas that are permanently saturated or perennially inundated. These features comprise roughly 66 percent (1,105 ac) of the Diked Lands Project Area, surrounding or interspersed with the large open water (non-tidal perennial aquatic) areas in the central portion of the island that support aquatic vegetation (Figure 4-8). This community is dominated by cattails (*Typha latifolia*), common tule (*Schoenoplectus acutus*), and water smartweed (*Persicaria amphibia*). Common reed (*Phragmites australis*), common rush (*Juncus effusus*), water primrose (*Ludwigia* sp.), and southern bulrush (*Schoenoplectus californicus*) are also interspersed in this community.

Non-Tidal Perennial Aquatic

Nontidal perennial aquatic communities are areas of mostly open water found interspersed with the freshwater marsh, riparian, and upland communities at the Project site. Non-tidal perennial aquatic communities make up approximately 20 percent (340 ac) of the Diked Lands Project Area, occurring as large ponded areas in the central portion of the south property and interspersed within non-tidal perennial emergent wetland on the north property (Figure 4-8). Vegetation in this community includes native aquatic plants such as smartweed, duckweed (*Lemna minor*), and mosquito fern (*Azolla filiculoides*), and non-native plants such as water primrose (*Ludwigia* sp.), parrotfeather (*Myriophyllum aquaticum*), and curlyleaf pondweed (*Potamogeton crispus*).

Riparian communities

The valley/foothill riparian community is a transition zone between aquatic and upland terrestrial habitat. Eight percent (139 ac) of the Diked Lands Project Area is mapped as valley/foothill riparian; it occurs along the higher elevation margins and on the levees (Figure 4-8). Riparian woodland/forest species include Goodding's willow (*Salix gooddingii*), arroyo willow (*Salix lasiolepis*), cottonwood (*Populus fremontii*), Oregon ash (*Fraxinus latifolia*), and boxelder (*Acer negundo*). Riparian shrub species that make up a riparian scrub/shrub community or are present as understory plants in riparian forest include: sandbar willow (*Salix exigua*), Himalayan blackberry (*Rubus armeniacus*), California blackberry (*Rubus ursinus*), California rose (*Rosa californica*), red-osier dogwood (*Cornus ssp. sericea*) and blue elderberry (*Sambucus nigra ssp. caerulea*). Numerous snags of large relict riparian trees protrude above the water

surface in many inundated areas of the island that formerly supported riparian woodland.

Upland communities

Upland communities existing on the site consist of grasslands and (former) agricultural/cultivated lands. Grassland is composed of non-native or native annual and perennial grasses and forbs (non-grass herbaceous species). Grasslands are often found adjacent to wetland and riparian habitats. Approximately four percent (68 ac) of the Diked Lands Project Area is mapped as grassland (Figure 4-8); it occurs around the higher elevation margins and on the levees. Grassland at the Project site consists primarily of non-native grasses including ripgut brome (*Bromus diandrus*), wild oats (*Avena fatua*), rye grass (*Festuca perenne*), Bermduda grass (*Cynodon dactylon*), poison hemlock (*Conium maculatum*), fennel (*Foeniculum vulgare*), wild radish (*Raphanus sativus*), milk thistle (*Silybum marianum*), perennial pepperweed (*Lepidium latifolium*) and white sweetclover (*Melilotus albus*). Native species include western goldenrod (*Euthamia occidentalis*) and mugwort (*Artemisia douglasiana*). An additional one percent (18 acres) of the Diked Lands Project Area is mapped as agricultural/cultivated lands.

4.4.2 Special-status species

Special-status Plants

There are many special-status plants documented to occur in the Project vicinity. The following discussion describes those most likely to occur on Prospect Island (i.e., at the Project site) under current conditions.

Special-status plant surveys were conducted at the Project site between March 3 and October 2, 2009 (DWR, unpubl. data). Five special-status plant species with a total of 12 occurrences have been documented at the Project site during the DWR field surveys or by the CDFW's California Natural Diversity Database (CNDDB) (CDFW 2013) (Table 4-3). Figure 4-9 shows special-status plant species' occurrences documented in the CNDDB within a 5-mile vicinity of the Project site.

In order to assess the potential for other species to occur at the Project site, the California Native Plant Society's (CNPS) online Inventory of Rare and Endangered Vascular Plants of California (CNPS 2013), CDFW CNDDB (CDFW 2013), and the USFWS list of federally listed and proposed endangered, threatened, and candidate species (USFWS 2013) were queried. Appendix A

presents a list of special-status plant species identified from the database queries along with an estimated likelihood of their occurrence at the Project site under pre- and post-restoration conditions.

Fifteen special-status plant species were identified as having low, moderate, or high potential to occur at the Project site. The likelihood of special-status species occurring at the site was determined by: (1) documented observations of a species on the site; (2) the presence and quality of potential habitat; and/or (3) proximity to known occurrences. This review and analysis resulted in the following categories of the likelihood for a special-status species to occur in the Project site:

- None: the species' required habitat (i.e., plant community types and elevation range) is lacking from the Project site.
- Low: the species' required habitat occurs in the Project site but it is of very low quality.
- Moderate: the species' required habitat occurs in the Project site.
- High: the species has been documented in the Project site.

A summary of life history, habitat associations, and location information is provided below for those special-status plant species that have been documented at the Project site (i.e., high potential likelihood).

Table 4-3. Special-status Plant Occurrences Documented at the Project Site (CNDDB; DWR, unpubl. data).

Common name *Scientific name*	Status[1] Federal/State/CRPR	Suitable habitat type	Likelihood to occur at the Project site under current conditions
Delta tule pea *Lathyrus jepsonii* var. *jepsonii*	– /– /1B.2	Freshwater and brackish marshes and swamps	**High;** one occurrence is documented in the Project site; 40 additional occurrences are documented in the Project region (CNDDB)
Mason's lilaeopsis *Lilaeopsis masonii*	– /CR/1B.1	Brackish or freshwater marshes and swamps and riparian scrub	**High;** two occurrences are documented in the Project site; 102 additional occurrences are documented in the Project region (CNDDB)
Delta mudwort *Limosella australis*	– /– /2B.1	Usually mud banks of freshwater or brackish marshes and swamps, and riparian scrub	**High;** one occurrence is documented in the Project site; 37 additional occurrences are documented in the Project region (CNDDB)
Sanford's arrowhead *Sagittaria sanfordii*	– /– /1B.2	Assorted shallow freshwater marshes and swamps	**High;** four occurrences are documented in the Project site (CNDDB; DWR, unpubl. data); 7 additional occurrences are documented in the Project region (CNDDB)
Suisun Marsh aster *Symphyotrichum lentum*	– /– /1B.2	Brackish and freshwater marshes and swamps	**High;** four occurrences are documented in the Project site (CNDDB); 94 additional occurrences are documented in the Project region

[1] Status:
– None
State: CR = Rare under the CNPPA
CRPR: 1B = Plants rare, threatened, or endangered in California and elsewhere
2B = Plants rare, threatened, or endangered in California, but more common elsewhere
0.1 = Seriously threatened in California
0.2 = Moderately threatened in California

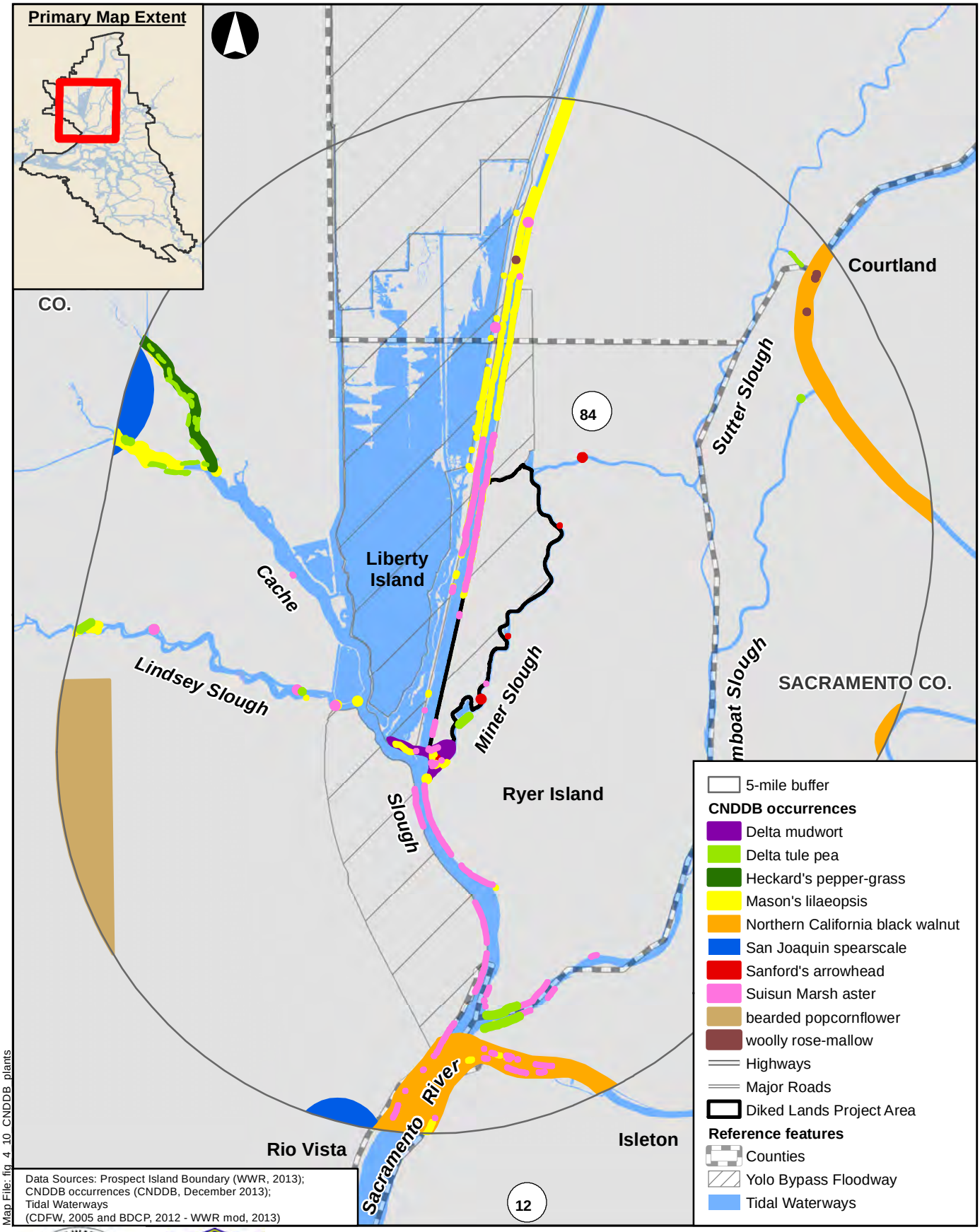


Figure 4-9

Special-status Plant Species Occurrences Documented in CNDDB within a 5-mile vicinity of the Project site

PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT

Special-status Fish

Nine special-status fish species are documented to occur in the Project vicinity. The following section describes the likelihood of these species to occur on Prospect Island (i.e., at the Project site) under current conditions. Table 4-4 provides habitat associations of special-status fish species as well as an initial assessment of their likelihood to occur at Prospect Island under current conditions (Appendix B includes an assessment of the likelihood to occur post-restoration). Eight of the nine special-status fish species present in the Project vicinity are considered to have a low likelihood to occur at the Project site under current conditions. Only the Sacramento Splittail, a California Species of Special Concern, currently has a moderate likelihood to occur at the site. None of these nine species was documented in fish surveys conducted at the Project site in August, 2013 (DWR, unpubl. data) or by the CNDDB (CDFW 2013).

The likelihood of occurrence at the Project site is based on (1) documented occurrence of a species during surveys conducted at the Project site in August, 2013 (DWR, unpubl. data) or by the CNDDB (CDFW 2013), and (2) current presence and access to suitable habitat at the Project site.

Table 4-4. Special-status Fish Species with the Potential to Occur at the Project Site.

Common name *Scientific name*	Status[a] Federal/ State	Habitat associations	Likelihood to occur at the Project site under current conditions [b]
Pacific Lamprey *Entosphenus tridentatus*	FSC/–	Adults spawn on sand and gravel in streams (lotic environment), but have been observed spawning in stagnant and muddy (lentic) environments; larvae (ammocoetes) bury themselves and feed in silty or sandy backwaters or stream edges with temperatures below 68°F	**Low**; suitable rearing habitat likely present but Delta rearing for this species has not been documented; access to site (from adjacent Miner Slough) is poor; the species has not been documented at the Project site
River Lamprey *Lampetra ayresi*	FSC/SSC	Spawning adults need riffle habitat with clean gravels in permanent streams; larvae (ammocoetes) bury themselves and feed in silty or sandy backwaters or stream edges with temperatures below 77°F	**Low**; suitable rearing habitat likely present but Delta rearing for this species has not been documented; access to site (from adjacent Miner Slough) is poor; the species has not been documented at the Project site
North American Green Sturgeon: southern distinct population segments (DPS) *Acipenser medirostris*	FT/SSC	Spawn in pools of large freshwater rivers with cool water and cobble, clean sand, or bedrock; in San Francisco Bay adults swim near the surface or forage along the bottom in water less than 33 ft deep; juveniles may rear in Delta for two years or more but Delta rearing habitat use has not been documented	**Low**; suitable rearing habitat likely present but rearing distribution and habitat use in the Delta largely unknown; access to site (from adjacent Miner Slough) is poor; the species has not been documented at the Project site
Sacramento Splittail *Pogonichthys macrolepidotus*	–/SSC	Low-elevation rivers and estuaries with low to moderate salinity (0–18 ppt); shallow, flooded vegetated habitat for spawning and foraging	**Moderate**; suitable habitat for all life stages is present, but access to habitat (from adjacent Miner Slough) is poor; the species has not been documented at the Project site

Common name *Scientific name*	Status[a] Federal/ State	Habitat associations	Likelihood to occur at the Project site under current conditions [b]
Delta Smelt *Hypomesus transpacificus*	FT/SE	Estuarine or brackish waters up to 18 parts per thousand (ppt); spawn in shallow brackish water upstream of the mixing zone (zone of saltwater-freshwater interface) where salinity is around 2 ppt	**Low**; habitat suitability in Miner Slough for movement to site is poor (P. Poirier and A. Rockriver, DFW, pers. comm., 16 January 2014); suitable habitat for all life stages is present; the species has not been documented at the Project site
Longfin Smelt *Spirnichus thaleichthys*	FPT/ST	Adults in large bays, estuaries, and nearshore coastal areas; migrate into freshwater rivers to spawn; salinities of 15–30 ppt	**Low;** habitat suitability in Miner Slough for movement to site is poor (P. Poirier and A. Rockriver, DFW, pers. comm., 16 January 2014); habitat suitability for spawning and rearing is low; the species has not been documented at the Project site
Chinook Salmon, central Valley spring-run Evolutionary Significant Unit (ESU) *Oncorhynchus tshawytscha*	FT/ST	Low- to mid-elevation rivers and streams with cold water, clean gravel of appropriate size for spawning and adequate rearing habitat; typically rear in freshwater for one or more years before migrating to the ocean; species documented to rear in Yolo bypass and other Delta habitats	**Low;** suitable rearing habitat is present but access to habitat (from adjacent Miner Slough) is poor; the species has not been documented at the Project site
Chinook Salmon, Sacramento River winter-run ESU *Oncorhynchus tshawytscha*	FE/SE	Mainstem river reaches with cool water and available spawning gravel; rear five to ten months in the river and estuary (potentially including Yolo bypass and similar habitats); migrate to the ocean to feed and grow until sexually mature	**Low;** suitable rearing habitat is present but access to habitat (from adjacent Miner Slough) is poor; the species has not been documented at the Project site

Common name ***Scientific name***	**Status[a] Federal/ State**	**Habitat associations**	**Likelihood to occur at the Project site under current conditions [b]**
Steelhead, Central Valley DPS *Oncorhynchus mykiss*	FT/–	Rivers and streams with cold water, clean gravel of appropriate size for spawning, and suitable rearing habitat; typically rear in freshwater for one or more years before migrating to the ocean; prevalence of Delta rearing largely unknown	**Low;** suitable rearing habitat likely present but rearing distribution and habitat use in the Delta largely unknown; access to potential rearing habitat (from adjacent Miner Slough) is poor; the species has not been documented at the Project site

[a] Status codes:

Federal

FE = Listed as endangered under the federal Endangered Species Act

FT = Listed as threatened under the federal Endangered Species Act

FPT = Federally proposed as threatened

FSC = Federal Species of Concern

State

SE = Listed as Endangered under the California Endangered Species Act

ST = Listed as Threatened under the California Endangered Species Act

SSC = California Species of Special Concern

[b] Likelihood of occurrence based on (1) documented occurrence of a species during surveys conducted at the Project site in August, 2013 (DWR, unpubl. data) or in CNDDB (CDFW 2013), and (2) presence of and access to suitable habitat.

Special-status wildlife

There are many special-status wildlife species documented to occur in the Project vicinity. The following discussion describes those most likely to occur on Prospect Island (i.e., at the Project site) under current conditions (Appendix B includes an assessment of the likelihood to occur post-restoration).

Special-status wildlife surveys were conducted at the Project site between 2009 and 2014 (DWR, unpubl. data 2009-2011; J. Downs, CDFW pers. comm). Six special-status wildlife species have been documented at the Project site during the DWR field surveys or by the CDFW's CNDDB (CDFW 2013) (Table 4-5). Figure 4-10 shows special-status wildlife species' occurrences documented in the CNDDB within a 5-mile vicinity of the Project site.

Twenty-three special-status wildlife species were identified as having low, moderate, or high potential to occur at Project site (Table 4-5). The likelihood of these species occurring at the site was determined by: (1) documented observations of a species during surveys conducted by DWR between 2009 and 2011; (2) the presence and extent of potential habitat; and/or (3) proximity to known occurrences, such as from CNDDB (CDFW 2013) or eBird (2013) (an online program that the birding community uses to report bird sightings). This review and analysis resulted in the following categories of the likelihood for a special-status species to occur:

- None: the Project site is outside the species' known range and/or the species' required habitat is lacking from the Project site.
- Low: the species' known range overlaps with the Project vicinity but not the Project site, and/or the species' required habitat is of very low quality or quantity in the Project area; documented sightings of the species in the Project vicinity are rare, if any.
- Moderate: The species' known distribution or elevation range overlaps with the Project site and the species' required habitat occurs in the Project site; there is also a reasonable chance for the species to occur based on frequency of documented sightings in the Project vicinity.
- High: The species has been documented in the Project site and/or its required habitat occurs in the Project site, is of high quality, and there are documented sightings of the species in the Project vicinity.

Seven special-status species have a high potential to occur or are known to occur at the site: western pond turtle, northern harrier, Swainson's hawk, yellow

warbler, yellow-breasted chat, song sparrow ("Modesto" population), and western red bat. These species are described in the table below.

Table 4-5. Special-status Wildlife Species with the Potential to Occur at the Project Site.

Common name *Scientific name*	Status [a] Federal/State	Habitat associations	Likelihood to occur at the Project site under current conditions
INVERTEBRATES			
Valley elderberry longhorn beetle *Desmocerus californicus dimorphus*	FT/–	Riparian and oak savanna habitats below 915 m (3,000 ft) with host plant blue elderberry (*Sambucus nigra* ssp. *caerulea)*.	**Low**; the Project site is likely outside of the species' known range; elderberry plants were observed during surveys in December 2013 and April 2014, no exit holes were observed (J. Downs, CDFW, pers. comm.)
REPTILES			
Western pond turtle *Actinemys marmorata*	–/SSC	Permanent, slow-moving fresh or brackish water with available basking sites and adjacent open habitats or forest for nesting	**High**; this species has been observed within the Project site (J.Downs, CDFW, pers. comm.); there is suitable non-tidal perennial aquatic habitat present at the Project site; nesting habitat present on dry levees and uplands; species is commonly sighted in the Delta
Giant garter snake *Thamnophis gigas*	FT/ST	Sloughs, canals, low-gradient streams and freshwater marsh habitats where there is a prey base of small fish and amphibians; also found in irrigation ditches and rice fields; requires grassy banks and emergent vegetation for basking and areas of high ground protected from flooding during winter	**Low**; this species was not detected during intensive trapping surveys in 2009 (DWR, unpubl. data), though there is suitable habitat present; emergent marsh provides foraging habitat and levees provide winter upland retreat from flooding
BIRDS			
Redhead *Aythya americana*	–/SSC	Freshwater emergent wetlands with dense stands of cattails (*Typha* spp.) and bulrush (*Schoenoplectus* spp.) interspersed with areas of deep, open water; forage and rest on large, deep bodies of water	**Low**; permanent freshwater emergent wetland at the Project site may provide suitable breeding habitat; rarely documented in Central Valley, and prefer larger lakes for nesting

Common name *Scientific name*	Status [a] Federal/State	Habitat associations	Likelihood to occur at the Project site under current conditions
Least bittern *Ixobrychus exilis*	–/SSC	Freshwater and brackish marshes with dense aquatic or semiaquatic vegetation interspersed with clumps of woody vegetation and open water	**Low**; permanent freshwater emergent wetland at the Project site may provide suitable breeding habitat, though species is rare in the Delta
White-tailed kite *Elanus leucurus*	–/SFP	Lowland grasslands and wetlands with open areas; nests in trees near open foraging area	**Moderate**; may nest in large riparian trees at Project site, and use emergent marsh and grasslands for foraging
Northern harrier *Circus cyaneus*	–/SSC	Nests, forages, and roosts in wetlands or along rivers or lakes, but also in grasslands, meadows, or grain fields	**High**; documented nesting and foraging at the Project site (CNDDB and DWR, unpubl. data)
Swainson's hawk *Buteo swainsoni*	–/ST	Nests in oaks or cottonwoods in or near riparian habitats; forages in grasslands, irrigated pastures, and grain fields	**High**; nesting documented in riparian forest habitats at the Project site (CNDDB and DWR, unpubl. data)
California black rail *Laterallus jamaicenis coturniculus*	–/ST, SFP	Large tidally-influenced marshes with saline to brackish water, typically with a high proportion of pickleweed (*Salicornia virginica*); also can be associated with bulrush (*Schoenoplectus* spp.), cattail (*Typha* spp.), or rushes (*Juncus* spp.); peripheral vegetation at and above mean high higher water necessary to protect nesting birds during extremely high tides	**Low**; suitable brackish or saline habitats are absent
Greater sandhill crane *Grus canadensis tabida*	–/ST, SFP	Forages in harvested rice fields, corn stubble, barley, and newly planted grain fields; occasionally in managed freshwater marshes	**Low** (wintering/foraging only); the Project site is on the edge of the species' known range; low potential to forage in freshwater emergent wetland habitats
Western yellow-billed cuckoo *Coccyzus americanus*	FC/SE	Summer resident of valley foothill and desert riparian habitats; nests in open woodland with clearings and low, dense, scrubby vegetation	**Low**; rare in the Project vicinity; very low probability of nesting (nesting cuckoos require large/extensive patch size of habitat)

Common name *Scientific name*	Status [a] Federal/State	Habitat associations	Likelihood to occur at the Project site under current conditions
Western burrowing owl *Athene cunicularia hypugaea*	–/SSC	Level, open, dry, heavily grazed or low- stature grassland or desert vegetation with available burrows	**Low**; there is a limited amount of suitable available nesting or foraging habitat in grasslands at western perimeter of Project site along dry levees and uplands
Short-eared owl *Asio flammeus*	–/SSC	Irrigated alfalfa or grain fields, ungrazed grasslands, old pastures, and salt or freshwater marshlands	**Moderate**; may forage in permanent freshwater emergent marsh and upland habitats, primarily in winter; very low potential for nesting at the Project site due to limited upland breeding sites
Loggerhead shrike *Lanius ludovicianus*	–/SSC	Open shrubland or woodlands with short vegetation and and/or bare ground for hunting; some tall shrubs, trees, fences, or power lines for perching; typically nest in isolated trees or large shrubs	**Low**; may nest in isolated trees at the Project site, though suitability of foraging habitat is marginal
Least Bell's vireo *Vireo bellii pusillus*	FE/SE	Nests in dense vegetative cover of riparian areas; often nests in willow or mulefat; forages in dense, stratified canopy	**Low**; while this species is a rare migrant in the Project vicinity, there is general optimism that the species could be increasing in the Central Valley; one recent nesting record in restored habitat at San Joaquin River National Wildlife Refuge, and recent documented singing males in Yolo Bypass Wildlife Area
Yellow warbler *Dendroica petechia*	–/SSC	Open-canopy, deciduous riparian woodland close to water, along streams or wet meadows	**High**; documented during summer in riparian scrub-shrub at the Project site (breeding status unknown) (DWR, unpubl. data); the Project site is outside of what is considered the species' current breeding range (Heath 2008)
Yellow-breasted chat *Icteria virens*	–/SSC	Early-successional riparian habitats with a dense shrub layer and an open canopy	**High**; documented during summer using riparian scrub-shrub at the southern end of Prospect Island in 2009 (breeding status unknown) (DWR, unpubl. data); the Project site is outside of what is considered the species' current breeding range (Comrack 2008)

Common name *Scientific name*	Status [a] Federal/State	Habitat associations	Likelihood to occur at the Project site under current conditions
Grasshopper sparrow *Ammodramus savannarum*	–/SSC	Typically found in moderately open grasslands with scattered shrubs	**Low**; may nest in grassland habitats, which represent only a small area of the Project site
Song sparrow ("Modesto" population) *Melospiza melodia*	–/SSC	Emergent freshwater marshes, riparian willow thickets, and riparian forests	**High**; sightings common throughout the Project site during 2009 surveys, including nesting (DWR, unpubl. data)
Tricolored blackbird *Agelaius tricolor*	–/SSC	Feeds in grasslands and agriculture fields; nesting habitat components include open accessible water, a protected nesting substrate (including flooded or thorny vegetation), and a suitable nearby foraging space with adequate insect prey	**Low**; while permanent freshwater emergent wetland at the Project site may provide suitable breeding habitat, breeding colonies are uncommon in the Project vicinity; open water provides foraging habitat
Yellow-headed blackbird *Xanthocephalus xanthocephalus*	–/SSC	Breeds almost entirely in open marshes with relatively deep water and tall emergent vegetation, such as bulrush (*Schoenoplectus* spp.) or cattails (*Typha* spp.); nests are typically in moderately dense vegetation; forage within wetlands and surrounding grasslands and croplands	**Low**; while permanent freshwater emergent wetland at the Project site may provide suitable breeding habitat, breeding is uncommon in the Project vicinity; emergent marsh provides foraging habitat
MAMMALS			
Western red bat *Lasiurus blossevillii*	–/ SSC	Riparian forests, woodlands near streams, fields and orchards	**High**; species detected during acoustic monitoring in 2009 (DWR, unpubl. data); potential roosting habitat throughout riparian forest at the Project site, including maternity roosts

Common name *Scientific name*	Status [a] Federal/State	Habitat associations	Likelihood to occur at the Project site under current conditions
California ringtail *Bassariscus astutus raptor*	–/SFP	Mixture of forest and shrub habitats in association with rocky areas or riparian habitats, low to middle elevations	**Low to Moderate**; very little is known about this species in this region; may occur in riparian trees at the Project site, though there is a lack of connectivity to other riparian areas

[a] Status codes:

Federal
FE = Listed as endangered under the federal Endangered Species Act
FT = Listed as threatened under the federal Endangered Species Act
FC = Federal candidate species

State
SE = Listed as Endangered under the California Endangered Species Act
ST = Listed as Threatened under the California Endangered Species Act
SSC = California Species of Special Concern
SFP = CDFW Fully Protected species

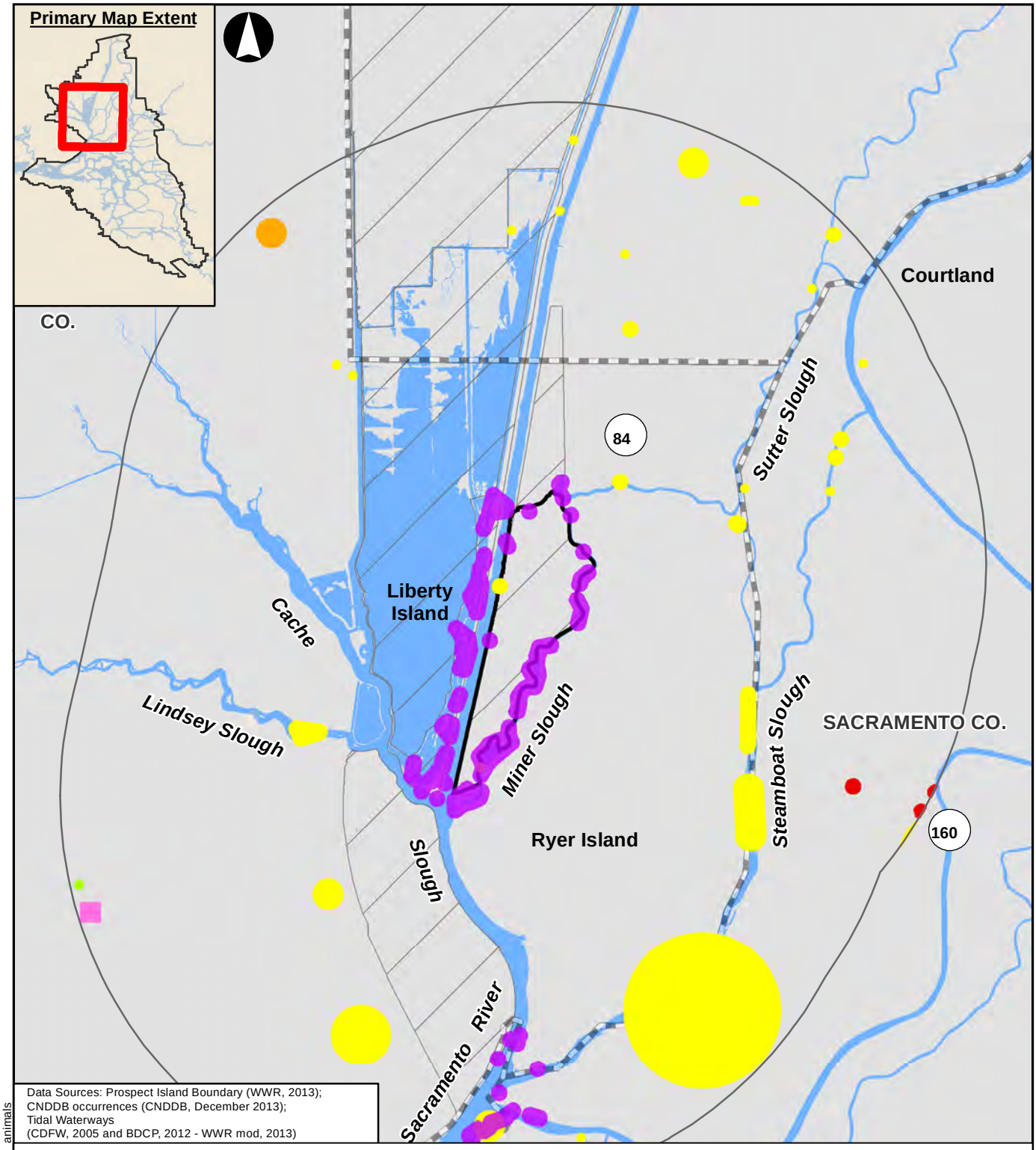


Figure 4-10

Special-status Wildlife Species Occurrences Documented in CNDDB within a 5-mile vicinity of the Project site

PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT

4.4.3 Jurisdictional wetlands and waters

The Diked Lands Project Area contains 340 acres of waters of the U.S and an additional 1,153 acres of jurisdictional wetlands. These waters and wetlands are summarized in Table 4-6, mapped in Figure 4-11, and described in greater detail in the *Preliminary Wetland Delineation* (DWR 2014b).

Table 4-6. Preliminary USACE jurisdictional waters and wetlands in the Project area.

Type of jurisdictional feature	Total (acres)
WATERS OF THE U.S.	
Tidal waters of the U.S. (below MHW)	None; adjacent to Project area[a]
Non-tidal waters of the U.S.	340[b]
Total waters of the U.S.	**340**
WETLANDS	
Non-tidal freshwater perennial emergent wetland	1,100[b]
Riparian scrub shrub wetland	53[b]
Total wetlands	**1,153**
TOTAL PRELIMINARY USACE JURISDICTIONAL WATERS AND WETLANDS	**1,493[b]**
NON-JURISDICTIONAL UPLANDS	
Uplands	181
TOTAL DIKED LANDS PROJECT AREA	**1,674**

[a] Subject to Section 10 of the Rivers and Harbors Act.
[b] Subject to Section 404 of the CWA.

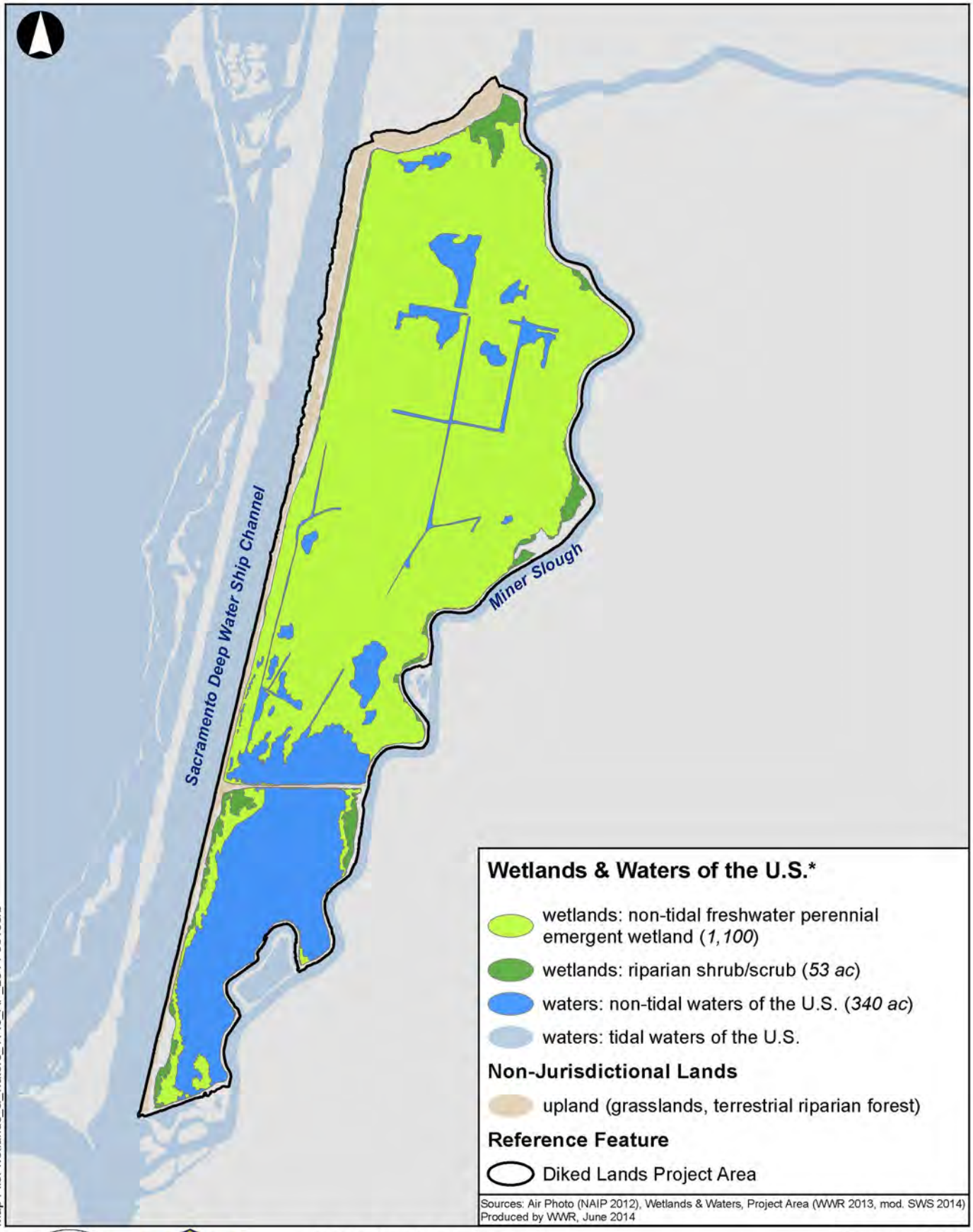


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Figure 4-11
Waters and Wetlands of the U.S. at Prospect Island

PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT

4.5 Cultural Resources

Parus Consulting, Inc. (PCI) prepared a cultural resources evaluation for the Prospect Island Tidal Habitat Restoration Project in May 2012. The PCI study included literature and Sacred Lands File searches, a walking survey of accessible areas (313 ac) of the approximately 1,652-ac area of potential effects (APE), and a Project effects assessment.

Although visualization of the ground surface was somewhat compromised by vegetation and inundation, no evidence of historic or cultural resources were observed during the March 2012 walking surveys.

The literature search was completed by the Northwest Information Center (NWIC) on March 20, 2012, and a Sacred Lands File search by the Native American Heritage Commission (NAHC) on March 22, 2012. Thirteen prior cultural resources studies were completed within or partially within the APE.

The NAHC search failed to indicate the presence of Native American sacred lands or traditional cultural properties within the immediate Project vicinity. In addition, considering that Prospect Island was a tule marsh prior to the start of reclamation activities in the Delta 150 years ago, and considering the agricultural history of the island between 1917 and 1995, there is an extremely low probability that intact prehistoric, ethnohistoric, or historic-era archaeological sites remain within the extensively disturbed island interior.

Two historic-era resources were previously recorded at the edge of the island within the APE: Prospect Island Homes (P-48-000417) and the Prospect Island Levee System (P-48-000787). One historic-era resource was newly identified: Prospect Island House (Parus-1H-12). P-48-000417 and a portion of the levee system recorded as P-48-000787 were previously determined ineligible for National Register listing. These resources are also considered not eligible for inclusion on the California Register.

The previously unevaluated portion of the P-48-000787 levee system and the Parus-1H-12 house, which was newly identified in the PCI study, are considered not eligible for listing on the National or California Register (PCI 2012). Therefore no significant historic resources were identified on the site.

A California State Lands Commission shipwreck search was requested on August 27, 2013. The search resulted in the identification of a potential shipwreck in Miner Slough near the Project area. Archival research indicates there is

potential for the wreck of the steamboat Zinfandel to be in the Project area. Additional surveys will be conducted by DWR.

4.6 Hazards and Hazardous Materials

In general, these lands and shallow waters have the potential to contain hazardous substances. A query of the California Department of Toxic Substances Control's (CDTSC's) database reveals that there are no known hazardous material sites within or immediately surrounding Prospect Island (CDTSC 2013). Additionally, a visual examination of the State's oil, gas, and geothermal fields map (CDC 2001) and energy map (CDC 2000) reveals that there are many natural gas fields and pipelines in the vicinity. There are six plugged, exploratory natural gas wells located on the island (see Section 4.3.7 above).

DWR's site assessment staff reviewed the Prospect Island Phase I/II Environmental Site Assessment report *(Phase I/Phase II Environmental Site Assessment, Prospect Island*, *February 20, 2008*) prepared by the U.S. Department of the Interior's Bureau of Reclamation. Staff determined that the report was sufficient to satisfy appropriate inquiry or due diligence under the Federal Comprehensive Environmental Response, Compensation, and Liability Act and that the report followed the Phase I process as outlined in the American Society for Testing and Materials E1527-05 standards.

5 OPPORTUNITIES AND CONSTRAINTS

The regional and site settings described in the previous two chapters translate into a suite of restoration opportunities and constraints. Opportunities reflect those elements that facilitate restoration designs to meet the Project purpose and objectives. Constraints reflect those elements that will or may impede the Project meeting its purpose and objectives. Constraints are either resolved or worked around with the restoration design.

Table 5-1 presents the opportunities and constraints identified for this Project. For each opportunity and constraint, the table summarizes relevance to the Project purpose and objectives, associated drivers or causal mechanisms that inform strategies for addressing the constraint, and the potential design accommodations. The restoration alternatives, presented in Chapter 6, then incorporate accommodations in various manners.

Table 5-1. Prospect Island Opportunities and Constraints Summary.

Constraint or opportunity	Relevance to outcomes	Associated drivers	Potential design accommodation(s)
OPPORTUNITIES			
Existing site elevations range from subtidal to intertidal and upland	Facilitates creation of a variety of open water, emergent marsh, and riparian habitats without extensive grading	Topography, bathymetry, geomorphology, hydrology (inundation regime)	Subsidence reversal is beneficial but not critical—create emergent marsh vegetation in locations with suitable existing elevations
Proximity to Cache Slough Complex and Sacramento River	Location provides direct connectivity to areas supporting native Delta fishes and migration corridor for juvenile salmonids	Bathymetry, regional biological resources, hydrodynamics	Select number and locations of breaches to promote target ecological outcomes (primary and secondary productivity and food availability for Delta Smelt and other native fishes; quantity and quality of salmonid rearing habitat)
Remnant agricultural ditches on site	Remnant agricultural ditches can be utilized to establish internal hydrologic connectivity with reduced excavation	Topography, bathymetry, geomorphology, hydrology	To the extent feasible, incorporate remnant agricultural ditches to constructed channel network; block or fill remnant agricultural ditches to create desired hydrologic connectivity and hydrodynamics
Future tidal flood protection not needed on site	Construction or improvement of levees to provide tidal flood protection to adjacent properties not needed	Regional hydrodynamics and tidal transport, flood protection	Maximum area is available for habitat creation as construction of new flood protection levees not needed
Existing emergent vegetation	Majority of target vegetation species are present on site and occupy much of the available suitable habitat	Inundation regime, site elevations, substrate, plant propagation ecology	Preserve target species vegetation to the extent possible during construction and control invasive aquatic vegetation ; prior to breaching, manage water levels inside Prospect Island to support recovery of emergent vegetation impacted by construction activities

Constraint or opportunity	Relevance to outcomes	Associated drivers	Potential design accommodation(s)
Presence of rare plant populations nearby	Appropriate habitats and enhanced connectivity to source populations will be created with restoration	Site elevations, substrate, hydrology, plant propagation ecology	Create a variety of habitat types across the site to maximize opportunities for colonization by rare plants
Site is within the Sacramento Flood Control Project	Restoration will improve flood storage capacity over the full range of storm flows (formerly only available during extreme events that overtopped restricted height levees)	Topography (levees), hydrology, hydrodynamics	All design alternatives improve Prospect Island flood storage capacity
Regional turbidity conditions	Certain breach configurations can create conditions that result in higher turbidity between Cache Slough and Prospect Island	Geomorphology, hydrology, hydrodynamics	Select numbers and locations of breaches to maximize 'draw' of turbidity up Miner Slough to Prospect Island breach locations based on modeling results
CONSTRAINTS			
Adjacent Landowner Access	Maintaining access limits the number and location of breaches	Private property access easement(s)	1) Relocate access easements to accommodate desired restoration features 2) Exclude breaches along existing easements 3) Negotiate extinguishment of existing easements
Arrowhead Harbor boating access	Northern Miner Slough breach has potential to subject boats entering Arrowhead Harbor to higher velocities along the outer bend of Miner Slough, creating potential navigation hazard	Regional hydrodynamics and tidal transport	Locate breaches far enough away from marina entrance to eliminate impacts

Constraint or opportunity	Relevance to outcomes	Associated drivers	Potential design accommodation(s)
Extensive invasive aquatic plants on and adjacent to Prospect Island	Potential to diminish outcomes, especially with increased hydrologic connectivity between site and surrounding waters	invasive species propagation ecology, hydrology, wildlife	1) Pre-restoration control as part of interim management program 2) Post-restoration control and monitoring
Existing tree snags and debris within Prospect Island	Potential to restrict or interfere with tidal exchange and circulation, resulting low velocities promote establishment of invasive SAV	topography, bathymetry, hydrology, hydrodynamics, invasive SAV propagation ecology	Remove or relocate snags/debris as part of site preparation or interim management program – – some snags relocated as raptor perches; placed on interior slopes for turtle basking and natural decomposition.
DWSC navigation	Cross currents from breaches along DWSC could impact navigation	DWSC commercial shipping, recreational boating use regional hydrodynamics and tidal transport	Exclude breaches along the DWSC
Miner Slough spur channel	Size and depth of Miner Slough spur channel could constrain exchange between Prospect Island and Miner Slough	Bathymetry, hydrology, regional hydrodynamics and tidal transport	1) Dredge channel 2) Allow channel to scour
Mineral rights	Some measure of access may need to be allowed in the future for gas exploration	Property access easement	1) Purchase mineral rights 2) Maintain existing access 3) Pursue quiet title action to terminate mineral rights
Internal cross levee	Restricts tidal exchange between north and south properties	Topography, bathymetry, hydrology, hydrodynamics	1) Create breach in internal cross levee 2) Remove internal cross levee entirely 3) Leave internal cross levee intact and create two hydraulically separate restoration areas

Constraint or opportunity	Relevance to outcomes	Associated drivers	Potential design accommodation(s)
Poor Prospect Island Levee conditions	Unintended breaches could alter internal flow dynamics and external (Miner, DWSC) hydrodynamics, with potential to reduce flood protection levels for Ryer Island	Regional hydrodynamics and tidal transport, flood protection	1) Improve/repair levees prior to restoration 2) Create toe berm within Prospect Island along eastern levee to improve stability and reduce potential impacts to Ryer Island flood protection levels
Scour potential to Ryer Island Miner Slough levee	Could limit feasibility of locations and/or number of Miner Slough breach locations due to associated cross channel flow velocities	Regional hydrodynamics and tidal transport, surrounding waterways bathymetry	1) Limit number of breaches along Miner Slough 2) Locate breaches at channel bends to align flows with long-channel flow and avoid increased cross-channel flow velocities
Barker Slough Pumping Plant intake	Restored Prospect Island site could export dissolved organic carbon to BSPP intake, reducing water quality	Regional hydrology and tidal transport, water quality	Choose number and location of breaches to minimize potential DOC impacts based on modeling results
Prospect Island is located within the Yolo Bypass	Prospect Island must retain function as a flood storage basin during extreme flood events	Regional hydrodynamics and tidal transport, flood protection	Cannot obstruct flood storage function of property or decrease flood protection levels to surrounding lands (e.g. Ryer)

6 PROPOSED PROJECT AND ALTERNATIVES

This chapter presents the Proposed Project description and the restoration alternatives that will be evaluated under the California Environmental Quality Act (CEQA) in the Project EIR.

This chapter provides the following information:

- Section 6.1– brief overview of the features of the Proposed Project and the alternatives.
- Section 6.2 – complete description of the Proposed Project, including configurations, quantities, and construction methods.
- Section 6.3 – summary of site maintenance, monitoring, and management activities for which regulatory authorizations are needed.
- Section 6.4 – description of the alternatives. Only elements of the alternatives that differ from the Proposed Project are presented.

The Proposed Project and alternatives were selected by DWR and CDFW FRP staff, as described below.

6.1 Overview of Proposed Project and Alternatives

The Proposed Project and alternatives consist of a suite of features to prepare the site for restoration, construct restoration features, and restore tidal action to the site. This section summarizes the levee breach configurations and major restoration features of the Proposed Project and all alternatives. Table 6-1 presents an overview of general restoration features, Table 6-2 describes the restoration activities and features in greater detail, and Table 6-3 presents quantities and dimensions for major restoration activities and features of the Proposed Project and alternatives.

Major Features Common to Proposed Project and Alternatives

The Proposed Project and Alternatives 2 and 3 include the following major features:

- One or more breaches of the Miner Slough levee.
- Construction of a levee toe berm (eastern toe berm) on the interior side of the eastern levee. In Alternative 3, that toe berm is limited to the north (DWR) property.

- Construction of an intertidal bench (eastern intertidal bench) on the north property.
- Construction of interior subtidal channels (constructed channel network). The extent and exact layout of the channels varies between the Proposed Project and the Alternatives.

Proposed Project

Under the Proposed Project, the Miner Slough levee would be breached in two locations: one in the north property, approximately 0.5 miles south of Arrowhead Harbor; and one in the south (Port) property, at the location of the formerly repaired breach connecting to the Miner Slough spur channel (Figure 6-1). The internal cross levee separating the north and the south properties would also be breached. Once these breaches were completed, the north and south portions of the site would be subject to daily tidal inundation.

Alternative 1 (No Project)

Alternative 1 (not shown) represents the No Project Alternative to be evaluated under CEQA. Under this alternative, current management practices would continue except in the event of levee failure. The USACE would continue to maintain the Deep Water Ship Channel levee as a Navigation Project Levee. RD 1667 would continue levee maintenance activities as their duties required. Ongoing levee maintenance activities would include periodic vegetation removal along the levee crown, for both access and levee inspection purposes. Minor and/or emergency levee repairs could require removal of mature riparian vegetation, and import and placement of riprap and other fill material.

Alternative 2

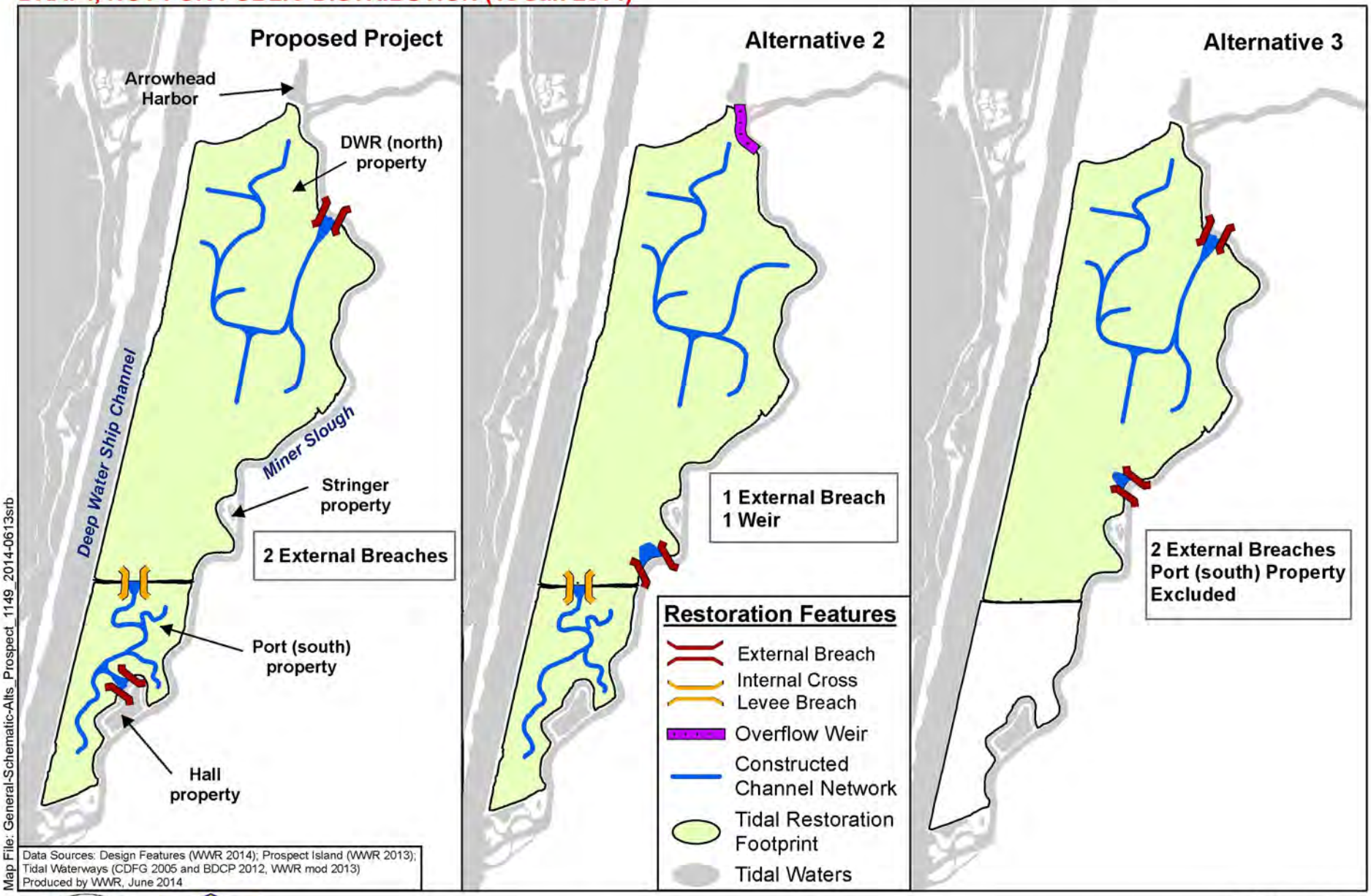
Alternative 2 would include a breach of the Miner Slough levee in the central portion of Prospect Island, just north of the existing internal cross levee, and an overflow weir, in the far northeast corner of the island (Figure 6-1). The internal cross levee separating the north and south properties would also be breached under this alternative. Once breached, the north and south portions of the site would be subject to daily tidal inundation.

Alternative 3

Under Alternative 3, two breaches would be constructed on the Miner Slough levee: one in the north property, approximately 0.5 miles south of Arrowhead Harbor, and one in the central portion of the island (also located on the north property), just north of the Stringer property (Figure 6-1). Under this alternative, the internal cross levee separating the north and the south properties would

remain intact, and the south property would not be included in the Project. Once breached, the north property would be subject to daily tidal inundation.

DRAFT, NOT FOR PUBLIC DISTRIBUTION (13 Jun 2014)



Map File: General-Schematic-Alts_Prospect_1149_2014-0613srb

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Figure 6-1
General Schematics of Proposed Project and Alternatives

PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT

Table 6-1. General Project Features

Project Feature		Proposed Project	Alternative 2	Alternative 3
1	**Project extent**	North (DWR) and south (Port) properties	*Same as Proposed Project*	North property only
2	**Levee breaches**	• Northern Miner Slough • Southern Miner Slough • Internal cross levee	• Central Miner Slough • Internal cross levee	• Northern Miner Slough • Central Miner Slough
3	**Levee weir**	• None	• Northern Miner Slough	• None
4	**Breach velocity dissipation**	Include gentle side slope transition feature at one breach location (TBD)	*None*	*None*
5	**Soil disposal and reuse**	Reuse all soils excavated on site to construct eastern toe berm, eastern intertidal bench, interior topographic features , and to fill ditches	*Same as Proposed Project*	*Same as Proposed Project*
6	**Eastern toe berm**	Build toe berm along full length of interior side of Miner Slough levee on north and south properties	*Same as Proposed Project*	Toe berm along interior side of Miner Slough levee on north property only
7	**Eastern intertidal bench**	Build 'bench' to intertidal elevations only in subtidal areas adjacent to interior levee slopes subject to wind wave action	*Same as Proposed Project*	*Same as Proposed Project*
8	**Interior topographic features**	Create small, isolated mounds along constructed channel network • Top elevations approximately MHHW • "Soft" features, not engineered	*Same as Proposed Project*	*Same as Proposed Project*
9	**Planting & revegetation**	• Upland areas along Miner Slough levee and eastern toe berm: limited planting with native riparian species • Eastern intertidal bench: 1) If needed, plant tules in areas subject to wind-wave erosion to augment natural recruitment, but no more than 20' in width. 2) Limited experimental planting	*Same as Proposed Project*	*Same as Proposed Project*

1 Table 6-2. Restoration Activities and Features of the Proposed Project and Alternatives

Section No.	Restoration Activities and Project Features	Proposed Project	Alternative 2	Alternative 3
Site Preparation				
6.2.1	**South property levee repairs**	• Install sheet pile cut-off wall on land side of prior breach repair • Place compacted earth or rock fill at 2:1 slopes on both sides of cutoff wall • Rock armor placed above low permeability geotextile	*Same as Proposed Project*	No levee repair included
6.2.2	**Site Dewatering**	• Rehabilitate existing or install temporary pumps at southeast corner of north property • Install temporary pumps on south property • Provide power using on site diesel generators	*Same as Proposed Project*	• Rehabilitate existing or install temporary pumps at southeast corner of north property • Provide power using on site diesel generator
6.2.2	**Pre-construction clearing and grubbing**	Clearing of vegetation within 25ft of channel excavation, breaches, eastern toe berm, eastern intertidal bench, access roads/ramps, and staging area footprints. To the extent practicable, large (living) trees will be left in place at eastern toe berm and bench locations.	*Same as Proposed Project*	*Same as Proposed Project, on north property only*
6.2.2	**Access roads & ramps**	• Utilize levee roads to the fullest extent possible • Build ramps from levees down into site interior at grades suitable for	*Same as Proposed Project*	*Same as Proposed Project, on north property only*

Section No.	Restoration Activities and Project Features	Proposed Project	Alternative 2	Alternative 3
		construction equipment • Where possible, build interior access roads over alignment of constructed channel network • Re-use access road materials on site (e.g. for re-surfacing levee roads) (locations TBD)		
6.2.2	**Staging & stockpile areas**	• Utilize levees to the fullest extent possible • Acquire temporary easement along northern cross-levee (TBD) • To the extent practicable, avoid areas supporting riparian trees >4" dbh	*Same as Proposed Project*	*Same as Proposed Project, on north property only*
6.2.3	**Pre-restoration invasive plant species control**	• Upland and wetland/upland species: Apply mechanical and/or herbicide methods • Aquatic species: application of aquatic-approved herbicide and/or physical removal with clearing and grubbing (below)	*Same as Proposed Project*	*Same as Proposed Project, on north property only*
6.2.4	**Debris, old infrastructure, and dead tree/snag removal**	• Clear snags, debris and invasive veg. spp. from within 25 ft buffer of excavation and construction footprint within intertidal and subtidal areas • Re-use of woody debris in riparian zones as raptor perches and turtle basking sites where possible • Fill or remove existing Miner Slough culvert	*Same as Proposed Project*	*Same as Proposed Project, on north property only*

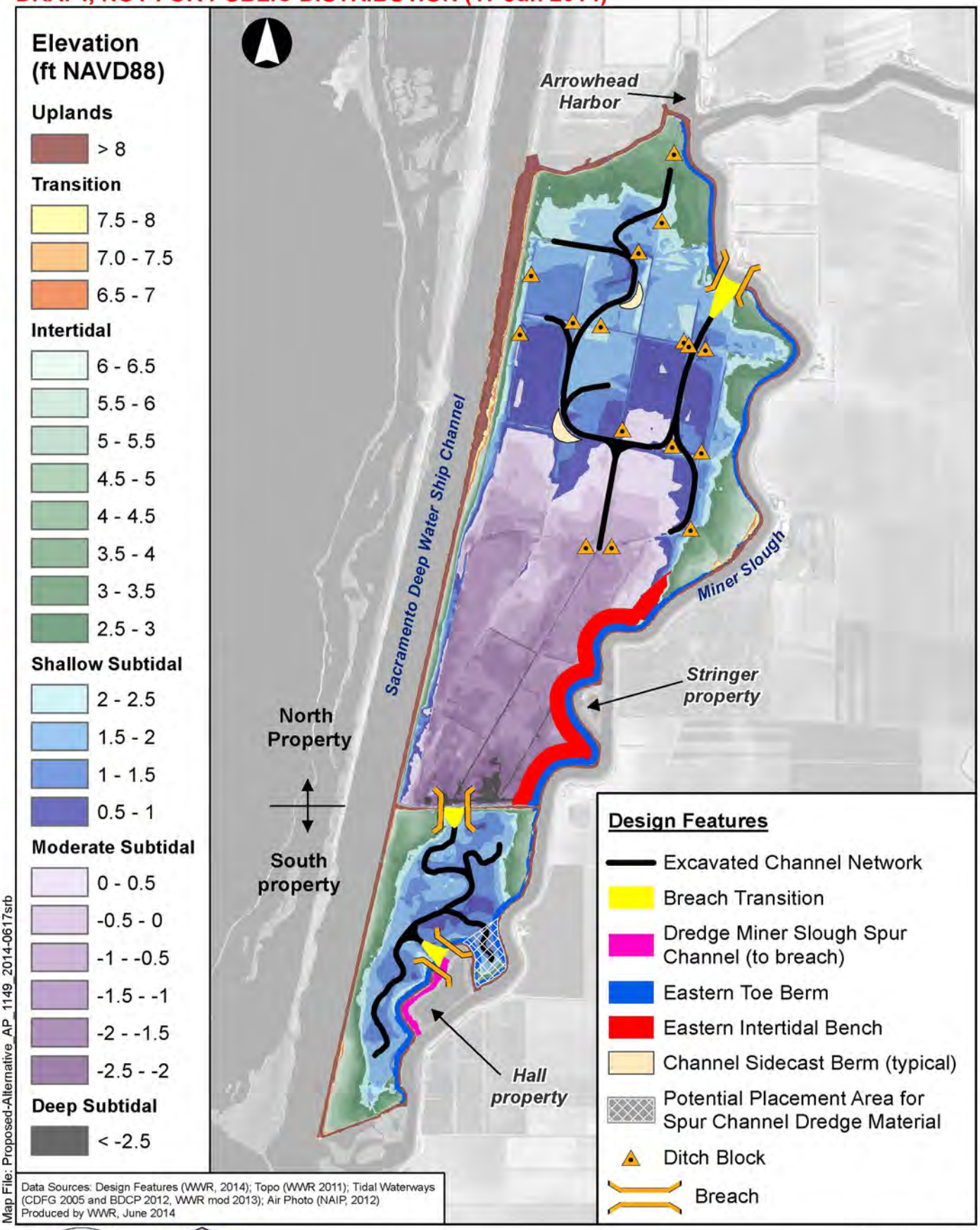
Section No.	Restoration Activities and Project Features	Proposed Project	Alternative 2	Alternative 3
		• Remove dilapidated pump house, remains of bunkhouse, and any other remains of outbuildings on the north property, and remove collapsed house on south property • PG&E to remove abandoned poles		
Project Construction				
6.2.5	**Interior channel network excavation**	Excavate tidal channels in areas above -1 ft NAVD88	*Same as Proposed Project*	*Same as Proposed Project, on north property only*
6.2.6	**Block or fill remnant agricultural ditches**	Use excavated soils to block or fill remnant agricultural ditches not incorporated into constructed channel network	*Same as Proposed Project*	*Same as Proposed Project, on north property only*
6.2.7	**Construct interior topographic features**	• Create small patches of higher intertidal habitat within the site with side cast of materials excavated from channel network • Max elevation ~ MHW to MHHW (6-6.5 ft NAVD88)	*Same as Proposed Project*	*Same as Proposed Project, on north property only*
6.2.8	**Construct eastern toe berm**	• Construct levee toe berm along full length of Miner Slough levee on north and south properties • Plant limited upland areas with native riparian species	*Same as Proposed Project*	*Same as Proposed Project on north property only*
6.2.9	**Construct eastern intertidal**	• Construct 'bench' to intertidal elevations along Miner Slough levee interior in areas where subtidal lands adjacent to levee	*Size and dimensions of bench may vary from estimates for the Proposed Project, based on*	*Size and dimensions of bench may vary from estimates for the bench in Proposed Project, based*

Section No.	Restoration Activities and Project Features	Proposed Project	Alternative 2	Alternative 3
	bench	are subject to wind wave action • Construct from fill generated by channel network excavation • If needed, plant with tules in areas subject to wind wave erosion to augment natural recruitment, but no more than 20' in width • Limited experimental planting	*differences in excavation volumes determined during design*	*on differences in excavation volumes determined during design*
6.2.10	**Breach internal cross levee**	• Breach invert elevation: -3 ft NAVD88 • Breach invert width: ~ 400 ft • Side slopes: 2:1 • Use soils excavated for breach to block/fill borrow ditch that runs along north side of the internal cross levee	*Same as Proposed Project*	No internal cross levee breach
6.2.11	**Construct breach velocity dissipation**	• Place fill excavated from construction of the channel network and from upland portions of levee breaches onto the interior sides of the levee at one of the two breach locations • Grade to slope gently downward, longitudinally along the banks of the inside of the breach and laterally along the interior toe of the levee	*Same as Proposed Project*	*Same as Proposed Project*
6.2.12	**Dredge Miner Slough spur channel**	• Dredge spur channel between Miner Slough and south property breach to accommodate volume of tidal exchange between Miner	Not included	Not included

Section No.	Restoration Activities and Project Features	Proposed Project	Alternative 2	Alternative 3
		Slough and the restored Project site • Dewater and stabilize dredge material in south property		
6.4.2.1	**Construct high stage overflow weir from Northern Miner Slough**	Not included	Build weir to elevation 7 ft NAVD88 to maximize winter overtopping	Not included
6.2.13 6.4.2.2 6.4.3.1	**Breach Miner Slough levee**	Northern Miner Slough • Invert elevation: -4.6 ft NAVD88 • Breach invert width: ~ 531 ft • Side slopes: 2:1 Southern Miner Slough • Invert elevation: -4.0 ft NAVD88 • Breach invert width: ~ 394 ft • Side slopes: 2:1	Central Miner Slough • Invert elevation: -5.9 ft NAVD88 • Breach invert width: ~659 ft • Side slopes: 2:1	Northern Miner Slough • Invert elevation: -4.0 ft NAVD88 • Breach invert width: ~ 438 ft • Side slopes: 2:1 Central Miner Slough • Invert elevation: -4.4 ft NAVD88 • Breach invert width: ~507 ft • Side slopes: 2:1

6.2 Proposed Project

This section describes the restoration features included in the Proposed Project. The restoration activities that would be undertaken to create these features are presented in the general sequence in which they would be constructed, starting with pre-construction site preparation, followed by site modifications internal to the Island, and ending with breaching the levees to allow tidal inundation of the Project site. Figure 6-2 depicts a general design schematic for the Proposed Project, Figure 6-3 illustrates site preparation elements, and Table 6-3 provides estimated material quantities and dimensions for the restoration activities and features of the Proposed Project and alternatives.



Data Sources: Design Features (WWR, 2014); Topo (WWR 2011); Tidal Waterways (CDFG 2005 and BDCP 2012, WWR mod 2013); Air Photo (NAIP, 2012)
Produced by WWR, June 2014

Map File: Proposed-Alternative_AP_1149_2014-0617srb

1:31,680 (1 in = 0.5 miles at letter size)
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Figure 6-2
Proposed Project

PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT

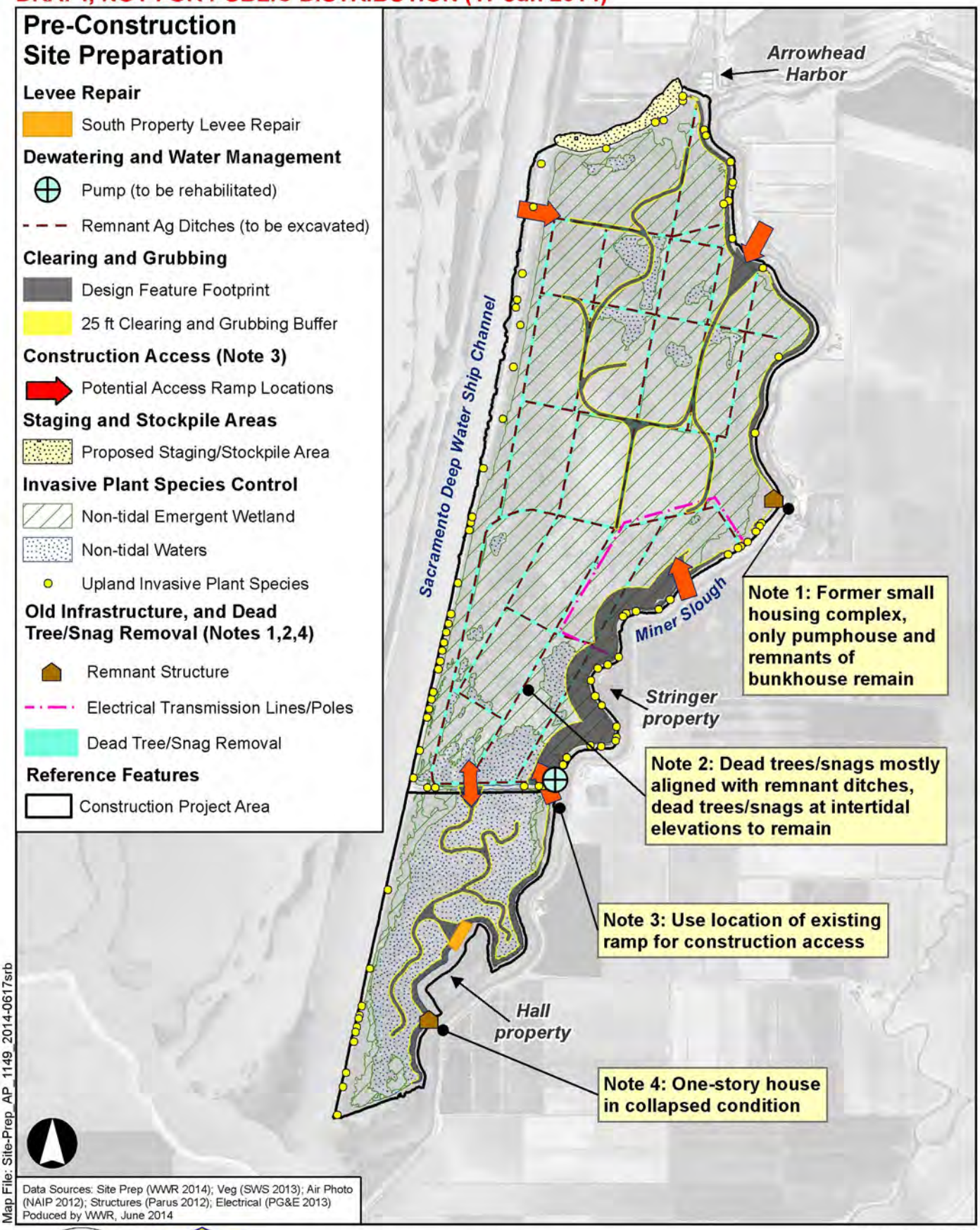


Figure 6-3
Site Preparation

PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT

Table 6-3. Material Quantities and Dimensions

No.	Restoration Activities and Project Features	Units	Quantities		
			Proposed Project	Alt 2	Alt 3
1	South (Port) property levee repair				
	Fill placement	cubic yards	3,000	3,000	NA
	Sheet piles	feet	200	200	NA
	Geotextile	sq ft	10,000	10,000	NA
	Stone armoring	cubic yards	200	200	NA
2	Pre-construction site preparation				
2a	Dewatering and water management				
	North Property				
2a1	Clear existing ditches				
	Length	feet	73,000	73,000	73000
	Area	acres	25	25	25
	Volume of cut	cubic yards	(81,000)	(81,000)	(81,000)
2a2	Rehab pump	# pumps	1	1	1
	South Property				
2a4	Install temporary pump	# pumps	1	1	NA
2b	Clearing and grubbing (channels, toe berm, bench, breaches, cross levee breach, 25-ft buffer)	acres	213	204	152
2c	Roads and ramps				
	Ramps				
	Locations	each	6	6	5
	Length	feet	695	695	578
	Area	acres	0.6	0.6	0.5
	Volume of fill	cubic yards	4,000	4,000	4,000
	Volume of rock protection	cubic yards	300	300	200
	Roads (contingency volume if site cannot be dewatered to fully support equipment)				
	Volume of fill	cubic yards	26,000	26,000	17,000
2d	Staging and stockpile areas	acres	19	19	19
3	Pre-restoration invasive plant species control				
3a	Treatment Area				
	Aquatic	acres	1,440	1,440	1,196
	Upland (backpack spot treatment)	acres	6.5	6.5	5.4
3b	Herbicide application (See Table 6-4)				
	Aquatic	pounds	38,796	38,796	32,208
	Upland	pounds	8.4	8.4	7
4	Debris, old infrastructure, and dead tree/snag removal				
	Dead tree/snag removal along existing ditches	cubic yards	-2,000	-2,000	-2,000
	Clearing and grubbing	cubic yards	-17,000	-17,000	-16,000
	Woody debris (beaver lodges)	cubic yards	-3,000	-3,000	-2,000
	Remnant Structures	each	3	3	1
5	Excavate constructed channel network				
	Length	feet	31,000	30,000	20,000
	Area	acres	47	47	30
	Volume of cut (calculated)				
5a	Tapered connections to channel network	cubic yards	(96,000)	(66,000)	(88,000)
5b	Channel network	cubic yards	(273,000)	(265,000)	(167,000)
6	Block or fill remnant agricultural ditches				
	Length	feet	6,000	6,000	6,000
	Area	acres	2	2	2
	Volume of fill (estimated)	cubic yards	17,000	17,000	17,000
7	Construct interior topographic features				
	Quantity	# mounds	6	6	6
	Volume of fill (estimated)	cubic yards	27,000	27,000	27,000

Table 6-3. Material Quantities and Dimensions

No.	Restoration Activities and Project Features	Units	Quantities		
			Proposed Project	Alt 2	Alt 3
8	Construct eastern toe berm				
8a	Construct berm				
	Length	feet	27,100	27,100	18,000
	Area	acres	44	44	24
	Volume of fill (calculated)	cubic yards	115,000	115,000	69,000
8b	Plant berm (maximum potential area shown, not all will be planted)				
	Riparian	acres	5	5	3
	Wetland	acres	0	0	0
9	Construct eastern intertidal bench				
9a	Construct bench				
	Length	feet	6,600	6,600	6,600
	Area	acres	60	60	60
	Volume of fill (calculated)	cubic yards	321,000	290,000	254,000
9b	Experimental planting	acres	3	3	3
10	Breach internal cross levee				
10a	Excavate breach				
	Invert Width	feet	400	400	NA
	Area	acres	0.2	0.2	NA
	Volume of cut (calculated)	cubic yards	(6,000)	(6,000)	NA
10b	Fill borrow ditch				
	Length	feet	1,800	1,800	NA
	Area	acres	3	3	NA
	Volume of fill (calculated)	cubic yards	6,000	6,000	NA
11	Construct breach transitions				
	Area	acres	1	NA	NA
	Volume of fill	cubic yards	5,000	NA	NA
12	Dredge Miner Slough spur channel				
	Length	feet	2,400	NA	NA
	Area	acres	7	NA	NA
	Volume of cut	cubic yards	(72,000)	NA	NA
	Potental total hydraulic dredge volume (sediment and water)	cubic yards	(360,000)	NA	NA
	Potential Containment Area	acres	14	NA	NA
13	Breach Miner Slough levee				
	Total Top Width	feet	1060	738	1097
	Area	acres	1	0.5	1
	Rock Slope Protection	cubic yards	120	60	120
13a	Volume of cut (above MHHW)	cubic yards	(15,000)	(11,000)	(15,000)
13b	Volume of cut (below MHHW)	cubic yards	(20,000)	(16,000)	(16,000)
14	Construct high stage overflow weir				
	Total Top Width	feet	NA	1500	NA
	Area	acres	NA	0.5	NA
	Volume of excavation	cubic yards	NA	(10,000)	NA

Table 6-3. Material Quantities and Dimensions

No.	Restoration Activities and Project Features	Units	Quantities		
			Proposed Project	Alt 2	Alt 3
TOTAL CUT-FILL ESTIMATES					
Cut - Reuse on Site					
	Drainage ditches North (2a1)		(81,000)	(81,000)	(81,000)
	Tapered connections to channel network (5a)		(96,000)	(66,000)	(88,000)
	Channel network (5b)		(273,000)	(265,000)	(167,000)
	Interior cross levee (10a)		(6,000)	(6,000)	NA
	Miner Slough levee breach(es) above MHHW(13a)		(15,000)	(11,000)	(15,000)
	Miner Slough levee breach(es) below MHHW (13b)		(20,000)	(16,000)	(16,000)
	High stage overflow weir (14)		NA	(10,000)	NA
	TOTAL CUT REUSE		(491,000)	(455,000)	(367,000)
Dredge - Not Available for Reuse					
	Miner Slough spur channel (12)		(72,000)	NA	NA
	TOTAL CUT OTHER		(72,000)	0	0
Fill - Reuse					
	Ditch blocks/fill (6)		17,000	17,000	17,000
	Interior topographic features (7)		27,000	27,000	27,000
	Eastern toe berm (8)		115,000	115,000	69,000
	Eastern intertidal bench (9a)		321,000	290,000	254,000
	Borrow ditch (10b)		6,000	6,000	NA
	Breach transitions (11)		5,000	NA	NA
	TOTAL FILL REUSE		491,000	455,000	367,000
IMPORT AND DISPOSAL ESTIMATES					
Imported Materials					
	Levee Repair (1)				
	Fill placement	cubic yards	3,000	3,000	NA
	Sheet piles	feet	200	200	NA
	Geotextile	sq ft	10,000	10,000	NA
	Stone armoring	cubic yards	200	200	NA
	Ramps and Roads (2c)				
	Ramp				
	Volume of fill	cubic yards	4,000	4,000	4,000
	Volume of rock protection	cubic yards	300	300	200
	Road				
	Volume of fill	cubic yards	26,000	26,000	17,000
	Breach Miner Slough (13)				
	Rock Slope Protection	cubic yards	120	60	120
Disposal					
	Debris and dead tree/snag removal (4)	cubic yards	(22,000)	(22,000)	(20,000)

6.2.1 South property levee repair

The purpose of repairing the south property Miner Slough levee would be to facilitate dewatering of the south property for the duration of Project construction. This activity would involve restoration of proper function to the levee where a previous breach was repaired (and is currently leaking) at the end of the Miner Slough spur channel (Figure 6-3).

No documentation of the design or material composition of the breach repair has been identified. From site visits and examination of current and historical aerial photos, it appears that the remaining repair material consists of large-diameter rock, placed up to elevations slightly above tidal inundation levels. The leaking breach repair is approximately 150 feet long. Based upon geologic investigations of a nearby breach on the north property conducted by USBR (2008), the original ground surface in the area is clay, and forms a layer impermeable to seepage flows from lower strata.

Fixing the leaking breach repair would be accomplished by installing a sheet pile cut-off wall along the interior side of the existing breach repair. Earth or rock fill would be placed and compacted on both sides of the cut-off wall. A layer of low-permeability geotextile would be placed above the earth fill, and armored with stone at a 2:1 slope to protect against erosion from the new levee crest down to the base of the slope, below the water.

Under current conditions, the Miner Slough levee is not passable for construction equipment south of the internal cross levee. Any necessary levee clearing would be conducted under a separate 1602 routine maintenance agreement with CDFW. Construction materials and equipment would then access the site along the Miner Slough levee. Depending upon existing water depths in the adjacent Miner Slough spur channel, construction materials and equipment may also be brought in by barge..

6.2.2 Pre-construction site preparation: dewatering, clearing and grubbing, access roads and ramps, staging areas

The purpose of pre-construction site preparation activities would be to ready the site for equipment operations and access during Project construction, including removal of snags and other debris (described in Section 6.2.4), and to facilitate invasive plant species control activities (described in Section 6.2.3). Figure 6-3 illustrates the general locations of these activities to the extent they are currently defined.

Pre-construction site preparation activities would include the following:

1. **Dewatering and water management, for the purpose of creating suitable conditions for Project construction**

   Under existing conditions, both the north and the south properties are inundated. Dewatering the north property would require a combination of gravity-driven drainage through an existing culvert and pumping. The existing (non-operating) pump station would be rehabilitated with repair or replacement of the pump motor, or a temporary pump would be installed at this location. As no electrical service remains to Prospect Island, the pump(s) would be powered by a diesel generator. Diesel fuel would either be stored on site, on the levee or at a staging area, or the pumps would be serviced regularly with a refueling vehicle. All or portions of the existing remnant agricultural drainage network would be rehabilitated and used as needed, through a combination of deepening, widening, and/or vegetation and sediment removal. Specific equipment needs for accomplishing this work would be determined based on soil moisture conditions, and could include amphibious excavators, low ground pressure (LGP) excavators, or standard excavators. Excavated soils and vegetation would be temporarily placed alongside work areas in piles no higher than 2 ft above surrounding grade, and piles would be arranged with gaps between them to promote efficient field drainage.

   Dewatering the south property would be accomplished with installation of either a new culvert through the internal cross levee, to allow drainage into the deeper north property drainage network, and/or a diesel-powered pump. As there are no remnant agricultural ditches on the south property, temporary, drainage ditches may be excavated, with soils placed alongside work areas, as stated above for the north property. As for the north property, equipment needs would be determined based on soil moisture conditions, and could include amphibious excavators, LGP excavators, or standard excavators.

   Water management during construction would be accomplished by operation of the drainage pumps, similar to practices typical of Delta island drainage operations. Site saturation levels would be maintained as necessary to allow construction equipment to operate and maneuver within the site for the duration of construction. Including site dewatering,

the Project construction period is estimated to be 3 years (see Section 6.2.14). Appropriate maximum soil saturation tolerance levels would be determined in final design.

2. **Clearing and grubbing, for the purpose of facilitating construction access, materials staging, excavation, and grading**

   This activity would involve clearing of the areas to be excavated for the creation of tidal channels and levee breaches, the footprint of the eastern toe berm and eastern intertidal bench, the footprint of the breach locations, and the footprint of the interior breach transitions, as well as areas needed for construction access and (possibly) materials staging purposes.

   Clearing and grubbing of the Project site would require a variety of construction equipment and methods. Smaller trees, brush, and debris would be cleared using a combination of bulldozers, excavators, and wheel loaders. Larger standing dead trees (snags) may need to be cut down and bucked by hand crews using chain saws. Woody debris (large tree trunk/limbs and root wads) would, to the extent practicable, be reused on site to enhance habitat structure in upland areas (e.g., higher elevation areas of the eastern toe berm). Some large (living) trees, such as willows and cottonwoods, that can survive having their trunks buried, would be left within the footprint of the eastern toe berm, and fill would be placed around them. All other debris would be loaded into dump trucks for removal and proper disposal off site, or ground, chipped, and incorporated into fill areas, or burned on site, as appropriate.

3. **Creation of temporary ramps and roads, for the purpose of creating construction access into and out of the site interior**

   This activity would involve constructing temporary access ramps and roads within the Project site to facilitate construction. The site is currently surrounded by levees on all sides, with levee side slopes that are generally too steep to allow construction equipment to be safely driven down into the site interior. Additionally, depending on the types of equipment needed to complete construction, and on the conditions of site soils and ground surfaces, temporary access/haul roads may need to be established within the site to facilitate construction of many of the restoration features. Existing levee roads would be utilized to the fullest

extent possible so as to minimize needs for temporary fill placement within the site interior.

Where necessary, temporary access ramps and roads would be constructed by importing and placing clean fill along designated access points and routes. These access locations may be aligned with the constructed channel network and breach locations. The number of ramps needed would be determined during final design. Geotextile fabric base may be used as determined by engineering analyses. Ramps and roads would be surfaced with aggregate road base, Road and ramp construction would be accomplished using a combination of excavators, bulldozers, and wheel loaders. One (1) to three (3) access roads would be kept in place for future monitoring access. To the extent practicable, remaining access road materials would be re-used on site (e.g. for re-surfacing levee roads) following construction of restoration features. Any excess materials that could not be utilized on site would be removed and properly disposed of offsite.

Locations and dimensions of access features would be determined during final design, and would depend on the specific restoration activities and features selected for the final Project.

4. Creation of temporary staging and stockpile areas, for the purpose of managing construction activities

This activity would involve designating temporary staging and stockpile areas within and adjacent to the Project site to facilitate construction. Under existing conditions, the only areas that exist above tidal elevations, and are therefore suitable for construction staging or stockpiling, are the levees that surround the Project site and lands to the north of the site. To the maximum extent possible, these locations would be used.

Final staging and stockpiling areas would be identified and prepared for use prior to commencement of Project construction. Staging and stockpiling areas would be cleared of vegetation and/or any debris. To the extent practicable, areas with riparian trees larger than 4 inches diameter at breast height (dbh) would not be used for staging or stockpiling.

6.2.3 Pre-restoration invasive plant species control

The purpose of this restoration activity would be to remove existing non-native, invasive plants found at Prospect Island. Invasive plant control would help to promote restoration success and it would help to prevent the site from becoming a source of invasive plant species dispersal into the surrounding tidal waterways.

Under current conditions, the Project site is host to several ecologically disruptive, invasive plant species (see Section 4.4.1). This restoration activity would involve removing existing invasive plants (to the greatest extent practicable) at the Project site prior to restoration, with a focus on controlling those species with the potential to: 1) interfere with Project ecological objectives and/or 2) to spread outside the site and degrade surrounding habitats. The most significant invasive plant species present at the site is the aquatic weed, water primrose, which covers between 160-200 ac of the wetted areas of the site (Table 6-4). Other invasive plant species present include emergent, submerged aquatic, riparian, and upland species, including: taro, Eurasian water-milfoil, curlyleaf pondweed, giant reed, yellow star thistle, poison hemlock, pampas grass, fennel, perennial pepperweed, wild radish, Himalayan blackberry, red sesbania, and tamarisk. Additionally, water hyacinth and Brazilian waterweed are documented in the waters adjacent to Prospect Island; these occurrences outside of the Project Site are not being targeted at this time. In addition to the non-native, invasive aquatic emergent plant species targeted for removal, herbicide application across the native emergent vegetation (predominantly cattails and smartweed, with some patches of tules) will assist in clearing interior portions of the Project Site to facilitate access of construction equipment.

The first control measure would be to dewater the site. This will allow physical access and maximize effectiveness of subsequent herbicide application and mechanical removal (e.g., excavation, mowing, or burning) (Section 6.2.2). After dewatering, herbicide and mechanical control methods would be initiated. Eradication methods have been selected to target as many species as is feasible, while yielding high rates of removal of plant material and source propagules. Aquatic emergent plant species will be targeted using application of a tank-mix of State Water Resources Control Board-approved aquatic herbicides (i.e., imazapyr, glyphosate, or other similar products; possibly aminopyralid, if it is approved before Project implementation). Further detail regarding control techniques, including techniques for removal of terrestrial weed species, is provided in Table 6-4. A detailed timeline for invasive vegetation control activities is provided in Table 6-5.

Table 6-4. Removal techniques for aquatic emergent and terrestrial non-native invasive plant species (WWR-Stillwater Sciences 2013).

Scientific name (common name)	Approximate Extent on Prospect	Technique	Herbicide	Dewatering Timing	Herbicide Timing	Mechanical Timing
Aquatic Emergent Plant Species						
Colocasia esculenta (taro)	small patch	dewater, herbicide, and physical removal	tank-mix of imazapyr (est. 6 pints/acre of Habitat or Polaris), glyphosate (est. 8 qts/acre of Roundup Custom or AquaMaster), or other approved products	Jun-Jul	post-dewatering	post-herbicide
Ludwigia spp. (*peploides*-ss *montevendensis*) (water primrose)	160-200 acres					
Myriophyllum spicatum (Eurasian water-milfoil)	50-60 acres					
Potamogeton crispus (curlyleaf pondweed)	5-7 acres					
Terrestrial Plant Species						
Arundo donax (giant reed)	<0.1 acre	physical rhizome removal and cut/herbicide	spot application of glyphosate (est. 3.3 qts/acre of Roundup ProMax)	N/A	Sep-Oct	3 wks-3 months prior to herbicide
Foeniculum vulgare (fennel)	2 acres	herbicide	spot application of triclopyr (est. 8 qts/acre of Garlon 4 Ultra)		Mar-Apr	N/A
Centaurea solstitialis (yellow star-thistle)	0.2 acres	mowing and herbicide	spot application of glyphosate (est. 3.3 qts/acre of Roundup ProMax)		Apr-May	prior to herbicide, Apr-May

Scientific name (common name)	Approximate Extent on Prospect	Technique	Herbicide	Dewatering Timing	Herbicide Timing	Mechanical Timing
Sesbania punicea (red sesbania)	<0.01 acre	physical and herbicide	spot application of triclopyr (est. 8 qts/acre of Garlon 4 Ultra)		Apr-May	year-round, immediately prior to herbicide
Rubus armeniacus (Himalayan blackberry)	2-5 acres (estimated)	mowing and herbicide	spot application of triclopyr (est. 8 qts/acre of Garlon 4 Ultra)		Mar-April	Mar, immediately prior to herbicide
Cortaderia selloana (pampas grass)	<0.01 acre	mowing and herbicide	spot application of glyphosate (est. 3.3 qts/acre of Roundup ProMax)		Sep-Nov	Sep-Nov, immediately prior to herbicide
Lepidium latifolium (perennial pepperweed)	unknown	herbicide	spot application of chlorsulfuron (est. 2.5 oz/acre of Telar)		Apr-May	N/A

Table 6-5. Timeline of invasive plant species removal techniques.

Scientific name (common name)	Jan 2016	Feb 2016	Mar 2016	Apr 2016	May 2016	Jun 2016	Jul 2016	Aug 2016	Sep 2016	Oct 2016	Nov 2016	Dec 2016
Aquatic Emergent Plant Species												
Colocasia esculenta (taro)						Dewater completed (initiated November 2015)		Apply herbicide	Mechanical removal			
Ludwigia spp. (*peploides*-ss *montevendensis*) (water primrose)												
Myriophyllum spicatum (Eurasian water-milfoil)												
Potamogeton crispus (curlyleaf pondweed)												
Terrestrial Plant Species												
Arundo donax (giant reed)							Mechanical removal		Herbicide			
Foeniculum vulgare (fennel)			Herbicide									
Centaurea solstitialis (yellow star-thistle)				Mechanical removal followed immediately by herbicide								
Sesbania punicea (red sesbania)				Mechanical removal followed immediately by herbicide								

Scientific name (common name)	Jan 2016	Feb 2016	Mar 2016	Apr 2016	May 2016	Jun 2016	Jul 2016	Aug 2016	Sep 2016	Oct 2016	Nov 2016	Dec 2016
Rubus armeniacus (Himalayan blackberry)			Mechanical removal followed immediately by herbicide									
Cortaderia selloana (pampas grass)									Mechanical removal followed immediately by herbicide			
Lepidium latifolium (perennial pepperweed)				Herbicide								

6.2.4 Debris, old infrastructure, and dead tree/snag removal

The purpose of this restoration activity would be to remove debris, old infrastructure, and dead trees that have the potential to interfere with Project construction and/or with achieving Project ecological goals. Dead tree snags and debris can interfere with construction access, creation of restoration features, and provide habitats for predatory fish.

This restoration activity would involve removing a variety of types of debris at the Project site prior to restoration. Large areas within Prospect Island, primarily in the north property, are covered with stands of dead trees and snags. Clearing and grubbing will occur following site dewatering within 25 ft of the existing drainage ditch network, all channel and breach excavation areas, as well as the footprint of the eastern levee toe berm and intertidal bench. The site contains some remnants of dilapidated, long-abandoned structures from a complex of buildings on the north property, and a collapsed residence on the south property (Parus 2012). Other miscellaneous debris remain from agriculture uses (discarded and/or broken irrigation piping, scrap metal), recreational use (abandoned row boat), and debris brought in during times when levees failed and the site was flooded.

Removal of these materials from the Project site would require a variety of construction equipment and methods. These efforts would require access to the site interior, which would be undertaken after dewatering (Section 6.2.2). Where practicable, debris from invasive species control activities (Section 6.2.3) and snags would be cleared using a combination of bulldozers, excavators, and wheel loaders. Larger standing dead trees may need to be cut down and bucked by hand crews using chain saws. Woody debris (large tree trunk/limbs and root wads) would, to the extent appropriate, be reused on site to enhance habitat structure in upland areas (e.g., the eastern toe berm). Snags and other woody debris from clearing the levee could also be used to construct brush boxes, small erosion protection features that could be installed along the water line of the eastern toe berm and/or eastern intertidal bench. Woody materials would be reused on site to the maximum extent feasible, in order to reduce the volume of debris that would need to be transported and disposed of offsite. All excess and/or unusable debris would be loaded into dump trucks for removal and proper disposal off site, or ground and chipped for incorporation into fill areas on site, as appropriate. Following completion of construction activities requiring dewatering of the site, or earlier if it is not used for dewatering, the pump existing on the north property will also be removed and transported off site for disposal or re-use.

PG&E would be responsible for removal of old power poles and remaining power lines that currently exist on site.

6.2.5 Excavate constructed channel network

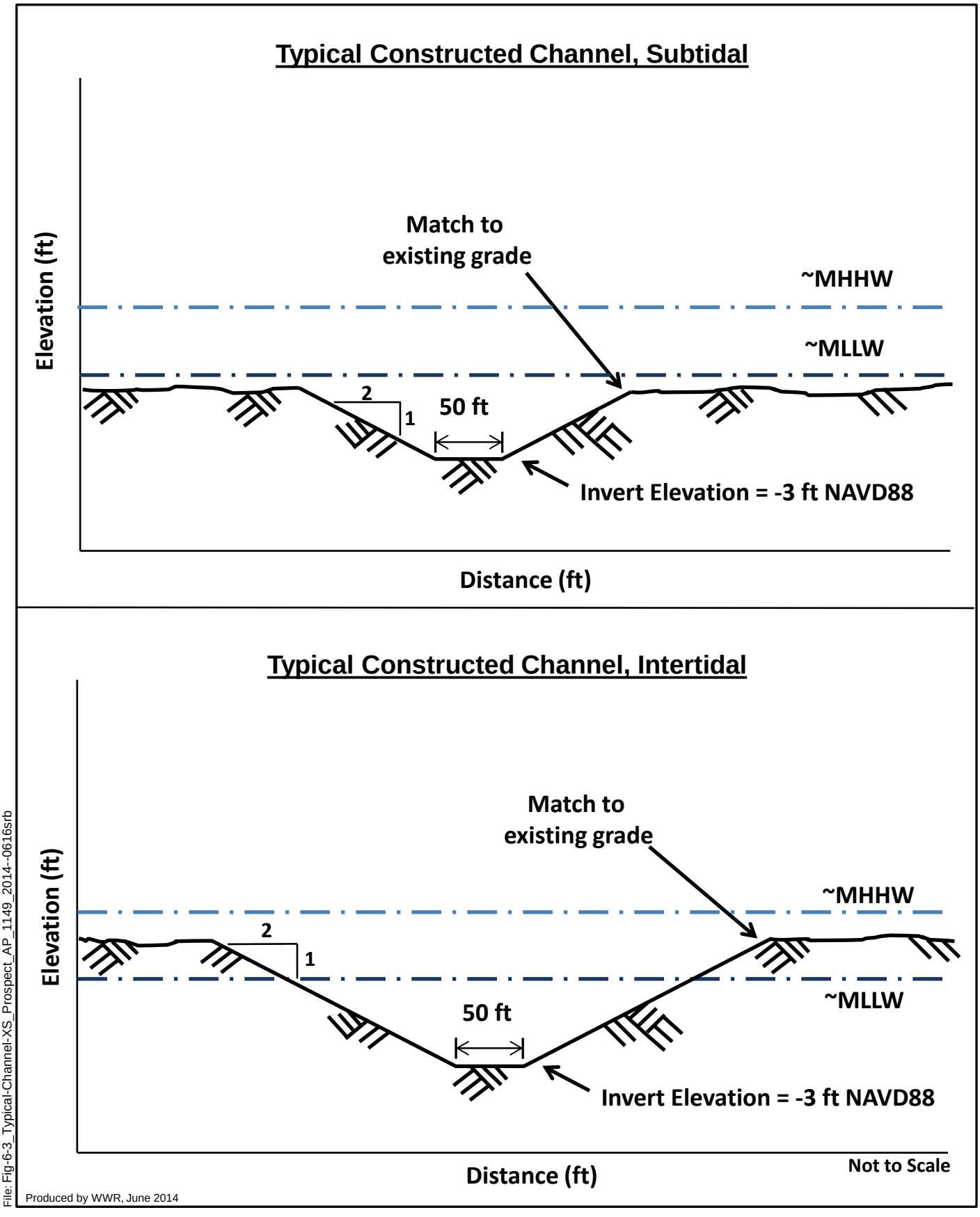
The purpose of this restoration activity would be to construct a network of tidal channels within the restored site. Excavated tidal channels would serve three functions. First, within the emergent marsh areas they would provide open water-edge habitats. Second, they would provide hydraulic connectivity and transport pathways for fish, phytoplankton, and organic matter within the restored site. Third, as the restoration site rebuilds its elevation through the natural processes of sedimentation and plant matter accumulation (aggradation), these channels would become more distinct geomorphically and serve as the "template" for the continued evolution of a tidal channel network on the site.

The design for the constructed channel network on the site was developed using the following guiding principles:

1. Draw upon historical planform morphological characteristics of the Delta (Whipple et al. 2012, Atwater 1979) and other tidal marshes in the region in order to establish an appropriate natural channel template – sinuosity, branching (bifurcation), and total length of channel (linear density).
2. Draw upon historical cross section geometry characteristics of the Delta (SFEI 2012) and other tidal marshes in the region in order to establish appropriate invert elevations and widths, to encourage natural geomorphic function and to avoid colonization by emergent marsh vegetation.
3. Utilize existing features such as remnant channels and agricultural ditches to the greatest extent possible, where beneficial, in order to minimize earthwork.
4. Size channels to promote higher water velocities in order to minimize potential for establishment of Brazilian waterweed, to the extent practicable.

Based on preliminary design calculations, the channels would be excavated in the site interior to have fixed invert elevations of -3 ft NAVD 88 (about -5 ft MLLW), invert widths of 50 ft, and side slopes of 2:1 (Figure 6-4). Channel segments connecting to breaches would have gradual longitudinal slopes. Invert widths of these connecting channel segments would narrow from the widths of the breach inverts to the widths of the constructed channel inverts at a uniform angle, over the length of the connecting segment.

For the Proposed Project, the total excavation volume for the constructed channel network is shown in Table 6-3. Material excavated from the site would be re-used on site. Construction of the channel network would be accomplished using a combination of excavators, bulldozers, and wheel loaders.



File: Fig-6-3_Typical-Channel-XS_Prospect_AP_1149_2014--0616srb

Produced by WWR, June 2014

Figure 6-4

Typical Constructed Channel Cross Sections

6.2.6 Block or fill remnant agricultural ditches

The purpose of this restoration activity would be to close-off sections of remnant agricultural ditches that would not be incorporated into the constructed channel network, so as to prevent flow capture and consequent hydraulic short circuiting.

The constructed channel network would cross several remnant agricultural ditches. This restoration activity would involve re-using soils excavated on site to block or completely fill certain remnant agricultural ditches. At the intersection of constructed channels with some of the larger of these ditches, fill soils would be placed within the ditches, up to the elevation of the surrounding subsided land surface. The lengths of these 'ditch blocks' would vary, based on the sizes and positions (intersecting angles) of the individual remnant agricultural ditches at such intersecting locations, relative to the flow velocities that can create scour.

Ditch blocks would be constructed by placing fill generated by excavation of the constructed channel network into portions of the remnant agricultural ditches, and compacting the fill to levels sufficient to minimize scour potential. Construction of these features would be accomplished using a combination of excavators, bulldozers, compactors, and wheel loaders. The estimated total fill volume that would be placed in creating these site features is shown in Table 6-3.

6.2.7 Construct interior topographic features

The purpose of this restoration activity would be to create small patches of higher intertidal habitat within the site interior, in order to benefit marsh development and support a greater diversity of wildlife species that may use the restored site.

Interior topographic features would be created by side casting excavated materials adjacent to the constructed channels, as they are excavated. These mounds would be built up to approximately MHW to MHHW elevation (6–6.5 ft NAVD88), with side slopes of approximately 5:1 to 10:1, and would be compacted only to the extent that would occur as a result of the use of construction equipment in placing and grading soils (i.e., levels of compaction would be incidental rather than engineered). These features would be constructed so as not to substantially diminish wind fetch across the restored site.

The estimated total volume placed for creation of these features is shown in Table 6-3.

6.2.8 Construct eastern toe berm

The purpose of this restoration feature would be to provide protection from wind wave erosion along the eastern Prospect Island levee, so as to minimize the potential for failure of this levee and the resultant potential for increased wind wave erosion on the Ryer Island levee, located directly across Miner Slough.

The eastern Prospect Island levee runs for approximately 27,600 ft (5.23 miles) along Miner Slough. Currently, the Prospect Island levees do not meet Federal Emergency Management Agency (FEMA) Hazard Mitigation Plan guidance, nor are they in compliance with the USACE PL84-99 standard (DWR 2012b).

With the Proposed Project, the interior side of the east levee would be subject to daily tidal inundation. Given subsided elevations within Prospect Island, large portions of the interior would become permanent, open water areas, with depths of up to 9 ft at high tides, and greater during winter high flow events.

The eastern toe berm would be constructed along the interior side of the eastern levee, at a 10:1 slope from elevation 10 ft NAVD88 down to the approximate MHW elevation (6ft NAVD88), and at 20:1 from MHW down to existing grade (see Figure 6-5).

The gentle slopes of the eastern toe berm would function to dissipate wind waves approaching the levee. The approach for constructing the eastern toe berm would consist of the following actions prior to levee breaching:

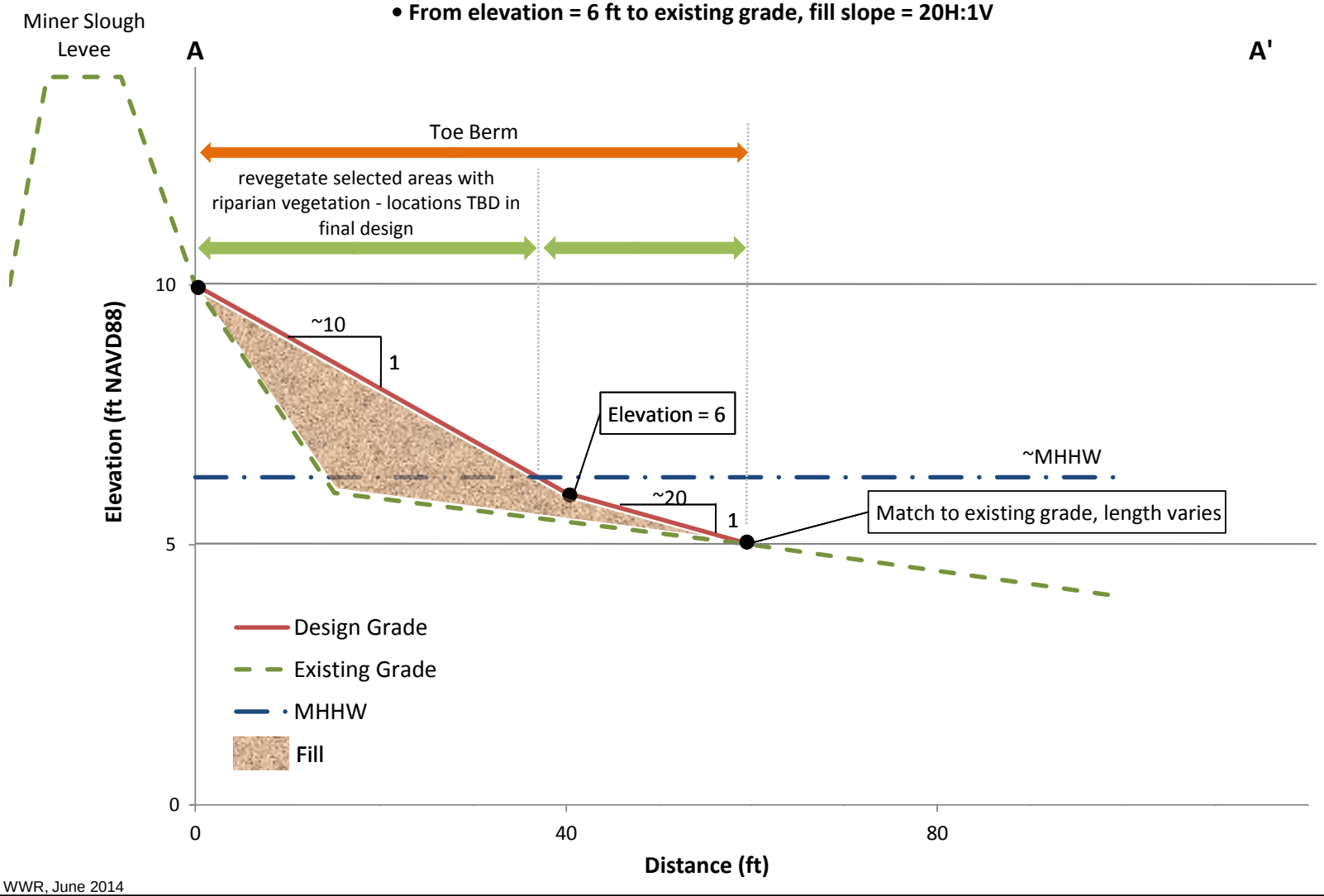
1. Clearing and grubbing of areas within the footprint of the toe berm (30 acres). Large trees would be left in place where practicable (see Section 6.2.2).
2. Placing geotextile fabric to help maintain slope stability, as determined in final design engineering analyses.
3. Transporting soils excavated during channel construction to placement locations within the toe berm footprint.
4. Grading of excavated soils to form the eastern toe berm. Compaction requirements for geotechnical stability and finish grades would be determined during final design.
5. Erosion control by hydro-seeding of native grass species as well as limited planting of native riparian vegetation at elevations along the eastern toe berm that would be above high tide following tidal restoration. Specific locations and extents of riparian revegetation zones, plant species

composition, and planting methods would be determined during final design.

6. Pre-breach maintenance and water management of plantings as needed to promote native vegetation establishment.

Eastern Toe Berm

- From elevation = 10 ft to 6 ft , fill slope = 10H:1V
- From elevation = 6 ft to existing grade, fill slope = 20H:1V



Produced by WWR, June 2014

File: Fig-6-5 Eastern-Toe-Berm-XS Prospect 1149 2014-0618srb

Figure 6-5

Eastern Toe Berm Typical Cross Section

6.2.9 Construct eastern intertidal bench

The purpose of this restoration feature would be to provide protection from wind wave erosion along the eastern Prospect Island levee, so as to minimize the potential for failure of this levee and the resultant increased wind wave erosion on the Ryer Island levee, located directly across Miner Slough.

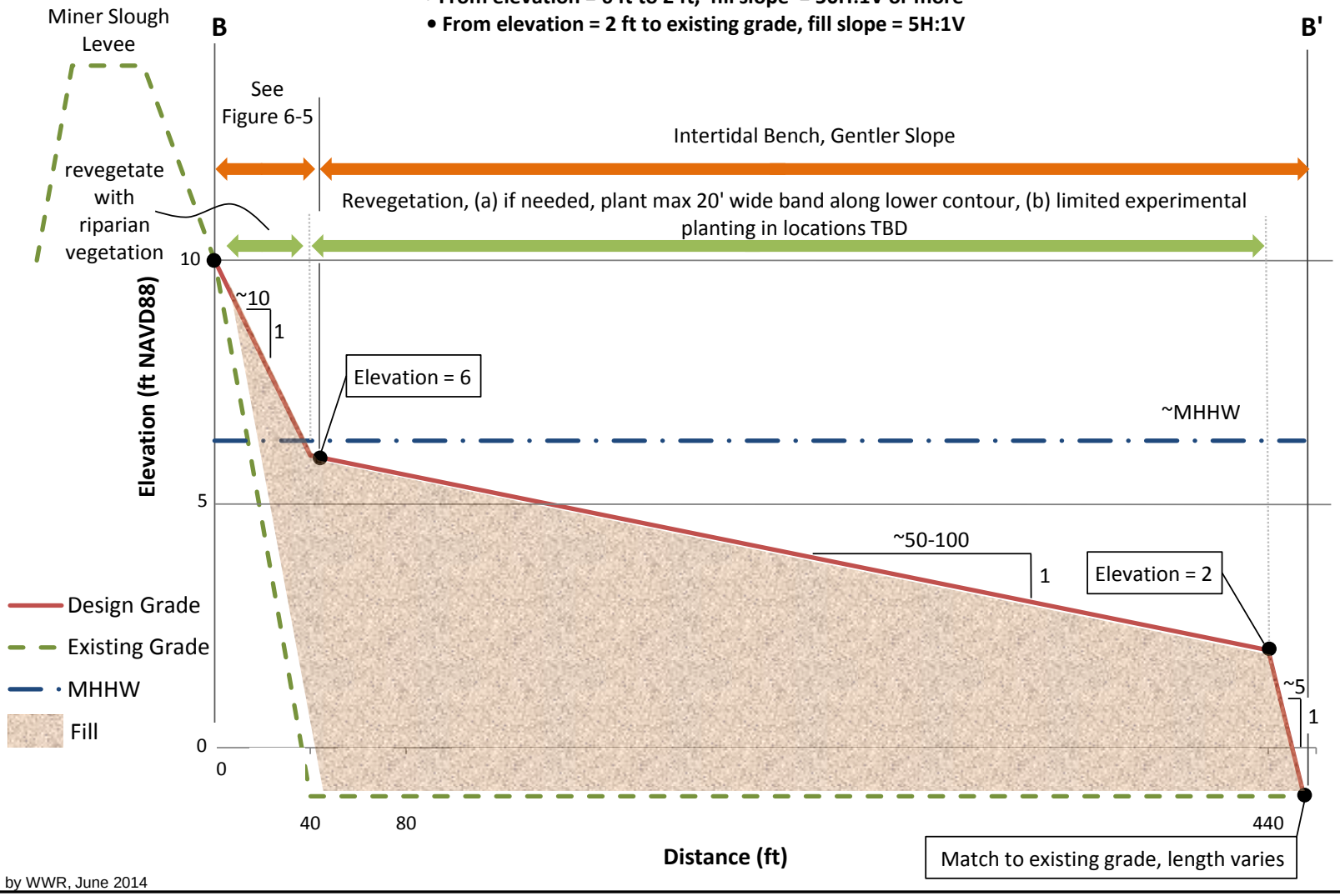
Creation of this feature would involve building a wide, earthen "bench" along the interior side of the eastern levee, to intertidal elevations, in areas where existing interior elevations adjacent to the levee are subtidal. These conditions are found from the internal cross levee north, approximately 1 mile. The bench would have a slope of approximately 100:1 from elevation 6 ft NAVD88 (roughly MHW) to 2 ft NAVD 88 (roughly MLLW), and at 2:1 from 2ft NAVD 88 until the bench edge elevation reached existing grade (Figure 6-6). Exact dimensions would be determined based on quantities of materials available to construct this feature.

The approach for constructing the bench would consist of the following activities, which would be implemented prior to restoring tidal action:

1. Clearing and grubbing of areas within the footprint of the intertidal bench (see Section 6.2.2).
2. Placing geotextile fabric near the bench toe transition to existing grade to help maintain slope stability, as determined in final design engineering analyses.
3. Transporting soils excavated during channel network construction to placement locations within the intertidal bench footprint.
4. Grading of soils. Compaction requirements for geotechnical stability and finish grades would be determined during final design.
5. If needed, native wetland vegetation may be planted in areas that would form open water edge habitat post breaching (i.e., highly energetic areas subject to undampened wind wave energy), to a maximum width of 20 ft. In addition, limited experimental plantings would be conducted to gain information on the relative success of planting methods and to compare vegetation establishment between planted and unplanted areas. Plot locations, dimensions, and planting methods would be determined during final design. The remainder of the intertidal bench would be left unplanted to allow for natural colonization.
6. Maintenance and water management as needed to promote Project objectives.

Eastern Intertidal Bench

- From elevation = 10 ft to 6 ft, fill slope = 10H:1V
- From elevation = 6 ft to 2 ft, fill slope = 50H:1V or more
- From elevation = 2 ft to existing grade, fill slope = 5H:1V



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File: Fig-6-6 Eastern-Tidal-Bench-XS Prospect 1149 2014-0618srb

Figure 6-6
Eastern Intertidal Bench Typical Cross Section

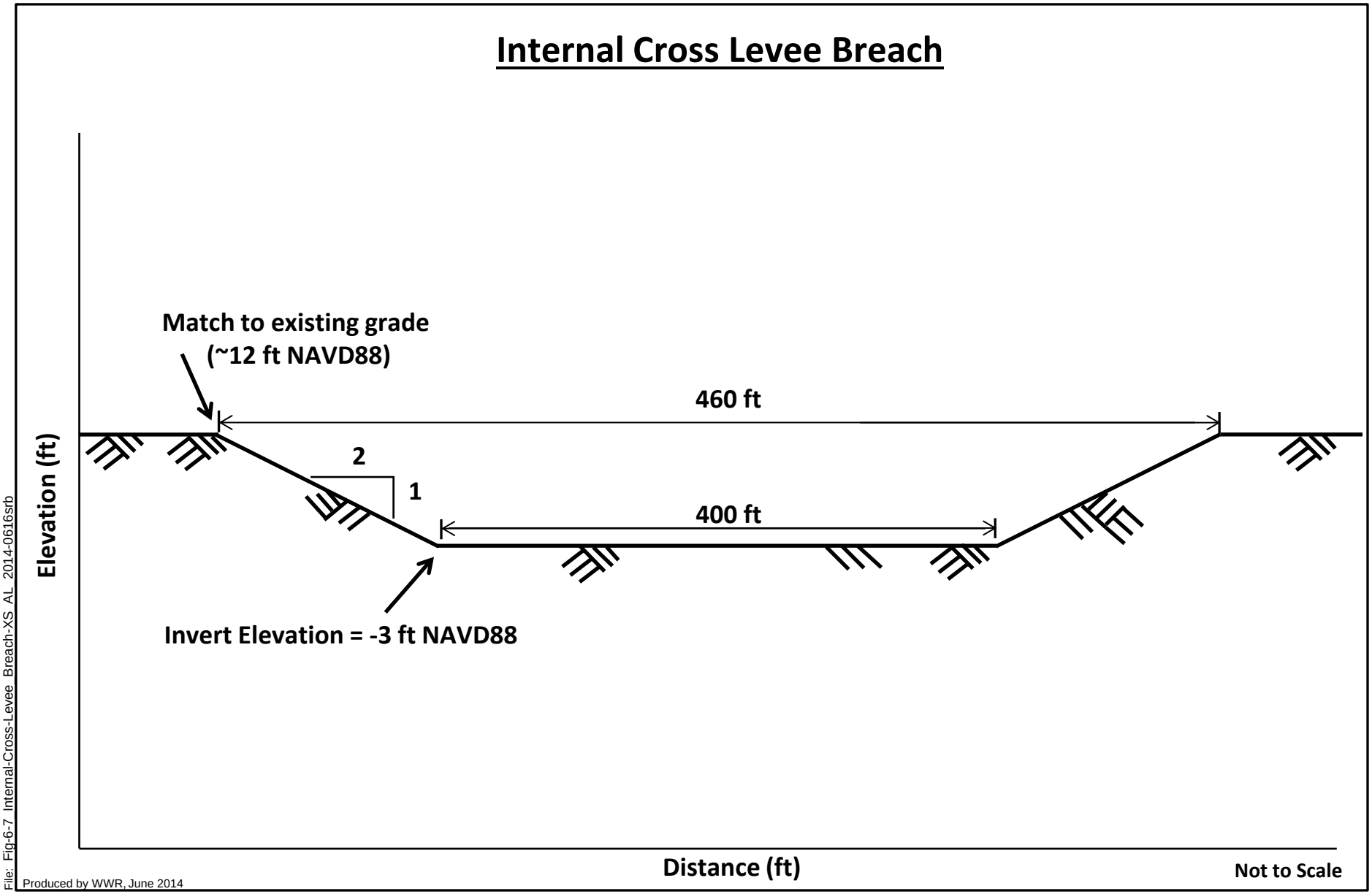
6.2.10 Breach internal cross levee

The purpose of this restoration activity would be to provide hydraulic connection between the north and south properties.

The internal cross levee breach would have a cross sectional area matching that of the south breach. The breach invert elevation would be at -3ft NAVD88, to match that of the constructed channel network in the south property and the existing grade in the north property adjacent to the internal cross levee breach location. Breach invert width would be approximately 400 ft, with side slopes of 2:1 (Figure 6-7). Construction of this breach would result in loss of legal access to the Stringer property (Figure 4-7).

Excavated soils would be used to fill the existing borrow ditch that runs along the north side of the internal cross levee to elevation -3ft NAVD88 at the breach. Fill in the borrow ditch would extend at least 100 ft to either side of the cross levee breach to create ditch blocks (see Section 6.2.6).

Breaching of the internal cross levee would be accomplished using excavators. Excavators and/or bulldozers would place and grade a portion of the excavated soils into the borrow ditch. Excavation volumes are shown in Table 6-3.



File: Fig-6-7 Internal-Cross-Levee Breach-XS AL 2014-0616srb

Produced by WWR, June 2014

Figure 6-7
Internal Cross Levee Breach Cross Section

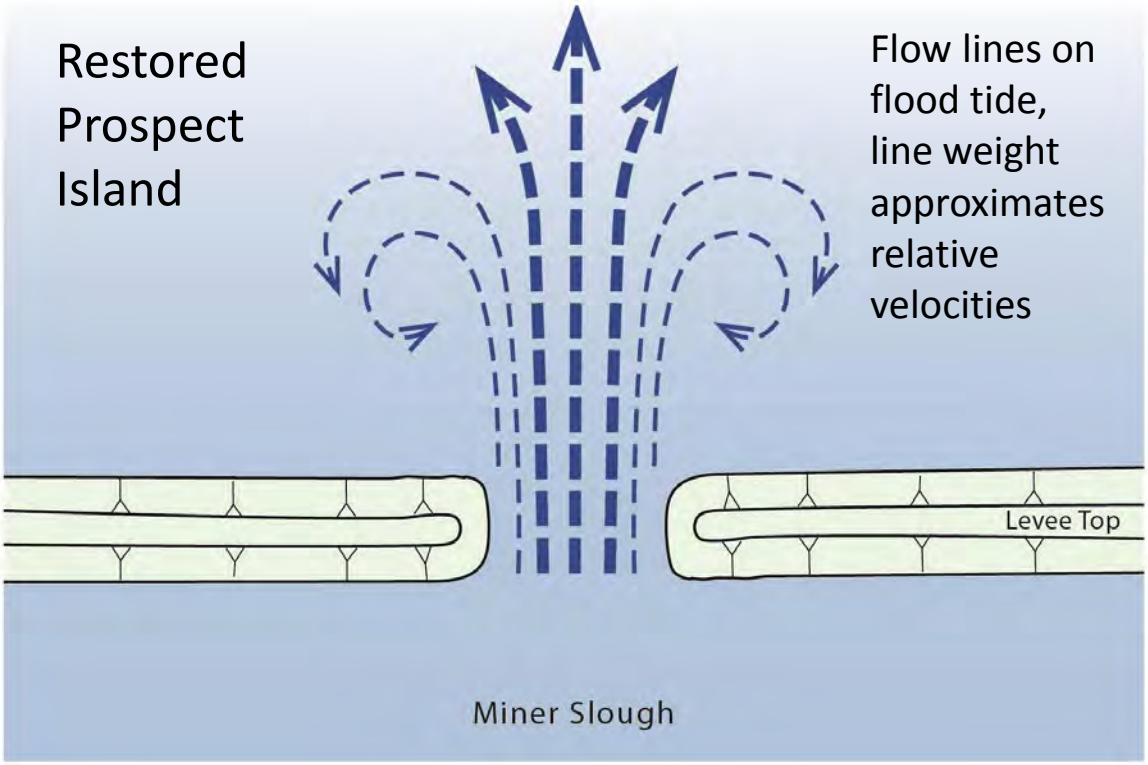
6.2.11 Construct breach velocity dissipation feature

The purpose of constructing a breach velocity dissipation feature is to test an experimental design intended to minimize strong velocity gradients on the interior side of levee breaches, where predatory fishes are known to congregate and prey successfully on smaller fishes.

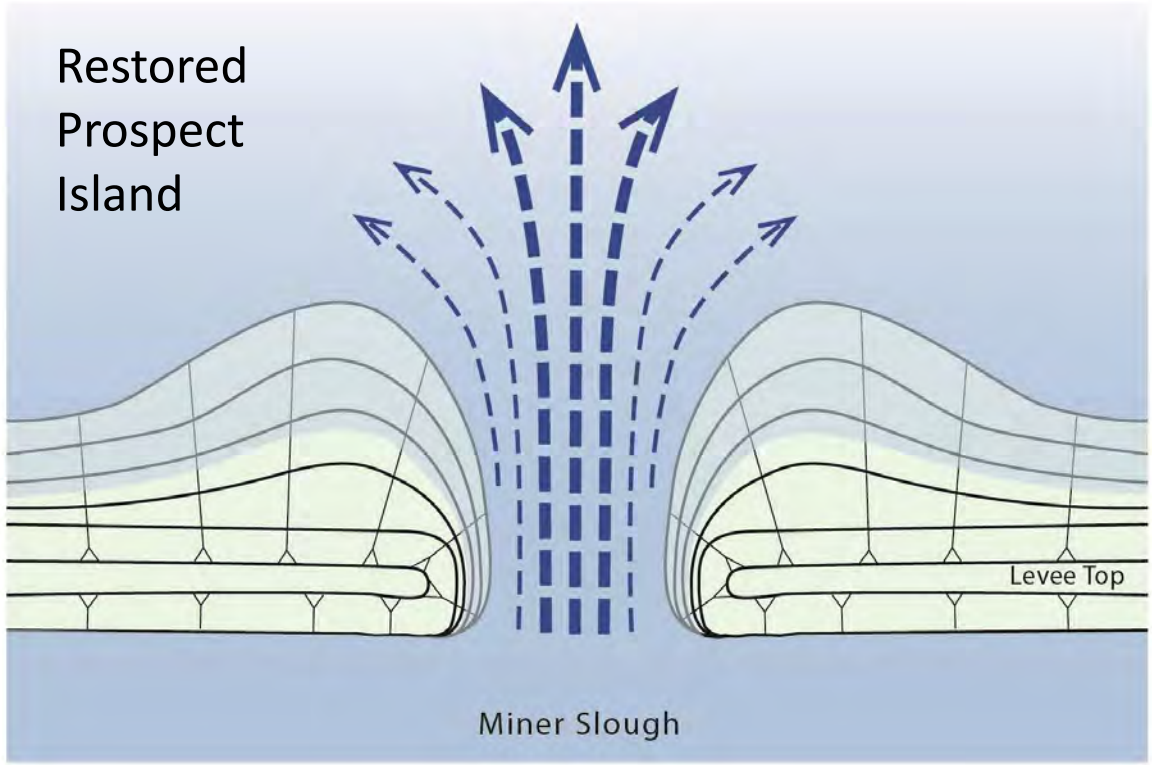
Hydrodynamic modeling conducted for the Project indicates that the proposed levee breaches would create velocity gradients and associated eddies on the internal sides of these breaches. Although no direct studies of higher predation rates effects within low velocity eddies adjacent to levee breaches have been identified, anecdotal observation of fish congregations within these areas suggests that predatory fish species preferentially seek out these habitats for foraging. USFWS and USBR monitoring of fish habitat use during gate operations in the 1990s at the Red Bluff Diversion Dam on the Sacramento River showed increased presence of Sacramento pikeminnow in turbulent areas, with striped bass habitat use concentrated along the turbulent eddy line adjacent to the gate structure (Tucker et al 2003). In studies of smallmouth bass, velocity refugia afforded by structures was hypothesized to allow fish to forage in high velocity areas that would otherwise be energetically unfavorable (Rankin 1986). In addition, fishermen often congregate at levee breaches and other locations that offer these strong velocity gradients, as well known locations for successful fishing.

Prior to breaching the levee, gradually sloping grade transitions would be constructed at one breach location. This would be accomplished by placing fill excavated in construction of the channel network onto the interior side of the levee, and grading to the appropriate design dimensions (Figure 6-8). The breach interior would slope downward longitudinally along the banks of the constructed channel inside the breach, and laterally along the interior toe of the levee. Construction of these features would utilize a combination of excavators and bulldozers. Compaction requirements would be determined during final design. Revegetation measures (if any) would be determined during final design and, if employed, would be similar to those described above for the eastern toe berm.

Levee Breach without Breach Transition



Levee Breach with Breach Transition



File:Fig-6-8_Breach Velocity Dissipater Features_AP_2014-0616srb

Produced by WWR, June 2014

Figure 6-8
Breach Velocity Dissipation Feature

6.2.12 Dredge Miner Slough spur channel

The purpose of this restoration activity is to ensure that unimpeded tidal exchange occurs through the southern breach to Miner Slough.

This restoration feature would involve dredging of the spur channel between Miner Slough and the south breach location. Hydraulic modeling results show that the current geometry of the Miner Sough spur channel is undersized for the anticipated volume of tidal exchange between Miner Slough and the restored Project site, and would, therefore, result in tidal dampening within the Project site.

Current depths in the spur channel range from -5 to -8 ft NAVD88. Preliminary design would lower the channel invert elevation to -16 ft NAVD88. The channel width would remain unchanged. Channel side slopes would vary between 2H:1V and 1.5H:1V. The volume of material dredged from the spur channel is shown in Table 6-3.

Dredging would occur after the south property levee is repaired (see Section 6.2.1), and prior to breaching the Project site (see Section 6.2.13). Dredging of the Miner Slough spur channel would be accomplished either by clamshell or hydraulic dredging with all materials retained on site. If the dredged material meets environmental screening criteria, it would be placed within the Project site (Figure 6-2). If dredged by clamshell, appropriate turbidity control measures (e.g., silt curtains) will be employed in the dead-end spur channel. Excavated materials would be loaded into a barge and transported to pre-constructed containment cells or re-used at one or more locations within the Project site. If employed, hydraulically dredged materials will be placed directly into the containment cells sized to contain the entire dredge volume. No decant of supernatant water will be discharged to the exterior waterways surrounding the Project site and dewatering would be accomplished by evaporative drying.

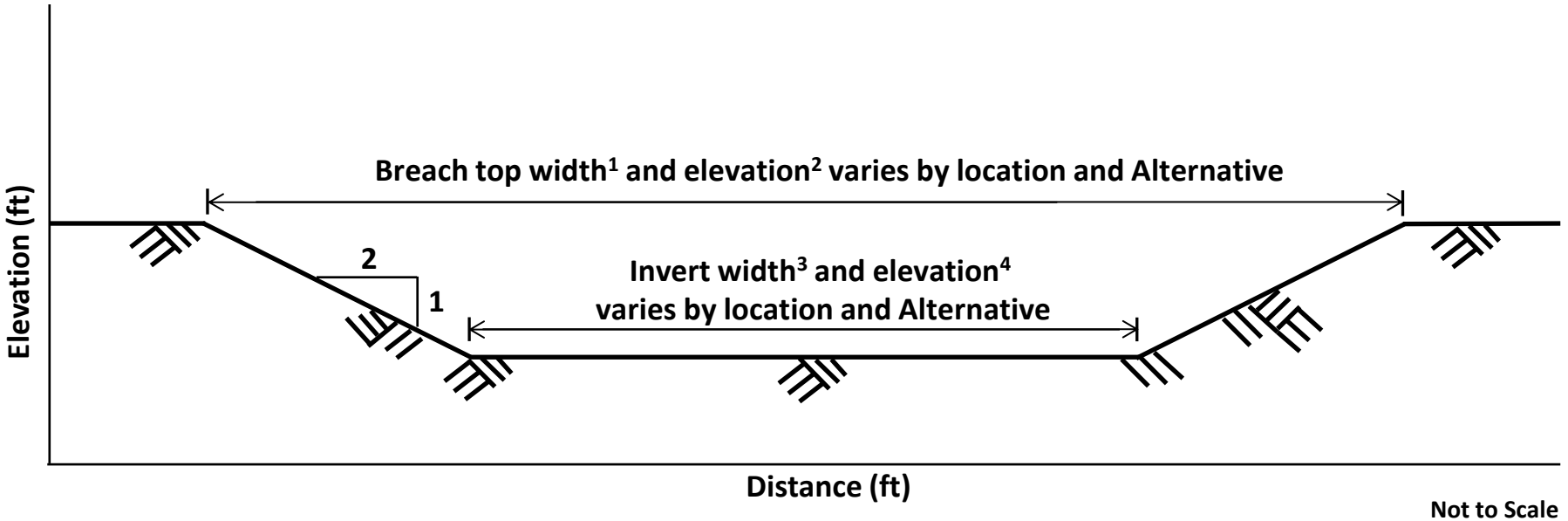
6.2.13 Breach Miner Slough levee

The purpose of this restoration activity is to reconnect the Project site to tidal action, and is the final step in the restoration construction process. This restoration activity would involve excavating two levee breaches to Miner Slough. One breach would be located in the north portion of Prospect Island, approximately 0.5 miles south of Arrowhead Harbor. The second breach would be located in the south property, at the location of the formerly repaired breach connecting to the Miner Slough spur channel (Figure 6-2).

Levee breaching would be accomplished using excavators. The material excavated from the levee would be handled in one or more of the following ways: (1) directly placed within the site interior near the levee breach, (2) spread on the top or interior side slopes of the levee as reinforcement, (3) loaded into dump trucks and hauled to other areas of the Project site for re-use, (4) or loaded into dump trucks and hauled off site. Materials excavated from portions of the levee that are above the high tide line would be readily moved and re-used within the site. Once excavation levels dropped below the elevation of high tide, and tidal waters could enter the site, placement of excavated soils would, for the most part, be limited to areas in the immediate proximity of the breach or on the levee, or the soils would be removed from the site. Total excavation volumes for the breaches are shown in Table 6-3. The need for environmental testing of excavated materials at potential breach locations is currently being evaluated as part of Project permitting.

To protect the remaining adjacent levees from erosion, stone slope protection may be placed on the interior, exterior, and levee end slopes near the breach. The stone slope protection would be placed from the levee crest down to the base of the slope in the water.

Miner Slough Levee Breach(es)



Breach Dimensions												
	[1]Top Width (ft)			[2]Top Elev (ft NAVD88)			[3]Invert Width (ft)			[4]Invert Elev (ft NAVD88)		
Location	PP*	Alt 2	Alt 3	PP	Alt 2	Alt 3	PP	Alt 2	Alt 3	PP	Alt 2	Alt 3
North	613	n/a	518	16	n/a	16	531	n/a	438	-4.6	n/a	-4
Central	n/a	738	579	n/a	14	13	n/a	659	507	n/a	-5.9	-4.4
South	447	n/a	n/a	9	n/a	n/a	394	n/a	n/a	-4	n/a	n/a

* PP = Proposed Project

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File: Fig-6-9 Miner Slough Breach-XS AL 2014-0616srb

Figure 6-9
Miner Slough Levee Breach(es) Cross Section

6.2.14 Construction implementation schedule

The purposes of providing an implementation schedule for the Proposed Project are to determine the time frames during which construction activities would take place, for CEQA evaluation, and to optimize sequencing and seasonality of construction activities to allow for the shortest viable construction duration. Table 6-6 provides the preliminary implementation schedule.

Table 6-6. Estimated Construction Implementation Timing

Restoration Activities	Start Date	End Date
Site Preparation	8/17/2015	7/10/2017
PG&E pole removal[1]	8/17/2015	1/28/2016
North (DWR) property Dewatering[2]	11/3/2015	7/31/2016
South (Port) property levee repair[3]	8/1/2016	10/1/2016
South (Port) property Dewatering[2]	10/2/2016	7/31/2017
Terrestrial Invasive spp. Control	3/1/2016	11/30/2016
Aquatic Invasive spp. Control	8/1/2016	10/31/2016
Access roads and ramps[4]	8/16/2016	10/3/2016
Clearing, grubbing, dead tree and snag removal[1]	10/4/2016	7/10/2017
Construction	8/1/2016	11/20/2018
Dredge Miner Slough spur channel[3]	8/1/2016	10/31/2017
Channel excavation & interior fill[5]	9/13/2017	7/17/2018
Toe berm & bench construction[5]	9/13/2017	7/17/2018
Planting and revegetation	8/1/2018	11/20/2018
Miner Slough levee breaches	8/1/2018	11/20/2018

[1] Pre-construction nesting bird surveys needed outside of Aug 16 to Feb 14 work window
[2] Includes rehabilitation of existing drainage network and pumps, or portable pumps
[3] In-water work window limited to August 1 to October 31 of each year
[4] Repurpose 1-3 construction access roads as boat ramps for future monitoring access
[5] May be restricted to summer (May 1 to Oct 1) work window for GGS

6.2.15 Anticipated Future Habitat Conditions, Proposed Project

This section describes the future habitat conditions anticipated following completion of the above-described site preparation and construction activities for the Proposed Project.

1. As-built conditions: Upon completion of construction and breaching of the Miner Slough levee, it is anticipated that the interior of Prospect Island would be primarily open water habitat (Figure 6-10 and Table 6-7). The retained natural communities would initially be limited to the perimeter riparian scrub/shrub wetland and valley foothill riparian habitats located

along the Deep Water Ship Channel levee, northern cross levee, and the upper slopes of the Miner Slough levee. Figure 6-11 depicts a cross-sectional view of anticipated habitat conditions on Prospect Island following breaching of the Miner Slough levee. With the exception of limited riparian plantings, all unvegetated upland areas would be hydroseeded for erosion control; thus, all upland areas that were not valley foothill riparian (as mapped in pre-restoration conditions) would be grassland in the immediate post-construction condition (Figure 6-10 and Table 6-7).

2. Future conditions: Figure 6-11 depicts a cross-sectional view of anticipated habitat conditions on Prospect Island in the 5 to 15 year timeframe. Over time, grassland habitat along the Miner Slough and internal cross levee crown would revert to valley foothill riparian, as the levees would no longer be maintained. Valley foothill riparian, riparian shrub/scrub, and tidal emergent wetland habitats on the restored Prospect Island site are anticipated to slowly colonize and expand from the as-built condition. It is assumed that riparian scrub/shrub wetland habitat will be maintained in approximately the same locations where it was found pre-restoration within intertidal elevations. Based upon observations in natural tidal marshes and known submergence tolerances, tidal emergent marsh is expected to establish in the intertidal zone down to MLLW (Simenstad et al 2000, Orr et al 2003). Figure 6-10 and Table 6-7 show estimated maximum future tidal emergent marsh extent corresponding to establishment throughout the intertidal zone (2.7 – 6.2 ft NAVD88). Tidal waters are expected to decrease from the as-built condition and become colonized over time with tidal emergent wetland. It is anticipated that emergent vegetation will colonize intertidal elevations down to MTL (4.4 ft NAVD88) within approximately 4–5 years and to MLLW (2.7 ft NAVD88) within approximately 10–15 years following breaching. Based on observations in natural tidal marshes as well as recent observations at Liberty Island (Simenstad et al 2000, Orr et al 2003, Hester et al 2013), marsh emergent vegetation may slowly colonize shallow subtidal habitats (approx. 1–2 ft below MLLW) over the long term via lateral growth (approx. 1–3 ft/year) from plants that establish in the adjacent low intertidal zone. However, there is currently uncertainty over the magnitude and rate at which such subtidal emergent vegetation can develop following restoration in the Delta (Hester et al 2013), especially given the expected trajectory of sea level rise over the next several decades.

Table 6-7. Prospect Island Habitats: Existing, Projected As-Built, and Future, Proposed Project[1]

Type of jurisdictional feature	Existing (acres)		As-Built[2] (acres)		Future[3] (acres)		Change in Area (acres)	
	North	South	North	South	North	South	North	South
Open Water								
Non-tidal waters of the U.S.	131	209	0	0	0	0	-131	-209
Tidal waters of the U.S.	0	0	1,204	246	1,031	185	+1,031	+185
Wetland								
Non-tidal freshwater perennial emergent wetland	1,064	35	0	0	0	0	-1,064	-35
Tidal emergent wetland	0	0	0	0	185	70	+185	+70
Riparian scrub/shrub wetland	35	18	27	16	27	16	-8	-2
Non-Jurisdictional Lands[4]								
Cultivated lands	18	0	18	0	18	0	-	-
Developed	3	2	3	2	3	2	-	-
Grassland	55	12	67	17	44	10	-11	-2
Non-tidal freshwater perennial emergent wetland	4	1	0	0	0	0	-4	-1
Valley foothill riparian	56	30	48	27	59	24	+2	-5

[1]Within Diked Lands Project Area
[2]As-built acres are immediately after breaching of Miner Slough levee
[3]Natural colonization potential assumed to be within intertidal elevations only (2.7-6.2 ft NAVD88)
[4]Non-Jurisdicational acreages based on Natural Communities Data (ESA, SWS 2014)

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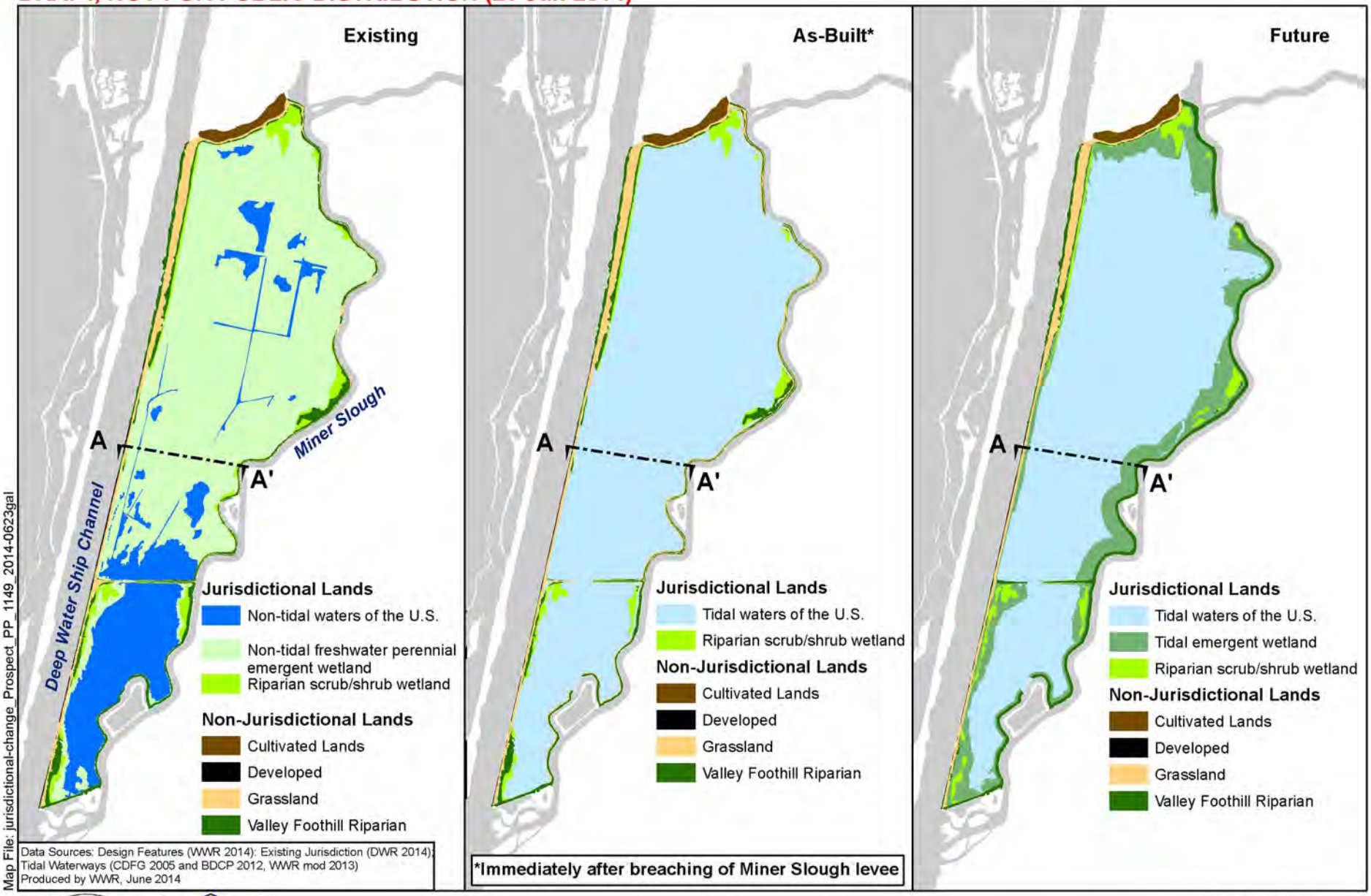

Map File: jurisdictional-change_Prospect_PP_1149_2014-0623gal

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Figure 6-10
Prospect Island Habitats: Existing, As-Built, and Future - Proposed Project

PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT

Profile A-A' (North Property)

Existing Conditions:

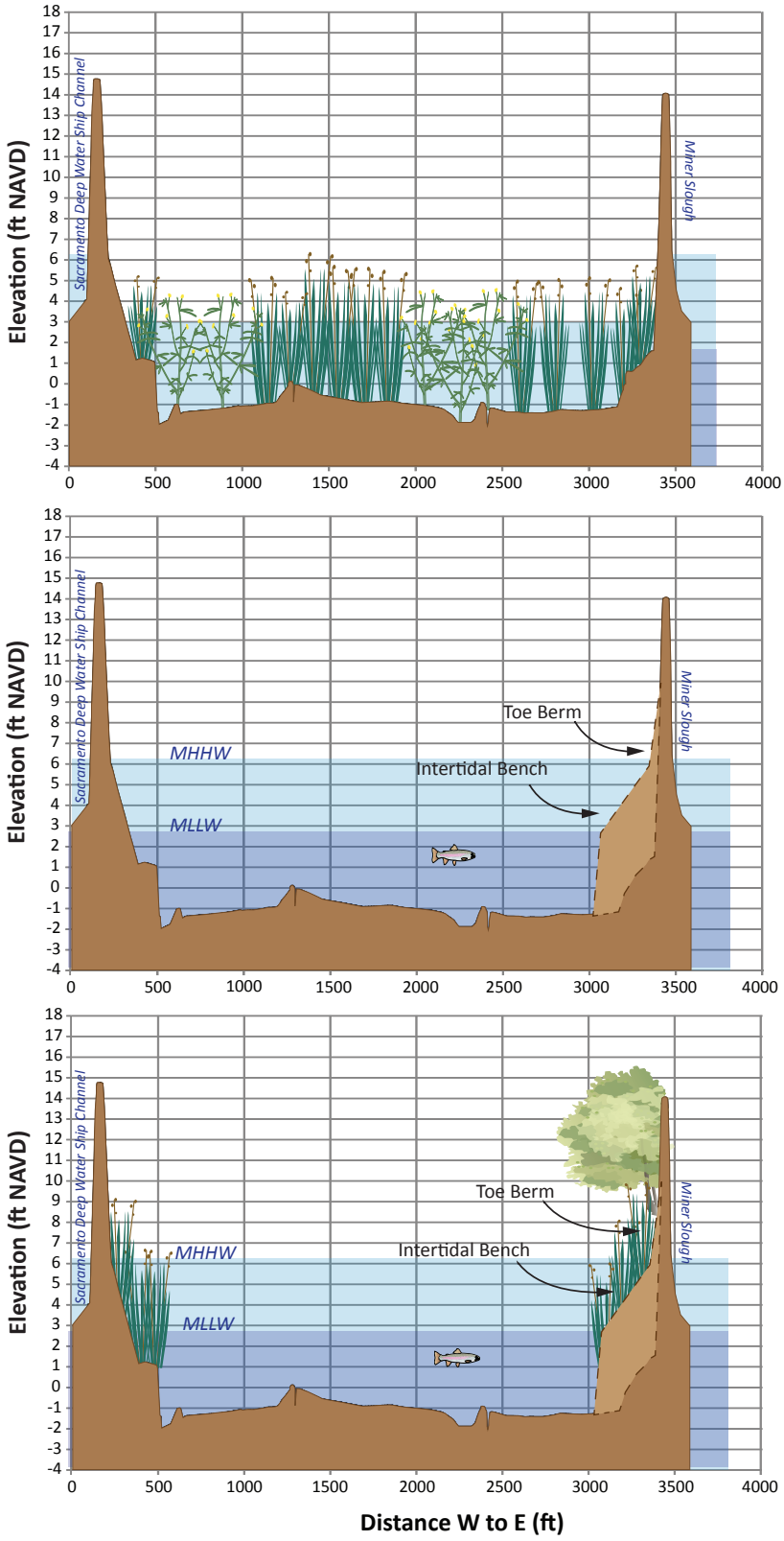
Emergent wetland vegetation persists across the subsided island bottom with essentially static water levels at app. +3 ft NAVD88. The edges of the northern portion of the island support limited riparian vegetation.

As-Built Conditions:

Pre-construction invasive plant species control measures are expected to eliminate existing marsh vegetation. Breaching introduces twice-daily high and low tides.

Future Conditions:

In the near-term, emergent wetland plants re-colonize the intertidal portions of the site. Over the long-term (perhaps decades), vegetation could extend into subtidal areas, though their footprint would be constrained by concurrent sea level rise. Riparian vegetation establishes on the toe berm.



Produced by WWR, June 2014

Graphic file:Fig 6-11_All Conditions_2014-0623ct.ai

Figure 6-11

Prospect Island Habitats: Existing, As-Built, and Future Conditions - Typical Profile

PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT

6.3 Post Construction Site Maintenance, Monitoring, and Adaptive Management Activities

Post construction activities on the site would be focused on monitoring three general areas: (1) evaluating how the site is meeting the restoration performance criteria to achieve the overall Project goals and objectives, (2) evaluating the need for any corrective measures to address potential problems, and (3) gathering scientific information for testing tidal restoration hypotheses to contribute to regional adaptive management science. The activities presented here are not intended to be exhaustive, but to provide a broad indication of site-level monitoring that will be detailed later in a separate Monitoring Plan.

The general suite of monitoring activities that may, to be developed in a Monitoring Plan, include the following broad categories:

- **Geomorphology**
- **Hydrology**
- **Vegetation communities**
- **Water quality**
- **Aquatic food web and fishes**

In addition, post-construction monitoring of the Project site would be necessary to identify potential problems and formulate corrective measures for addressing them. Potential problems that could occur at the Project site include:

- Colonization and establishment of invasive aquatic weeds
- Colonization and establishment of invasive wetland and upland plants
- Colonization by invasive fish
- Levee instability/erosion
- Harmful algal blooms

Lastly, in the context of regional ecosystem restoration adaptive management, studies may take place at Prospect Island, utilizing the design itself as the study subject.

6.4 Restoration Alternative 1

The "No Project" alternative, does not include any of the Proposed Project constructed features. Main differences include:

1. No breaches or weirs would be constructed on the Project site
2. No dredging of the Miner Slough spur channel would occur
3. Invasive plants, woody debris, and old infrastructure would not be removed
4. RD 1667 would continue levee maintenance activities as their duties required
5. Future levee repairs may be required to address scour hole formation or breaches

6.5 Restoration Alternative 2

Figure 6-12 illustrates the restoration features of Alternative 2. Differences of Alternative 2 from the Proposed Project are:

1. No dredging of the Miner Slough spur channel
2. No levee breach in the northeast corner
3. Construct a high-stage overflow weir in the northeast corner near Arrowhead Harbor
4. Construct a central Miner Slough breach, located between the Stringer property and interior cross-levee
5. The size and dimensions for the eastern intertidal bench would vary somewhat from that to be constructed with the Proposed Project, as the volume of excavated soils generated would be lesser under Alternative 2. The bench may, as a result have a smaller footprint and/or steeper side slopes.

The weir and central breach, which are not features of the Proposed Project, are described below.

6.5.1 Construct Overflow Weir

The purpose of this restoration feature is to allow hydrologic connectivity of the Project site to Miner Slough during winter and spring high-flow events to allow fish direct access into the site when juvenile salmonids are passing through the Delta and utilizing Sutter and Steamboat sloughs as migratory corridors.

The overflow weir would be constructed by lowering a section of the existing Miner Slough levee from its current elevation of approximately 16 ft NAVD88 to 7 ft NAVD88, and armoring the levee top and interior and exterior sides to prevent

erosion. This overflow weir would take the form of a wide, armored notch in the levee (see Figure 6-13). The 7ft NAVD88 invert elevation would allow Miner Slough flows with a 1-year recurrence interval or greater to overtop the weir, while minimizing tidal connectivity. Preliminary design of the overflow weir has set the invert elevation at 7 ft (NAVD88), the invert width at 1,000 ft, and weir slopes to the levee crest of 2.5%. Road width atop the weir would be wider than the existing levee road, and would match levee width at the constructed weir elevation (i.e., the road gets wider, lower in the levee prism).

The overflow weir would be constructed by excavating the proposed section of the levee using an excavator and grading to appropriate elevations and dimensions with a bulldozer. The weir would be armored to provide scour protection. Armoring material would consist of open-cell concrete block or rock material. The material used for weir armoring would be transported to the Project site by truck or barge. It is anticipated that between 12 and 90 weir overtopping events would occur in representative dry and wet water year types, respectively, with durations as short as one hour at high tide to as long as two weeks. The weir would be constructed to allow vehicle access across it when not inundated, thereby lessening access impacts.

6.5.2 Breach Miner Slough levee

This restoration activity would involve excavating one levee breach to Miner Slough, in the central portion of Prospect Island just north of the existing internal cross levee and south of the Stringer property (Figure 6-12). Construction of this breach would result in loss of legal access to the Stringer property (Figure 4-7).

Levee breaching and handling of materials would be accomplished using the same methods as the Proposed Project. The total excavation volume for the breach us shown in Table 6-3.

6.5.3 Anticipated Future Habitat Conditions, Alternative 2

This section describes the anticipated future habitat conditions following construction of Alternative 2.

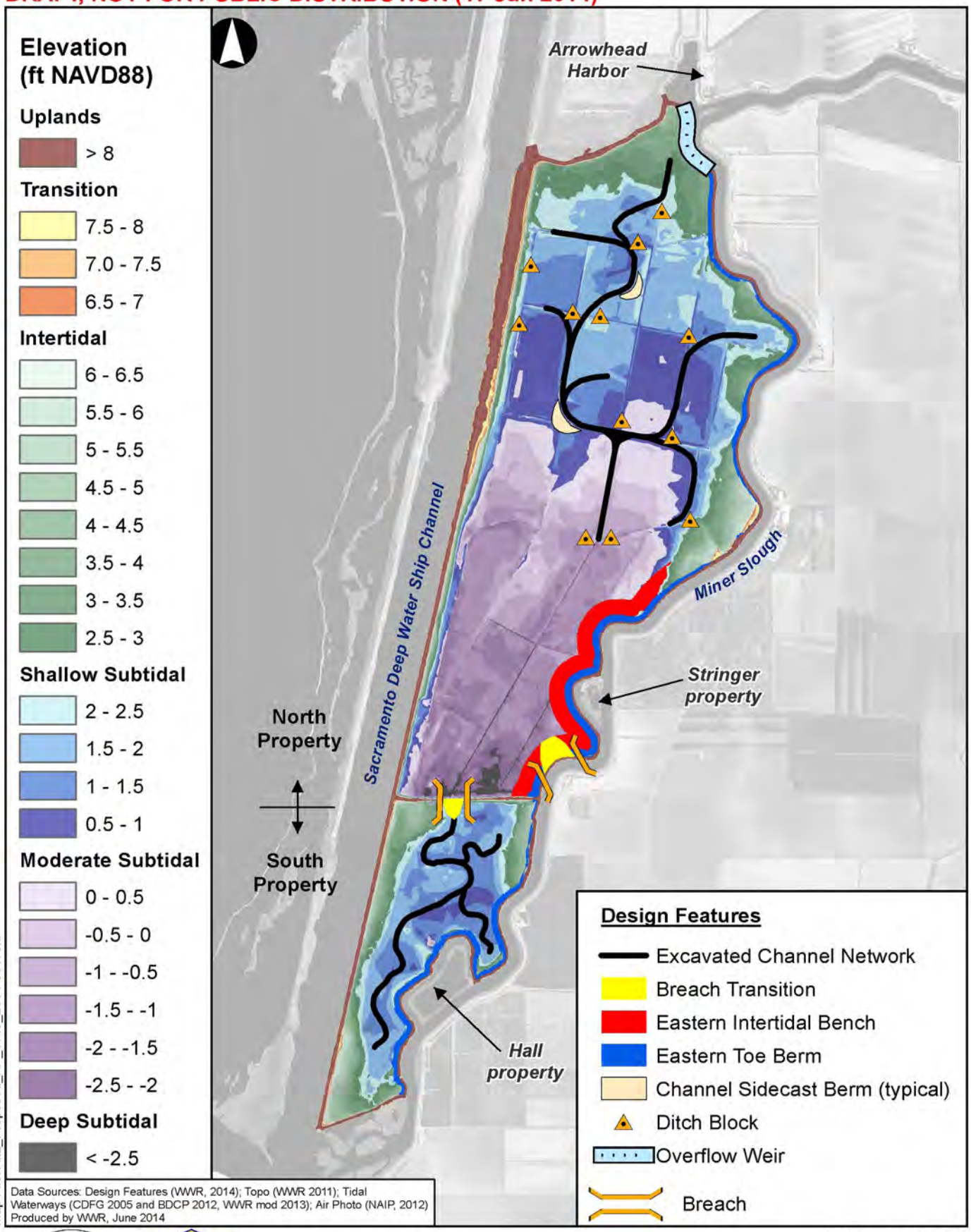
1. As-built conditions: Following Alternative 2 construction and breaching of the Miner Slough levee, it is anticipated that the interior of Prospect Island would be primarily open water habitat (Figure 6-14 and Table 6-8). Habitat conditions are expected to be the same as described in the anticipated as-built conditions for the Proposed Project.

2. Future conditions: Table 6-8 and Figure 6-14 depict the extent of future habitats on Prospect Island anticipated to develop under Alternative 2. Figure 6-11 depicts a cross-sectional view of anticipated future habitat conditions on Prospect Island following breaching of the Miner Slough levee. Habitat conditions are expected to be the same as described in the anticipated future conditions for the Proposed Project, with the following exceptions:
    - As with the Proposed Project, vegetation colonization into the intertidal zone over time will slightly reduce tidal waters from the as-built condition, reducing open water habitats to areas with subtidal elevations.
    - The continued maintenance of the DWSC and Miner Slough levee to provide access to the Stringer Property will preserve grassland habitat along the levee tops. However, the grassland habitat along the internal cross levee and the Miner Slough levee crown south of the Stringer Property will revert to valley foothill riparian habitat.
    - The construction of the overflow weir in the north property will convert 3 acres of grassland and valley foothill riparian into developed lands.

Table 6-8. Prospect Island Habitats: Existing, Projected As-Built, and Future, Alternative 2[1]

Type of jurisdictional feature	Existing (acres)		As-Built[2] (acres)		Future[3] (acres)		Change in Area (acres)	
	North	South	North	South	North	South	North	South
Open Water								
Non-tidal waters of the U.S.	131	209	0	0	0	0	-131	-209
Tidal waters of the U.S.	0	0	1,204	245	1,034	184	+1,034	+184
Wetland								
Non-tidal freshwater perennial emergent wetland	1,064	35	0	0	0	0	-1,064	-35
Tidal emergent wetland	0	0	0	0	182	71	+182	+71
Riparian scrub/shrub wetland	35	18	27	16	27	16	-8	-2
Non-Jurisdictional Lands[4]								
Cultivated lands	18	0	18	0	18	0	-	-
Developed	3	2	6	2	6	2	+3	-
Grassland	55	12	66	18	51	10	-4	-2
Non-tidal freshwater perennial emergent wetland	4	1	0	0	0	0	-4	-1
Valley foothill riparian	56	30	46	27	49	25	-7	-5

[1]Within Diked Lands Project Area
[2]As-built acres are immediately after breaching of Miner Slough levee
[3]Natural colonization potential assumed to be within intertidal elevations only (2.7-6.2 ft NAVD88)
[4]Non-Jurisdicational acreages based on Natural Communities Data (ESA, SWS 2014)



Data Sources: Design Features (WWR, 2014); Topo (WWR 2011); Tidal Waterways (CDFG 2005 and BDCP 2012, WWR mod 2013); Air Photo (NAIP, 2012)
Produced by WWR, June 2014

Map File: Alt2_Proposed_AP_1149_2014-0617srb

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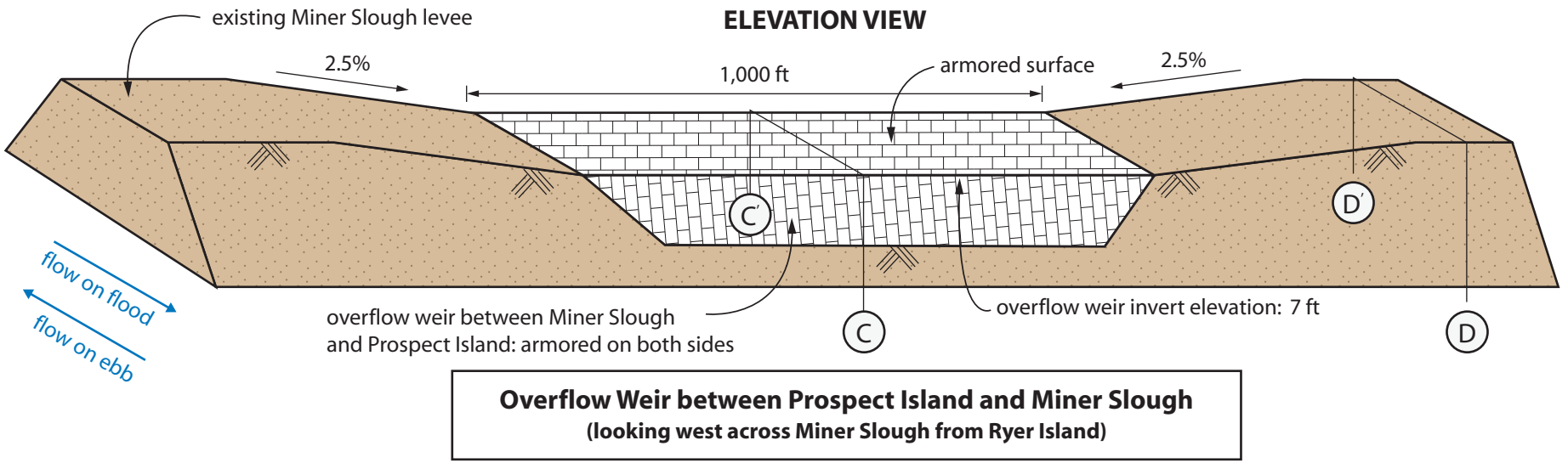
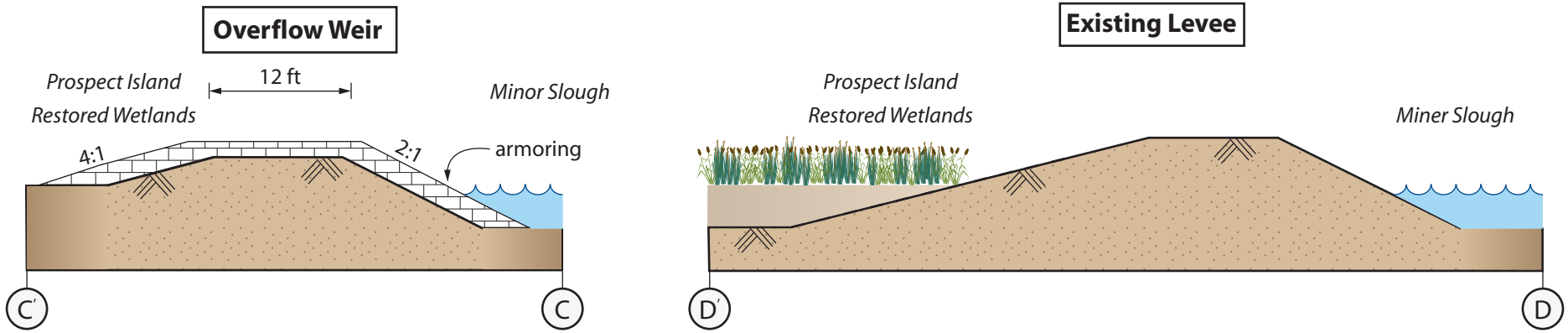
Figure 6-12

Restoration Alternative 2

PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT



Overflow Weir between Prospect Island and Miner Slough
(looking west across Miner Slough from Ryer Island)



Produced by WWR, June 2014

Graphic file: Overflow Weir Typical Detail_1149_2014-0616ct-srb.ai

Figure 6-13

Alternative 3 High Stage Miner Slough Overflow Weir Conceptual Engineering Detail

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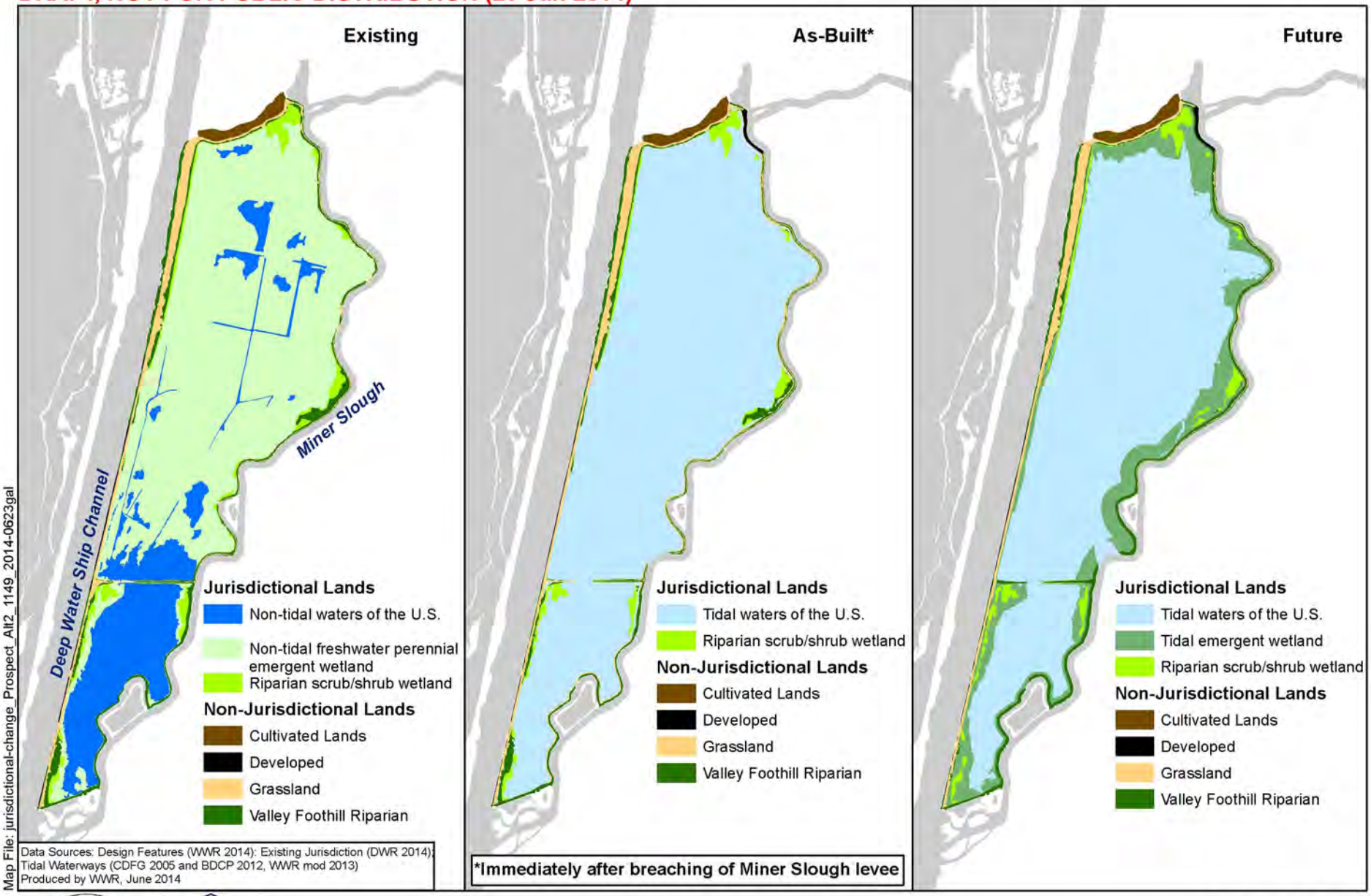

Map File: jurisdictional-change_Prospect_Alt2_1149_2014-0623gal

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Figure 6-14
Prospect Island Habitats: Existing, As-Built, and Future - Alternative 2

PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT

6.6 Restoration Alternative 3

Figure 6-15 illustrates the restoration features of Alternative 3. Differences of Alternative 3 from the Proposed Project are:

1. The south property would not be included in the Project.
2. The south property levee would not be repaired.
3. The south property would not be dewatered.
4. The eastern toe berm would not be constructed on the south property.
5. The size and dimensions for the eastern intertidal would vary from that to be constructed with the Proposed Project, as the volume of excavated soils generated would be significantly lesser under Alternative 3. The bench may, as a result have a smaller footprint and/or steeper side slopes.
6. The internal cross levee would not be breached
7. The Miner Slough spur channel would not be dredged
8. Two breaches on Miner Slough would be constructed: one approximately 0.5 miles south of Arrowhead Harbor and one just north of the Stringer property.

The locations and excavated volumes of the Miner Slough levee breaches are described below.

6.6.1 Breach Miner Slough levee

This restoration activity would involve excavating two levee breaches to Miner Slough. One breach would be located approximately 0.5 miles south of Arrowhead Harbor (the same location as with the Proposed Project). The second breach would be located just north of the Stringer property, in the central portion of Prospect Island (Figure 6-15). Construction of these breaches would maintain legal access to the Stringer property (Figure 4-7).

Levee breaching and handling of materials would be accomplished using the same methods as with the Proposed Project. The total excavation volume for the breach is shown in Table 6-3.

6.6.2 **Anticipated Future Habitat Conditions, Alternative 3**

This section describes the anticipated future habitat conditions following construction of Alternative 3.

1. As-built conditions: Following Alternative 3 construction and breaching of the Miner Slough levee, it is anticipated that the interior of Prospect Island would be primarily open water habitat (Figure 6-16 and Table 6-9). Habitat conditions are expected to be the same as described in the anticipated as-built conditions for the Proposed Project.
2. Future conditions: Table 6-9 and Figure 6-16 depict the extent of future habitats on Prospect Island anticipated to develop under Alternative 3. Figure 6-11 depicts a cross-sectional view of anticipated future habitat conditions on Prospect Island following breaching of the Miner Slough levee. Habitat conditions are expected to be the same as described in the anticipated future conditions for the Proposed Project, with the following exceptions:
    - As with the Proposed Project, vegetation colonization into the intertidal zone over time will slightly reduce tidal waters from the as-built condition, reducing open water habitats to areas with subtidal elevations.
    - Grassland habitat along the DWSC levee, internal cross levee and Miner Slough levee crown will be maintained to allow access to the Stringer Property from the South. The remaining grassland habitat along the Miner Slough levee will no longer be maintained and will convert into valley foothill riparian habitat.

Table 6-9. Prospect Island Habitats: Existing, Projected As-Built, and Future, Alternative 3[1]

Type of jurisdictional feature	Existing (acres)		As-Built[2] (acres)		Future[3] (acres)		Change in Area (acres)	
	North	South	North	South	North	South	North	South
Open Water								
Non-tidal waters of the U.S.	131	-	0	-	0	-	-131	-
Tidal waters of the U.S.	0		1,205		1,034		+1,034	
Wetland								
Non-tidal freshwater perennial emergent wetland	1,064	-	0	-	0	-	-1,064	-
Tidal emergent wetland	0		0		182		+182	
Riparian scrub/shrub wetland	35		27		27		-8	
Non-Jurisdictional Lands[4]								
Cultivated lands	18	-	18	-	18	-	-	-
Developed	3		3		3		-	
Grassland	55		67		46		-9	
Non-tidal freshwater perennial emergent wetland	4		0		0		-4	
Valley foothill riparian	56		48		57		+ <1	

[1]Within Diked Lands Project Area
[2]As-built acres are immediately after breaching of Miner Slough levee
[3]Natural recolonization potential assumed to be within intertidal elevations only (2.7-6.2 ft NAVD88)
[4]Non-Jurisdicational acreages based on Natural Communities Data (ESA, SWS 2014)

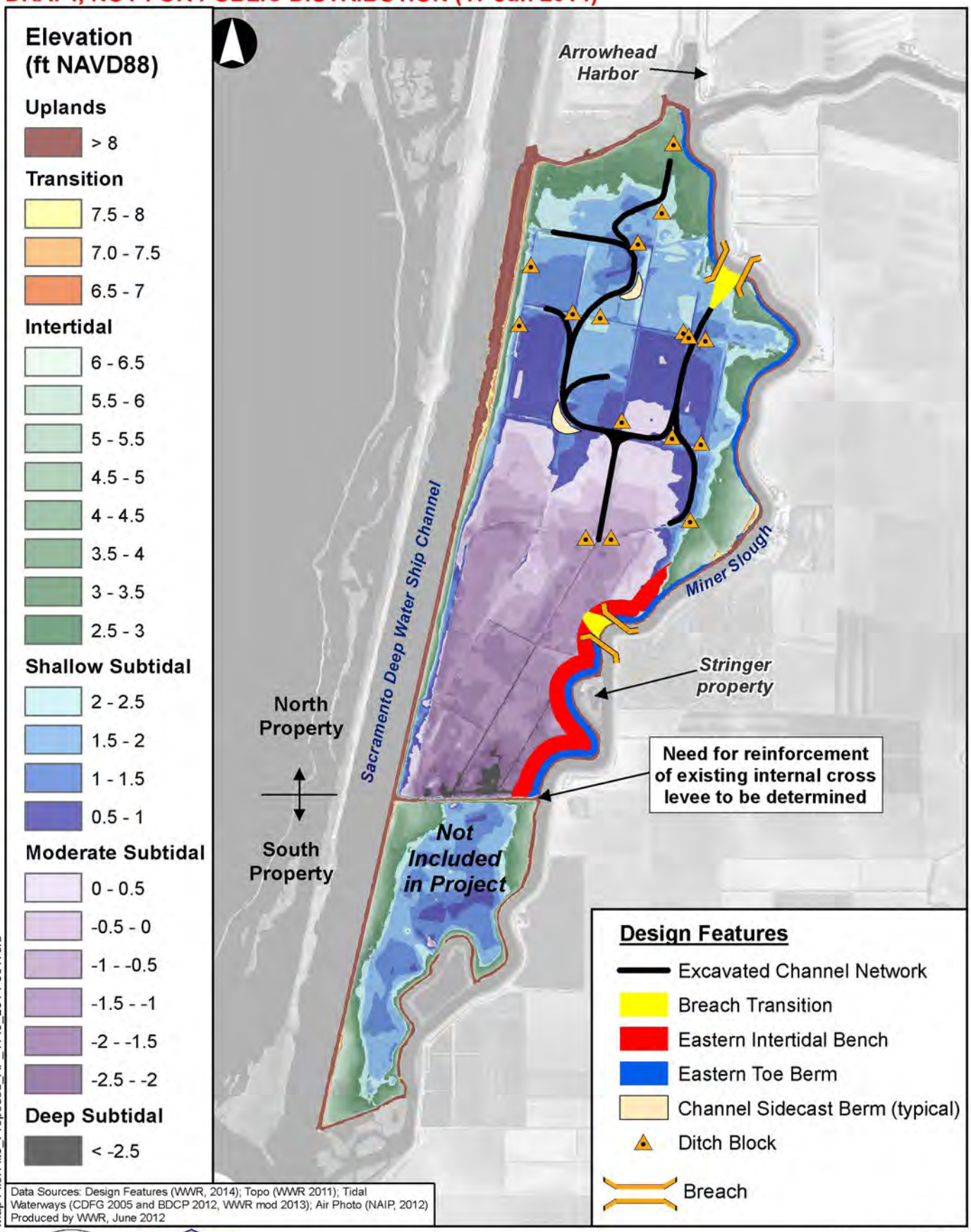

Figure 6-15
Restoration Alternative 3

PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT

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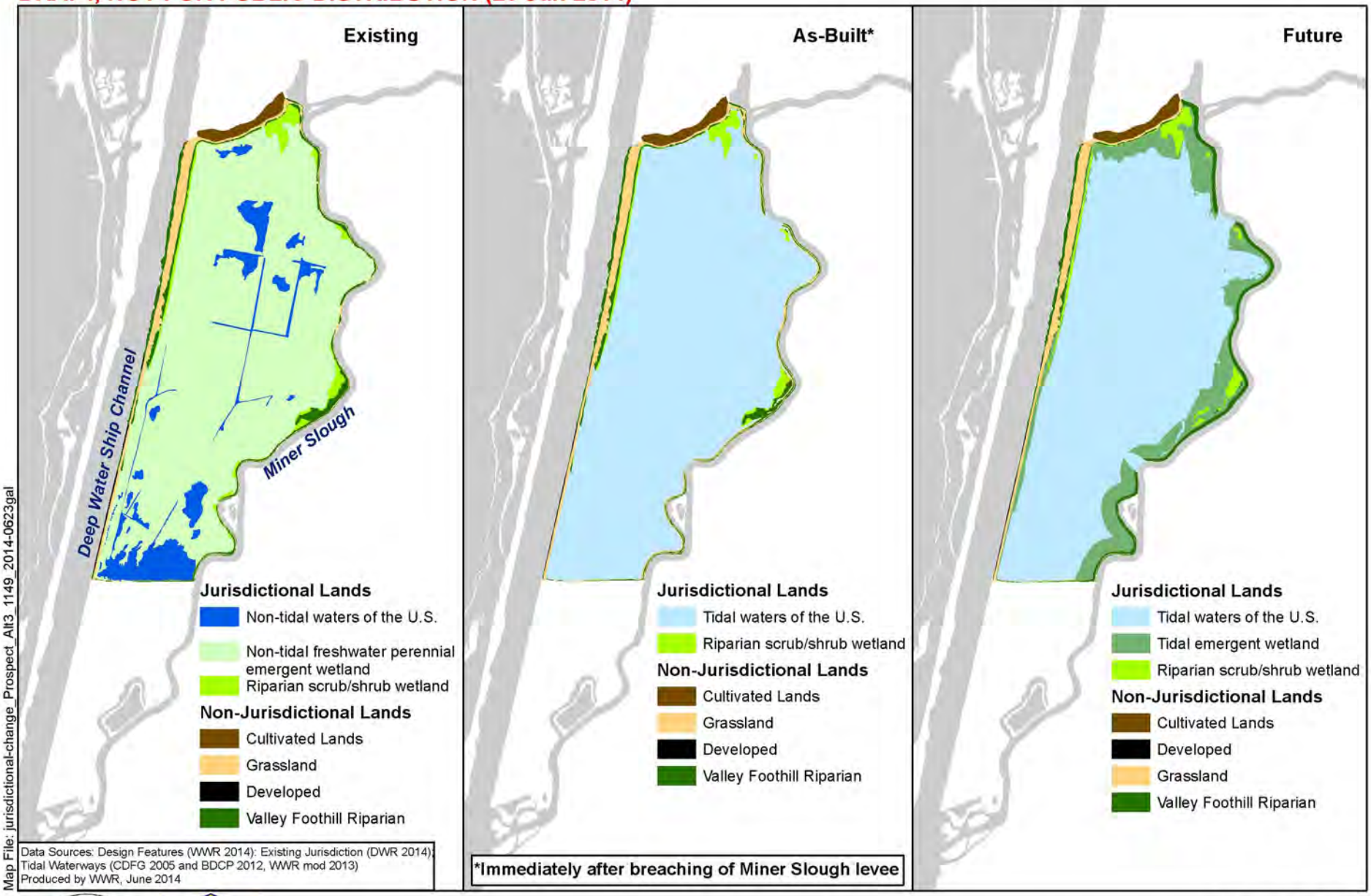

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Figure 6-16
Prospect Island Habitats: Existing, As-Built, and Future - Alternative 3

PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT

7 CONTRIBUTING AUTHORS

Primary author organizations of each chapter are listed. This section will be updated for the Final Restoration Plan.

Chapter 1: Introduction
Wetlands and Water Resources

Chapter 2: Project Purpose, Goal, and Objectives
Wetlands and Water Resources
Stillwater Sciences

Chapter 3: Regional Setting
Wetlands and Water Resources

Chapter 4: Existing Site Conditions
4.1 Site History
Wetlands and Water Resources
4.2 Current Land Use and Ownership
Wetlands and Water Resources
4.3 Physical Resources
Wetlands and Water Resources (levees, topography, hydrology, utilities/mineral rights/infrastructure/easements)
Stillwater Sciences (geology, soils)
4.4 Biological Resources
Stillwater Sciences
4.5 Cultural Resources
Grassetti Environmental (from Parus Consulting report)
4.6 Hazards and Hazardous Materials
Stillwater Sciences

Chapter 5: Opportunities and Constraints
Wetlands and Water Resources
Stillwater Sciences

Chapter 6: Restoration Alternatives
Wetlands and Water Resources
Stillwater Sciences

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Appendices

Appendix A

Special-status Plant Species Documented in CNDDB and CNPS in the Project Vicinity and Potential to Occur in the Project Site

Table A-1. Special-Status Plant Species Documented in CNDDB and CNPS in the Project Vicinity and Potential to Occur in the Project site.

Common name Scientific name	Query sources	Status[1]: Federal/ State/ CRPR	Blooming period	Elevation range (ft)	Suitable habitat type	Likelihood of occurrence in the Project site under current conditions[2]	Restoration enhances conditions for species?	Likelihood of occurrence in the Project site under post-restoration conditions[3]
Ferris' milk-vetch *Astragalus tener* var. *ferrisiae*	CNPS, CNDDB	– /– /1B.1	April– May	7–246	Vernally mesic soils in meadows and seeps and subalkaline flats in valley and foothill grassland.	**None;** suitable habitat not present	No	**None;** suitable habitat will not be created
alkali milk-vetch *Astragalus tener* var. *tener*	CNPS, CNDDB	– /– /1B.2	March–June	3–197	Playas, adobe clay in valley and foothill grassland, and alkaline vernal pools.	**None;** suitable habitat not present	No	**None;** suitable habitat will not be created
heartscale *Atriplex cordulata* var. *cordulata*	CNPS, CNDDB	– /– /1B.2	April–October	0–1,837	Saline or alkaline soils in chenopod scrub, meadows and seeps, and sandy soils in valley and foothill grassland.	**Low;** valley and foothill grassland habitat may be present but is highly disturbed	No	**Low;** valley and foothill grassland habitat will continue to be present but it will continue to be highly disturbed

Common name Scientific name	Query sources	Status[1]: Federal/ State/ CRPR	Blooming period	Elevation range (ft)	Suitable habitat type	Likelihood of occurrence in the Project site under current conditions[2]	Restoration enhances conditions for species?	Likelihood of occurrence in the Project site under post-restoration conditions[3]
crownscale *Atriplex coronata* var. *coronata*	CNPS	– /– /4.2	March–October	3–1,936	Alkaline, often clay soils in chenopod scrub, valley and foothill grassland, and vernal pools.	**None;** suitable habitat not present	No	**None;** suitable habitat will not be created
brittlescale *Atriplex depressa*	CNPS, CNDDB	– /– /1B.2	April–October	3–1,050	Alkaline or clay soils in chenopod scrub, meadows and seeps, playas, valley and foothill grassland.	**None;** suitable habitat not present	No	**None;** suitable habitat will not be created
San Joaquin spearscale *Atriplex joaquinana*	CNPS, CNDDB	– /– /1B.2	April–October	3–2,740	Alkaline soils in chenopod scrub, meadows and seeps, playas, valley and foothill grassland.	**None;** suitable habitat not present	No	**None;** suitable habitat will not be created
vernal pool smallscale *Atriplex persistens*	CNPS, CNDDB	– /– /1B.2	June–October	33–377	Alkaline soils in vernal pools.	**None;** suitable habitat not present	No	**None;** suitable habitat will not be created

Common name Scientific name	Query sources	Status[1]: Federal/ State/ CRPR	Blooming period	Elevation range (ft)	Suitable habitat type	Likelihood of occurrence in the Project site under current conditions[2]	Restoration enhances conditions for species?	Likelihood of occurrence in the Project site under post-restoration conditions[3]
big tarplant *Blepharizonia plumosa*	CNPS, CNDDB	– /– /1B.1	July–October	98–1,657	Valley and foothill grassland, usually in clay soils.	**None;** outside of the elevation range	No	**None;** outside of the elevation range
watershield *Brasenia schreberi*	CNPS, CNDDB	– /– /2B.3	June–September	98–7,218	Freshwater marshes and swamps.	**None;** outside of the elevation range	No	**None;** outside of the elevation range
round-leaved filaree *California macrophylla*	CNPS, CNDDB	– /– /1B.1	March–May	49–3,937	Clay soils in cismontane woodland and valley and foothill grassland.	**None;** suitable habitat not present	No	**None;** suitable habitat will not be created
bristly sedge *Carex comosa*	CNPS, CNDDB	– /– /2B.1	May–September	0–2,051	Coastal prairie, lake margins, marshes and swamps, and valley and foothill grassland.	**Moderate;** marshes present; valley and foothill grassland habitat may be present but is highly disturbed	Yes, marshes enhanced	**High;** additional habitat will be present and there are multiple occurrences (8) in the Project region (the closest occurrence is seven miles to the east)

Common name Scientific name	Query sources	Status[1]: Federal/ State/ CRPR	Blooming period	Elevation range (ft)	Suitable habitat type	Likelihood of occurrence in the Project site under current conditions[2]	Restoration enhances conditions for species?	Likelihood of occurrence in the Project site under post-restoration conditions[3]
pappose tarplant *Centromadia parryi* subsp. *parryi*	CNPS, CNDDB	– /– /1B.2	May–November	0–1,378	Often alkaline soils in chaparral, coastal prairie, meadows and seeps, coastal salt marshes and swamps, and vernally mesic valley and foothill grassland.	**None;** suitable habitat not present	No, the tidal influence will not be enough to create coastal salt marsh habitat	**None;** suitable habitat will not be created
Parry's rough tarplant *Centromadia parryi* subsp. *rudis*	CNPS	– /– /4.2	May–October	0–328	Alkaline, vernally mesic soils in, seeps, sometimes roadsides, valley and foothill grassland and vernal pools.	**None;** suitable habitat not present	No	**None;** suitable habitat will not be created
soft bird's-beak *Chloropyron molle* subsp. *molle* [*Cordylanthus mollis* subsp. *mollis*]	CNPS, CNDDB, USFWS	FE/CR/1B.2	July–November	0–10	Coastal salt marshes and swamps.	**None;** suitable habitat not present	No, the tidal salinities will be too low to create tidal salt marsh habitat	**None;** suitable habitat will not be created

Common name Scientific name	Query sources	Status[1]: Federal/ State/ CRPR	Blooming period	Elevation range (ft)	Suitable habitat type	Likelihood of occurrence in the Project site under current conditions[2]	Restoration enhances conditions for species?	Likelihood of occurrence in the Project site under post-restoration conditions[3]
Bolander's water-hemlock *Cicuta maculata* var. *bolanderi*	CNPS, CNDDB	– /– /2B.1	July– September	0–656	Coastal, fresh or brackish water marshes and swamps.	**Moderate;** freshwater marshes present	Yes, marshes enhanced	**High;** additional habitat will be present and there are multiple occurrences (5) in the Project region (closest occurrence is six miles to the west)
Hoover's cryptantha *Cryptantha hooveri*	CNPS, CNDDB	– /– /1A	April– May	30–492	Inland dunes, valley and foothill grassland in sandy soils.	**Low;** slightly outside of the elevation range	No	**Low;** slightly outside of the elevation range
dwarf downingia *Downingia pusilla*	CNPS, CNDDB	– /– /2B.2	March– May	3–1,460	Mesic soils in valley and foothill grassland and vernal pools.	**None;** suitable habitat not present	No	**None;** suitable habitat will not be created
Antioch Dunes buckwheat *Eriogonum nudum* var. *psychicola*	CNPS, CNDDB	– /– /1B.1	July– October	0–66	Inland dunes.	**None;** suitable habitat not present	No	**None;** suitable habitat will not be created

Common name Scientific name	Query sources	Status[1]: Federal/ State/ CRPR	Blooming period	Elevation range (ft)	Suitable habitat type	Likelihood of occurrence in the Project site under current conditions[2]	Restoration enhances conditions for species?	Likelihood of occurrence in the Project site under post-restoration conditions[3]
Mt. Diablo buckwheat *Eriogonum truncatum*	CNPS, CNDDB	– /– /1B.1	April–September (November),(December),	10–1,148	Sandy soils in chaparral, coastal scrub, and valley and foothill grassland.	**Low;** valley and foothill grassland habitat may be present is but highly disturbed	No	**Low;** valley and foothill grassland habitat will continue to be present but will continue to be highly disturbed
Contra Costa wallflower *Erysimum capitatum* var. *angustatum*	CNPS, CNDDB, USFWS	FE/CE/1B.1	March–July	10–66	Inland dunes.	**None;** suitable habitat not present and critical habitat outside of the Project site	No	**None;** suitable habitat will not be created
diamond-petaled California poppy *Eschscholzia rhombipetala*	CNPS, CNDDB	– /– /1B.1	March–April	0–3,199	Alkaline, clay soils in valley and foothill grassland.	**None;** suitable habitat not present	No	**None;** suitable habitat will not be created
fragrant fritillary *Fritillaria liliacea*	CNPS, CNDDB	– /– /1B.2	February–April	10–1,345	Often serpentinite soils in cismontane woodland, coastal prairie, coastal scrub, and valley and foothill grassland.	**Low;** valley and foothill grassland habitat may be present on non-serpentine soils but is highly disturbed	No	**Low;** valley and foothill grassland habitat will continue to be present but it will continue to be highly disturbed

Common name Scientific name	Query sources	Status[1]: Federal/ State/ CRPR	Blooming period	Elevation range (ft)	Suitable habitat type	Likelihood of occurrence in the Project site under current conditions[2]	Restoration enhances conditions for species?	Likelihood of occurrence in the Project site under post-restoration conditions[3]
adobe-lily *Fritillaria pluriflora*	CNDDB	– /– /1B.2	February–April	60–705	Often adobe soils in chaparral, cismontane woodland, and valley and foothill grassland.	**None;** outside of the elevation range	No	**None;** outside of elevation range
Boggs Lake hedge-hyssop *Gratiola heterosepala*	CNPS, CNDDB	– /CE/1B.2	April–August	33–7,792	Clay soils in marshes and swamps, lake margins and vernal pools.	**None;** suitable habitat not present	No	**None;** suitable habitat will not be created
woolly rose-mallow *Hibiscus lasiocarpos* var. *occidentalis*	CNPS, CNDDB	– /– /1B.2	June–September	0–394	Freshwater marshes and swamps.	**Moderate;** habitat present	Yes, marshes enhanced	**High;** additional habitat will be present and there are a high number of occurrences (48) including an occurrence 3 miles to the north in Cache Slough
Carquinez goldenbush *Isocoma arguta*	CNPS, CNDDB	– /– /1B.1	August–December	3–66	Alkaline soils in valley and foothill grassland.	**None;** suitable habitat not present	No	**None;** suitable habitat will not be created

Common name Scientific name	Query sources	Status[1]: Federal/ State/ CRPR	Blooming period	Elevation range (ft)	Suitable habitat type	Likelihood of occurrence in the Project site under current conditions[2]	Restoration enhances conditions for species?	Likelihood of occurrence in the Project site under post-restoration conditions[3]
Northern California black walnut *Juglans hindsii*	CNPS, CNDDB	– /– /1B.1	April– May	0–1,444	Riparian forest and riparian woodland.	**None;** habitat present however the CNDDB documented occurrence in the Project region was extirpated and any other black walnuts in the area are likely of hybrid origin and thus not protected	Yes, riparian forest and woodland habitat enhanced	**None;** habitat present however recruits are unlikely given hybridization issues
Contra Costa goldfields *Lasthenia conjugens*	CNPS, CNDDB, USFWS	FE/– /1B.1	March– June	0–1,542	Mesic soils in cismontane woodland, alkaline playas, valley and foothill grassland, and vernal pools.	**None;** suitable habitat not present	No	**None;** suitable habitat will not be created

Common name Scientific name	Query sources	Status[1]: Federal/ State/ CRPR	Blooming period	Elevation range (ft)	Suitable habitat type	Likelihood of occurrence in the Project site under current conditions[2]	Restoration enhances conditions for species?	Likelihood of occurrence in the Project site under post-restoration conditions[3]
Delta tule pea *Lathyrus jepsonii* var. *jepsonii*	CNPS, CNDDB	– /– /1B.2	May–July(September),	0–13	Freshwater and brackish marshes and swamps.	**High;** one occurrence is documented in the Project site; 40 additional occurrences are documented in the Project region (CNDDB)	Yes, marshes enhanced and tidal influence introduced	**High;** species already documented in the Project site and freshwater marsh habitat will be enhanced
legenere *Legenere limosa*	CNPS, CNDDB	– /– /1B.1	April– June	3–2,887	Vernal pools.	**None;** suitable habitat not present	No	**None;** suitable habitat will not be created
Heckard's pepper-grass *Lepidium latipes* var. *heckardii*	CNPS, CNDDB	– /– /1B.2	March–May	7–656	Alkaline flats in valley and foothill grasslands.	**None;** suitable habitat not present	No	**None;** suitable habitat will not be created

Common name Scientific name	Query sources	Status[1]: Federal/ State/ CRPR	Blooming period	Elevation range (ft)	Suitable habitat type	Likelihood of occurrence in the Project site under current conditions[2]	Restoration enhances conditions for species?	Likelihood of occurrence in the Project site under post-restoration conditions[3]
Mason's lilaeopsis *Lilaeopsis masonii*	CNPS, CNDDB	– /CR/1B.1	April–November	0–33	Brackish or freshwater marshes and swamps and riparian scrub.	**High;** two occurrences are documented in the Project site; 102 additional occurrences are documented in the Project region (CNDDB)	Yes, marshes enhanced and tidal influence introduced	**High;** species already documented in the Project site and freshwater marsh habitat will be enhanced
Delta mudwort *Limosella australis*	CNPS, CNDDB	– /– /2B.1	May–August	0–10	Usually mud banks of freshwater or brackish marshes and swamps, and riparian scrub.	**High;** one occurrence is documented in the Project site; 37 additional occurrences are documented in the Project region (CNDDB)	Yes, marshes enhanced and tidal influence introduced	**High;** species already documented in the Project site and freshwater marsh habitat will be enhanced
showy golden madia *Madia radiata*	CNPS	– /– /1B.1	March–May	82–3,986	Cismontane woodland and valley and foothill grassland.	**None;** outside of the elevation range	No	**None;** outside of the elevation range

Common name Scientific name	Query sources	Status[1]: Federal/ State/ CRPR	Blooming period	Elevation range (ft)	Suitable habitat type	Likelihood of occurrence in the Project site under current conditions[2]	Restoration enhances conditions for species?	Likelihood of occurrence in the Project site under post-restoration conditions[3]
little mousetail *Myosurus minimus* subsp. *apus*	CNPS	– /– /3.1	March–June	66–2,100	Alkaline soils in valley and foothill grassland and vernal pools.	**None;** outside of the elevation range	No	**None;** outside of the elevation range
Baker's navarretia *Navarretia leucocephala* subsp. *bakeri*	CNPS, CNDDB	– /– /1B.1	April– July	16–5,709	Mesic soils in cismontane woodland, lower montane coniferous forest, meadows and seeps, valley and foothill grassland, vernal pools.	**None;** suitable habitat not present	No	**None;** suitable habitat will not be created
Colusa grass *Neostapfia colusana*	CNPS, CNDDB, USFWS	FT/CE/1B.1	May–August	16–656	Adobe soils in large vernal pools.	**None;** suitable habitat not present and critical habitat outside of the Project site	No	**None;** suitable habitat will not be created
Antioch Dunes evening-primrose *Oenothera deltoides* subsp. *howellii*	CNPS, CNDDB, USFWS and critical habitat	FE/CE/1B.1	March–September	0–98	Inland dunes.	**None;** suitable habitat not present and critical habitat outside of the Project site	No	**None;** suitable habitat will not be created

Common name Scientific name	Query sources	Status[1]: Federal/ State/ CRPR	Blooming period	Elevation range (ft)	Suitable habitat type	Likelihood of occurrence in the Project site under current conditions[2]	Restoration enhances conditions for species?	Likelihood of occurrence in the Project site under post-restoration conditions[3]
bearded popcorn-flower *Plagiobothrys hystriculus*	CNPS, CNDDB	– /– /1B.1	April– May	0–899	Mesic soils in valley and foothill grassland, vernal pool margins and often vernal swales.	**None;** suitable habitat not present	No	**None;** suitable habitat will not be created
eel-grass pondweed *Potamogeton zosteriformis*	CNPS, CNDDB	– /– /2B.2	June– July	0–6,102	Assorted freshwater marshes and swamps.	**Moderate;** habitat present	Yes, marshes enhanced	**Moderate;** although additional habitat will be present, there is only one occurrence ten miles to the south of the Project
Sanford's arrowhead *Sagittaria sanfordii*	CNPS, CNDDB	– /– /1B.2	May– October	0–2,133	Assorted shallow freshwater marshes and swamps.	**High;** four occurrences are documented in the Project site (CNDDB; DWR, unpubl. data); 7 additional occurrences are documented in the Project region (CNDDB)	Yes, marshes enhanced	**High;** species already documented in the Project site and freshwater marsh habitat will be enhanced

Common name Scientific name	Query sources	Status[1]: Federal/ State/ CRPR	Blooming period	Elevation range (ft)	Suitable habitat type	Likelihood of occurrence in the Project site under current conditions[2]	Restoration enhances conditions for species?	Likelihood of occurrence in the Project site under post-restoration conditions[3]
marsh skullcap *Scutellaria galericulata*	CNPS, CNDDB	– /– /2B.2	June–September	0–6,890	Lower montane coniferous forest, mesic meadows and seeps, and marshes and swamps.	**Moderate;** marshes present	Yes, marshes enhanced	**High;** additional habitat will be present and there are multiple occurrences (3) including an occurrence 7 miles to the east/northeast (J. Witzman, pers. comm., January 2014)
side-flowering skullcap *Scutellaria lateriflora*	CNPS, CNDDB	– /– /2B.2	July–September	0–1,640	Mesic meadows and seeps, and marshes and swamps.	**Moderate;** marshes present	Yes, marshes enhanced	**High;** additional habitat will be present and there are multiple (3) occurrences seven miles to the east/ southeast
Keck's checkerbloom *Sidalcea keckii*	CNPS, CNDDB, USFWS	FE/– /1B.1	April–May(June),	246–2,133	Serpentinite and clay soils in cismontane woodland, and valley and foothill grassland.	**None;** outside the elevation range	No	**None;** outside the elevation range

Common name Scientific name	Query sources	Status[1]: Federal/ State/ CRPR	Blooming period	Elevation range (ft)	Suitable habitat type	Likelihood of occurrence in the Project site under current conditions[2]	Restoration enhances conditions for species?	Likelihood of occurrence in the Project site under post-restoration conditions[3]
Suisun Marsh aster *Symphyotrichum lentum*	CNPS, CNDDB	– /– /1B.2	May– November	0–10	Brackish and freshwater marshes and swamps.	**High;** four occurrences are documented in the Project site (CNDDB); 94 additional occurrences are documented in the Project region	Yes, marshes enhanced and tidal influence introduced	**High;** species already documented in the Project site and freshwater marsh habitat will be enhanced
saline clover *Trifolium hydrophilum*	CNPS, CNDDB	– /– /1B.2	April– June	0–984	Marshes and swamps (specifically saltmarsh according to Baldwin et al. [4]), mesic, alkaline soils in valley and foothill grassland, and vernal pools.	**None;** suitable habitat not present	No	**None;** suitable habitat will not be created
Crampton's tuctoria or Solano grass *Tuctoria mucronata*	CNPS, CNDDB, USFWS	FE/CE/1B.1	April– August	16–33	Mesic soils in valley and foothill grassland and vernal pools.	**None;** suitable habitat not present	No	**None;** suitable habitat will not be created

[1] Status:

– = None

Federal

FE = Endangered under the ESA

FT = Threatened under the ESA

State

CE = Endangered under the CESA

CR = Rare under the CNPPA

CRPR

1A = Plants presumed extirpated in California and either are or extinct elsewhere

1B = Plants rare, threatened, or endangered in California and elsewhere

2B = Plants rare, threatened, or endangered in California, but more common elsewhere

3 = Plants for which more information is need –a review list

4 = Plants of limited distribution – a watch list

0.1 = Seriously threatened in California

0.2 = Moderately threatened in California

0.3 = Not very threatened in California

[2] Likelihood for a special-status species to occur in the Project site under current conditions is defined as follows:

- None: the species' required habitat (i.e., plant community types and elevation range) is lacking from the Project site.
- Low: the species' required habitat occurs in the Project site but it is of very low quality.
- Moderate: the species' required habitat occurs in the Project site.
- High: the species has been documented in the Project site.

[3] Likelihood for a special-status species to occur in the Project site under post-restoration conditions is defined as follows:

- None: the species' required habitat is lacking from the Project site and restoration will not create this habitat.
- Low: the species' required habitat occurs in the Project site but it is of very low quality and is not enhanced by the restoration Project.
- Moderate: the species' required habitat occurs in the Project site but restoration will not enhance habitat availability for the species.
- High: the species has been documented in the Project site and/or restoration will enhance habitat availability for the species.

[4] Baldwin, B. G., D. H. Goldman, D. J. Keil, R. Patterson, T. J. Rosatti and D. H. Wilken, editors. 2012. The Jepson manual: vascular plants of California, second edition. University of California Press, Berkeley.

Appendix B

Special-status Wildlife and Fish Species Documented in CNDDB in the Project Vicinity and Potential to Occur in the Project Site

Table B-1. Special-Status Wildlife and Fish Species Documented in CNDDB in the Project Vicinity and Potential to Occur in the Project site (Listed in Taxonomic Order).

Common name Scientific name	Query sources	Status[a] Federal/ State	Distribution in California	Habitat association	Likelihood to occur[b,c] at the Project site under current conditions	Restoration enhances conditions for species?	Likelihood to occur in the Project site under post-restoration conditions
INVERTEBRATES							
Conservancy fairy shrimp *Branchinecta conservatio*	USFWS, CNDDB, DWR et al.	FE/–	Disjunct occurrences in Tehama, Glenn, Butte, Yolo, Solano, Stanislaus, Merced, and Ventura counties	Large, deep vernal pools in annual grasslands	**None**; there is no vernal pool habitat at the Project site	No	**None**; no vernal pool habitat will be created
Longhorn fairy shrimp *Branchinecta longiantenna*	DWR et al.	FE/–	Four known populations in San Luis Obispo, Merced, Alameda, and Contra Costa counties	Vernal pools; also found in sandstone rock outcrop pools, grass-bottomed pools, and claypan pools	**None**; the Project site is outside of the species' known range	No	**None**; the Project site is outside of the species' known range
Vernal pool fairy shrimp *Branchinecta lynchi*	USFWS, CNDDB, DWR et al.	FT/– Critical habitat (Designated)	Central Valley, central and south Coast Ranges from Tehama County to Santa Barbara County; isolated populations also in Riverside County	Vernal pools; also found in sandstone rock outcrop pools	**None**; there is no vernal pool habitat at the Project site	No	**None**; no vernal pool habitat will be created
Vernal pool tadpole shrimp *Lepidurus packardi*	USFWS, CNDDB, DWR et al.	FE/– Critical habitat (Designated)	Shasta County south to Merced County	Vernal pools and ephemeral stock ponds	**None**; there is no vernal pool habitat at the Project site	No	**None**; no vernal pool habitat will be created

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Valley elderberry longhorn beetle *Desmocerus californicus dimorphus*	USFWS, CNDDB, DWR et al.	FT/–	Streamside habitats throughout the Central Valley	Riparian and oak savanna habitats below 3,000 ft with host plant blue elderberry (*Sambucus nigra* ssp. *caerulea*)	**Low**; the Project site is likely outside of the species' known range; elderberry plants were observed during surveys in December 2013, and no exit holes were observed (J. Downs, CDFW, pers. comm.)	No	**Low**; the Project site is likely outside of the species' known range
Delta green ground beetle *Elaphrus viridus*	USFWS, CNDDB, DWR et al.	FT/– Critical habitat (Designated)	Only known to occur in Solano County	Grassland habitat interspersed with vernal pools	**None**; there is no vernal pool habitat at the Project site	No	**None**; no vernal pool habitat will be created
Lange's metalmark butterfly *Apodemia mormo langei*	USFWS, CNDDB	FE/–	Antioch Sand Dunes in Contra Costa County	Dunes; larval food plant is nakedstem buckwheat (*Eriogonum nudum* ssp. *auriculatum*); adult nectar plants include buckwheat, butterweed (*Senecio douglasii*) and snakeweed (*Gutierrezia divergens*)	**None**; the Project site is outside of the species' known range	No	**None**; the Project site is outside of the species' known range

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FISH							
Pacific lamprey *Entosphenus tridentatus*	Wetlands and Water Resources et al. 2012	FSC/–	Found in most major rivers that drain to the ocean as far south as the Santa Anna River but large spawning runs are rare south of Monterey Bay	Adults spawn on sand and gravel in streams (lotic environments), but have been observed spawning in stagnant and muddy (lentic) environments; larvae (ammocoetes) bury themselves and feed in silty or sandy backwaters or stream edges with temperatures below 20°C	**Low**; suitable rearing habitat likely present but Delta rearing for this species has not been documented; access to site (from adjacent Miner Slough) is poor; the species has not been documented at the Project site	Yes; improved connectivity with adjacent tidal channels and sloughs will provide access to potential rearing habitat; habitat quantity and quality may be increased	**Moderate**; access to existing and potentially enhanced habitat will be improved
River lamprey *Lampetra ayresi*	Wetlands and Water Resources et al. 2012	FSC/SSC	Lower Sacramento-San Joaquin River system: Napa River, Sonoma Creek, Alameda Creek, tributaries to the San Francisco Bay, and lower Sacramento and San Joaquin rivers; Salmon Creek, Russian River, Eel River	Spawning adults need riffle habitat with clean gravels in permanent streams; larvae (ammocoetes) bury themselves and feed in silty or sandy backwaters or stream edges with temperatures below 25°C	**Low**; suitable rearing habitat likely present but Delta rearing for this species has not been documented; access to site (from adjacent Miner Slough) is poor; the species has not been documented at the Project site	Yes; improved connectivity with adjacent tidal channels and sloughs will provide access to potential rearing habitat; habitat quantity and quality may be increased	**Moderate**; access to existing and potentially enhanced habitat will be improved

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North American green sturgeon: southern DPS *Acipenser medirostris*	USFWS, DWR et al.	FT/SSC Critical habitat (Designated)	San Francisco, San Pablo, Suisun, and Humboldt bays; Sacramento-San Joaquin Delta, Sacramento and Klamath rivers	Spawn in pools of large freshwater rivers with cool water and cobble, clean sand, or bedrock; in San Francisco Bay adults swim near the surface or forage along the bottom in water less than 33 ft deep; juveniles may rear in Delta for two years or more but Delta rearing habitat use has not been documented	**Low**; suitable rearing habitat likely present but rearing distribution and habitat use in the Delta largely unknown; access to site (from adjacent Miner Slough) is poor; the species has not been documented at the Project site	Yes; improved connectivity with adjacent tidal channels and sloughs will provide access to potential rearing habitat; habitat quantity and quality may be increased	**Moderate**; access to existing and potentially enhanced habitat will be improved
Sacramento splittail *Pogonichthys macrolepidotus*	CNDDB, DWR et al.	–/SSC	Lower portions of the Napa, Petaluma, Sacramento and San Joaquin rivers; Sacramento-San Joaquin Delta including Suisun Bay, Suisun Marsh	Low-elevation rivers and estuaries with low to moderate salinity (0–18 ppt); shallow, flooded vegetated habitat for spawning and foraging	**Moderate**; suitable habitat for all life stages is present, but access to habitat (from adjacent Miner Slough) is poor; the species has not been documented at the Project site	Yes; improved connectivity with adjacent tidal channels and sloughs will provide access to potential spawning and rearing habitat; habitat quantity and quality may be increased	**High**; access to existing and potentially enhanced habitat will be improved

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Delta Smelt *Hypomesus transpacificus*	USFWS, CNDDB, DWR et al.	FT/SE, Critical habitat (Designated)	Found only in the Sacramento-San Joaquin Estuary, including the lower reaches of Sacramento and Napa rivers; the Delta including Suisun Bay, Goodyear, Suisun, Cutoff, First Mallard, and Montezuma sloughs	Estuarine or brackish waters up to 18 ppt; spawn in shallow brackish water upstream of the mixing zone (zone of saltwater-freshwater interface) where salinity is around 2 ppt	**Low**; habitat suitability in Miner Slough for movement to site is poor (P. Poirier and A. Rockriver, DFW, pers. comm., 16 January 2014); suitable habitat for all life stages is present; the species has not been documented at the Project site.	Yes; improved connectivity with adjacent Miner Slough will provide access to potential habitat for all life stages; habitat quantity and quality may be increased	**Moderate**; access to existing and potentially enhanced habitat will be improved
Longfin Smelt *Spirnichus thaleichthys*	DWR et al.	FPT/ST	San Francisco estuary from Rio Vista or Medford Island in the Delta as far downstream as South Bay; concentrated in Suisun, San Pablo, and North San Francisco bays; historical populations in Humboldt Bay, Eel River estuary, and Klamath River estuary	Adults in large bays, estuaries, and nearshore coastal areas; migrate into freshwater rivers to spawn; salinities of 15–30 ppt	**Low;** habitat suitability in Miner Slough for movement to site is poor (P. Poirier and A. Rockriver, DFW, pers. comm., 16 January 2014); habitat suitability for spawning and rearing is low; the species has not been documented at the Project site.	Yes; improved connectivity with adjacent Miner Slough will provide access to potential spawning and rearing habitat; habitat quantity and quality may be increased	**Moderate**; access to existing and potentially enhanced habitat will be improved

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Chinook salmon, central Valley spring-run ESU *Oncorhynchus tshawytscha*	USFWS, DWR et al.	FT/ST Critical habitat (Designated)	Sacramento River and its tributaries (Deer, Mill, Antelope, Battle, Beegum, Butte, and Big Chico creeks and the Feather and Yuba rivers)	Low- to mid-elevation rivers and streams with cold water, clean gravel of appropriate size for spawning and adequate rearing habitat; typically rear in freshwater for one or more years before migrating to the ocean; species documented to rear in Yolo bypass and other Delta habitats	**Low;** suitable rearing habitat is present but access to habitat (from adjacent Miner Slough) is poor; the species has not been documented at the Project site	Yes; improved connectivity with adjacent waterways will improve access to potential rearing habitat; habitat quantity and quality may be increased	**High**; access to existing and potentially enhanced habitat will be improved
Chinook salmon, Sacramento River winter-run ESU *Oncorhynchus tshawytscha*	USFWS, DWR et al.	FE/SE Critical habitat (Designated)	Sacramento River and its tributaries; Sacramento-San Joaquin Delta; San Francisco, San Pablo and Suisun bays	Mainstem river reaches with cool water and available spawning gravel; rear five to ten months in the river and estuary (potentially including Yolo bypass and similar habitats); migrate to the ocean to feed and grow until sexually mature	**Low;** suitable rearing habitat is present but access to habitat (from adjacent Miner Slough) is poor; the species has not been documented at the Project site	Yes; improved connectivity with adjacent waterways will improve access to potential rearing habitat; habitat quantity and quality may be increased	**High**; access to existing and potentially enhanced habitat will be improved

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Steelhead, Central Valley DPS *Oncorhynchus mykiss*	USFWS, DWR et al.	FT/– Critical habitat (Designated)	Sacramento and San Joaquin rivers and their tributaries	Rivers and streams with cold water, clean gravel of appropriate size for spawning, and suitable rearing habitat; typically rear in freshwater for one or more years before migrating to the ocean; prevalence of Delta rearing largely unknown	**Low;** suitable rearing habitat likely present but rearing distribution and habitat use in the Delta largely unknown; access to potential rearing habitat (from adjacent Miner Slough) is poor; the species has not been documented at the Project site	Yes; improved connectivity with adjacent waterways will improve access to potential rearing habitat; habitat quantity and quality may be increased	**Moderate**; access to existing and potentially enhanced habitat will be improved; use of Delta habitat for rearing is uncertain
AMPHIBIANS							
California red-legged frog *Rana draytonii*	USFWS	FT/SSC Critical habitat (Designated)	Largely restricted to coastal drainages on the central coast from Mendocino County to Baja California; in the Sierra foothills south to Tulare and possibly Kern counties	Breeds in still or slow-moving water with emergent and overhanging vegetation, including wetlands, wet meadows, ponds, lakes, and low-gradient, slow moving stream reaches with permanent pools; uses adjacent uplands for dispersal and summer retreat	**None**; the Project site is outside of the species' known range	No	**None**; the Project site is outside of the species' known range

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California tiger salamander *Ambystoma californiense*	USFWS, CNDDB, DWR et al.	FT/ST Critical habitat (Designated)	Very fragmented; along the coast from Sonoma County to Santa Barbara County, in the Central Valley and Sierra foothills from Sacramento County to Tulare County	Grassland, oak savannah, or edges of woodland that provide subterranean refuge (typically mammal burrows); breeds in nearby temporary ponds, vernal pools, or slow-moving parts of streams	**None**; there is no suitable upland habitat at the Project site	No	**None**; no suitable upland habitat will be created
REPTILES							
Western pond turtle *Actinemys marmorata*	CNDDB, DWR et al.	–/SSC	From the Oregon border along the coast ranges to the Mexican border, and west of the crest of the Cascades and Sierras	Permanent, slow-moving fresh or brackish water with available basking sites and adjacent open habitats or forest for nesting	**High**; there is suitable non-tidal perennial aquatic habitat present at the Project site; nesting habitat present on dry levees and uplands; commonly sighted in the Delta	Yes, marshes enhanced	**High**; suitable marsh habitat present and will be enhanced
California legless lizard *Anniella pulchra*	CNDDB	–/SSC	Northern Contra Costa County south to northwestern Baja California; scattered occurrences in San Joaquin Valley, along the southern Sierra Nevada mountains, and in the western Mojave Desert	Sparsely vegetated areas of beach dunes, chaparral, pine-oak woodlands, desert scrub, sandy washes, and stream terraces; warm, moist, loose soil for burrowing	**None**; the Project site is outside of the species' known range and there is no suitable habitat at the Project site	No	**None**; the Project site is outside of the species' known range

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Giant garter snake *Thamnophis gigas*	USFWS, CNDDB, DWR et al.	FT/ST	Central Valley from the vicinity of Burrel in Fresno County north to near Chico in Butte County; has been extirpated from areas south of Fresno	Sloughs, canals, low-gradient streams and freshwater marsh habitats where there is a prey base of small fish and amphibians; also found in irrigation ditches and rice fields; requires grassy banks and emergent vegetation for basking and areas of high ground protected from flooding during winter	**Low**; this species was not detected during intensive trapping surveys in 2009 (DWR, unpubl. data), though there is suitable habitat present; emergent marsh provides foraging habitat and levees provide winter upland retreat from flooding	Yes, marshes (historic habitat) enhanced, improving foraging habitat; retained levees provide overwinter habitat	**Moderate**; habitat condition suitable, within historic range, few if any individuals have been detected within the Delta
BIRDS							
Redhead *Aythya americana*	DWR et al.	–/SSC	Summer resident; breeds in northeastern California, Central Valley, southern coasts, and southern desert	Freshwater emergent wetlands with dense stands of cattails (*Typha* spp.) and bulrush (*Schoenoplectus* spp.) interspersed with areas of deep, open water; forage and rest on large, deep bodies of water	**Low**; permanent freshwater emergent wetland at the Project site may provide suitable breeding habitat; rarely documented in Central Valley, and prefer larger lakes for nesting	Yes, marshes and open water enhanced, improving potential breeding and foraging habitat	**Low**; while habitat present and will be enhanced, this species is rarely documented in the Central Valley

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Least bittern *Ixobrychus exilis*	DWR et al.	–/SSC	Primarily a summer resident; breeds in northeastern California, Central Coast, Central Valley, southern coasts, and southern deserts	Freshwater and brackish marshes with dense aquatic or semiaquatic vegetation interspersed with clumps of woody vegetation and open water	**Low**; permanent freshwater emergent wetland at the Project site may provide suitable breeding habitat, though species is rare in the Delta	Yes, marshes and open water enhanced	**Low**; while habitat present and will be enhanced, this species is rarely detected in the Delta
White-tailed kite *Elanus leucurus*	CNDDB, DWR et al.	–/SFP	Year-round resident; found in nearly all lowlands of California west of the Sierra Nevada mountains and the southeast deserts	Lowland grasslands and wetlands with open areas; nests in trees near open foraging area	**Moderate**; may nest in large riparian trees at the Project site, and use emergent marsh and grasslands for foraging	Yes, riparian forest nesting habitat enhanced	**Moderate**; riparian forest nesting habitat enhanced
Northern harrier *Circus cyaneus*	DWR et al.	–/SSC	Year-round resident; scattered throughout California; in the northwest, nests largely within coastal lowlands from Del Norte County south to Bodega Head in Sonoma County, inland to Napa **County**	Nests, forages, and roosts in wetlands or along rivers or lakes, but also in grasslands, meadows, or grain fields	**High**; documented nesting and foraging at the Project site (CNDDB and DWR, unpubl. data)	Yes, marshes enhanced	**High**; suitable marsh habitat present and will be enhanced

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Swainson's hawk *Buteo swainsoni*	CNDDB, DWR et al.	–/ST	Summer resident; breeds in lower Sacramento and San Joaquin valleys, the Klamath Basin, and Butte Valley; highest nesting densities occur near Davis and Woodland, Yolo County	Nests in oaks or cottonwoods in or near riparian habitats; forages in grasslands, irrigated pastures, and grain fields	**High**; nesting documented in riparian forest habitats at the Project site (CNDDB and DWR, unpubl. data)	Yes, riparian forest nesting habitat enhanced	**High**; suitable riparian forest nesting habitat present and will be enhanced
Golden eagle *Aquila chrysaetos*	DWR et al.	BGEPA/SFP	Uncommon permanent resident and migrant throughout California, except center of Central Valley	Open woodlands and oak savannahs, grasslands, chaparral, sagebrush flats; nests on steep cliffs or large trees	**None**; no suitable nesting habitat on or near Project site	No	**None;** no suitable nesting habitat will be created

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California black rail *Laterallus jamaicenis coturniculus*	CNDDB, DWR et al.	–/ST, SFP	Northern San Francisco Bay area (primarily San Pablo and Suisun bays), Sacramento-San Joaquin Delta, and recent sightings in the Sierra Nevada foothills	Large tidally-influenced marshes with saline to brackish water, typically with a high proportion of pickleweed (*Salicornia virginica*); also can be associated with bulrush (*Schoenoplectus* spp.), cattail (*Typha* spp.), or rushes (*Juncus* spp.); peripheral vegetation at and above mean high higher water necessary to protect nesting birds during extremely high tides	**Low**; suitable brackish or saline habitats are likely absent	Yes, marshes enhanced and a tidal influence introduced	**Moderate**; marshes enhanced and an introduced tidal influence may encourage breeding
California clapper rail *Rallus longirostris obsoletus*	USFWS, DWR et al.	FE/SE, SFP	Predominantly in the marshes of the San Francisco estuary: South San Francisco Bay, North San Francisco Bay, San Pablo Bay, and sporadically throughout the Suisun Marsh area east to Browns Island	Salt and brackish water marshes, typically dominated by pickleweed (*Salicornia virginica*) and Pacific cordgrass (*Spartina foliosa*)	**None**; outside the species' known range	No	**None**; outside the species' known range

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Greater sandhill crane *Grus canadensis tabida*	DWR et al.	–/ST, SFP	Winter visitor and migrant; scattered locations in the Central Valley; breeds in extreme northeastern California	Forages in harvested rice fields, corn stubble, barley, and newly planted grain fields; occasionally in managed freshwater marshes	**Low** (wintering/foraging only); the Project site is on the edge of the species' known range; low potential to forage in freshwater emergent wetland habitats	No	**Low**; the Project site is on the edge of the species' known range
Mountain plover *Charadrius montanus*	CNDDB, DWR et al.	FPT/SSC	Winter visitor; found in the Central Valley south of Yuba County, along the coast in parts of San Luis Obispo, Santa Barbara, Ventura, and San Diego counties; parts of Imperial, Riverside, Kern, and Los Angeles counties	Occupies open plains or rolling hills with short grasses or very sparse vegetation; nearby bodies of water are not needed; may use newly plowed or sprouting grain fields	**None**; no suitable habitat at the Project site	No	**None**; no suitable grassland habitat will be created
California least tern *Sternula antillarum browni*	USFWS, DWR et al.	FE/SE, SFP	Pacific coast from San Francisco to Baja California	Sparsely vegetated coastal beaches and estuaries near shallow waters, above high tide line	**None**; no suitable habitat at the Project site	No	**None**; no suitable estuarine habitat will be created

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Western yellow-billed cuckoo *Coccyzus americanus*	CNDDB, DWR et al.	FC/SE	Breeds in limited portions of the Sacramento River and the South Fork Kern River; small populations may nest in Butte, Yuba, Sutter, San Bernardino, Riverside, Inyo, Los Angeles, and Imperial counties	Summer resident of valley foothill and desert riparian habitats; nests in open woodland with clearings and low, dense, scrubby vegetation	**Low**; uncommon in the Project vicinity; low probability of nesting	Yes, riparian forest nesting habitat enhanced	**Low**; while habitat present and will be enhanced, this species is uncommon in the Project vicinity
Western burrowing owl *Athene cunicularia hypugaea*	CNDDB, DWR et al.	–/SSC	Year-round resident throughout much of the state; Central Valley, northeastern plateau, southeastern deserts, and coastal areas; rare along south coast	Level, open, dry, heavily grazed or low- stature grassland or desert vegetation with available burrows	**Low**; there is a limited amount of suitable available nesting or foraging habitat in grasslands at western perimeter of Project site along dry levees and uplands	No	**Low**; grassland habitat will continue to be present in the Project site but extent will still be limited
Short-eared owl *Asio flammeus*	DWR et al.	–/SSC	Year-round resident in certain areas; breeding in California episodic and a widespread winter migrant, found primarily in the Central Valley, in the western Sierra Nevada foothills, and along the coastline	Irrigated alfalfa or grain fields, ungrazed grasslands, old pastures, and salt or freshwater marshlands	**Moderate**; may forage in permanent freshwater emergent marsh and upland habitats, primarily in winter; very low potential for nesting at the Project site due to limited upland breeding sites	Yes, marsh foraging habitat enhanced	**Moderate**; marsh foraging habitat enhanced

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Loggerhead shrike *Lanius ludovicianus*	DWR et al.	–/SSC	Year-round resident in most of California except for the forested coastal slope and the high elevations of the Sierra Nevada, southern Cascade, and Transverse Ranges	Open shrubland or woodlands with short vegetation and and/or bare ground for hunting; some tall shrubs, trees, fences, or power lines for perching; typically nest in isolated trees or large shrubs	**Low**; may nest in isolated trees at the Project site, though suitability of foraging habitat is marginal	Yes, riparian forest nesting habitat enhanced	**Low**; riparian forest nesting habitat will be enhanced, but foraging habitat will still be limited
Least Bell's vireo *Vireo bellii pusillus*	DWR et al.	FE/SE	Summer resident; breeds in scattered locations around southern California	Nests in dense vegetative cover of riparian areas; often nests in willow or mulefat; forages in dense, stratified canopy	**Low**; while this species is a rare migrant in the Project vicinity, there is optimism that the species could be increasing in the Central Valley; one recent nesting record in restored habitat at San Joaquin River National Wildlife Refuge, and recent documented singing males in Yolo Bypass Wildlife Area	Yes, riparian forest nesting habitat enhanced	**Low to Moderate**; habitat present and will be enhanced; while this species is a rare migrant in the Project vicinity, there is some optimism that the species may be recovering in the Central Valley

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Bank swallow *Riparia riparia*	CNDDB, DWR et al.	–/ST	Summer resident; occurs along the Sacramento River from Tehama County to Sacramento County, along the Feather and lower American rivers; and in the plains east of the Cascade Range in Modoc, Lassen, and northern Siskiyou counties; small populations near the coast from San Francisco County to Monterey County	Nests in vertical bluffs or banks, usually adjacent to water, where the soil consists of sand or sandy loam	**None**; no suitable vertical bank habitat at the Project site	No	**None**; no suitable vertical bank habitat will be created
Yellow warbler *Dendroica petechia*	DWR, unpub. data	–/SSC	Summer resident; nests in most of California, except most of the Central Valley, high Sierras, and Mojave and Colorado deserts	Open-canopy, deciduous riparian woodland close to water, along streams or wet meadows	**High**; documented during summer in riparian scrub-shrub at the Project site (breeding status unknown) (DWR, unpubl. data); the Project site is outside of what is considered the species' current breeding range (Heath 2008)	Yes, riparian forest nesting habitat enhanced	**High**; riparian forest nesting habitat will be enhanced

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Saltmarsh common yellowthroat *Geothlypis trichas sinuosa*	CNDDB, DWR et al.	–/SSC	San Francisco Bay region	Brackish marsh, riparian woodland/swamp, freshwater marsh, and salt marsh often near upland habitats	**None**; outside the species' known breeding range	No	**None**; outside the species' known breeding range
Yellow-breasted chat *Icteria virens*	DWR et al.	–/SSC	Uncommon summer resident and migrant in coastal California and in foothills of the Sierra Nevada	Early-successional riparian habitats with a dense shrub layer and an open canopy	**High**; documented during summer using riparian scrub-shrub at the southern end of Prospect Island in 2009 (breeding status unknown) (DWR, unpubl. data); the Project site is outside of what is considered the species' current breeding range (Comrack 2008)	Yes, riparian forest nesting habitat enhanced	**High**; riparian forest habitat will be enhanced
Grasshopper sparrow *Ammodramus savannarum*	CNDDB, DWR et al.	–/SSC	Summer resident; nests in Mendocino, Trinity, and Tehama counties south, west of the Cascade–Sierra Nevada axis and southeastern deserts, to San Diego County	Typically found in moderately open grasslands with scattered shrubs	**Low**; may nest in grassland habitats, which represent only a small area of the Project site	No	**Low**; grassland habitat will continue to be present in the Project site but extent will still be limited

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Song sparrow ("Modesto" population) *Melospiza melodia*	DWR et al.	–/SSC	Year-round resident; north-central portion of the Central Valley	Emergent freshwater marshes, riparian willow thickets, and riparian forests	**High**; sightings common throughout the Project site during 2009 surveys, including nesting (DWR, unpubl. data)	Yes, marsh nesting and foraging habitat enhanced	**High**; marsh nesting and foraging habitat enhanced
Suisun song sparrow *Melospiza melodia maxillaris*	CNDDB, DWR et al.	–/SSC	Resident of Suisun Bay	Brackish-water marshes	**None**; outside the species' known range	No	**None**; outside the species' known range
Tricolored blackbird *Agelaius tricolor*	CNDDB, DWR et al.	–/SSC	Permanent resident, but makes extensive migrations both in breeding season and winter; common locally throughout Central Valley and in coastal areas from Sonoma County south	Feeds in grasslands and agriculture fields; nesting habitat components include open accessible water, a protected nesting substrate (including flooded or thorny vegetation), and a suitable nearby foraging space with adequate insect prey	**Low**; while permanent freshwater emergent wetland at the Project site may provide suitable breeding habitat, breeding colonies are uncommon in the Project vicinity; open water provides foraging habitat	No	**Low**; while habitat present and will be enhanced, this species is uncommon in the Project vicinity

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Yellow-headed blackbird *Xanthocephalus xanthocephalus*	CNDDB, DWR et al.	–/SSC	Primarily a migrant and summer resident, though small numbers remain in winter; Central Valley, northeastern California, central and southern coasts, and southern deserts	Breeds almost entirely in open marshes with relatively deep water and tall emergent vegetation, such as bulrush (*Schoenoplectus* spp.) or cattails (*Typha* spp.); nests are typically in moderately dense vegetation; forage within wetlands and surrounding grasslands and croplands	**Low;** while permanent freshwater emergent wetland at the Project site may provide suitable breeding habitat, breeding is uncommon in the Project vicinity; emergent marsh provides foraging habitat	No	**Low;** while habitat present and will be enhanced, this species is uncommon in the Project vicinity
MAMMALS							
Salt marsh harvest mouse *Reithrodontomys raviventris*	USFWS, CNDDB	FE/SE, SFP	San Pablo, Suisun, and San Francisco bays in Marin, Sonoma, Napa, Solano, Contra Costa, Alameda, Santa Clara, and San Mateo counties	Tidal salt marshes; depend on dense cover, preferring pickleweed (*Salicornia pacifica*) and saltgrass	**None**; outside the species' known range	No	**None**; outside the species' known range

Common name Scientific name	Query sources	Status[a] Federal/ State	Distribution in California	Habitat association	Likelihood to occur[b,c] at the Project site under current conditions	Restoration enhances conditions for species?	Likelihood to occur in the Project site under post-restoration conditions
Western red bat *Lasiurus blossevillii*	CNDDB, DWR et al.	–/SSC	Near the Pacific Coast, Central Valley, and the Sierra Nevada	Riparian forests, woodlands near streams, fields and orchards	**High**; species detected during acoustic monitoring in 2009 (DWR, unpubl. data); roosting habitat throughout riparian forest at the Project site, including maternity roosts	Yes, riparian forest roosting habitat enhanced	**High**; riparian forest roosting habitat will be enhanced
San Joaquin kit fox *Vulpes macrotis mutica*	USFWS	FE/ST/BLMS	San Joaquin Valley floor and surrounding foothills of the coastal ranges, Sierra Nevada, and Tehachapi mountains	Annual grasslands or open areas dominated by scattered brush, shrubs, and scrub	**None**; no suitable habitat at the Project site	No	**None**; no suitable grassland habitat will be created
American badger *Taxidea taxus*	CNDDB	–/SSC	Throughout the state except in the humid coastal forests of Del Norte County and the northwest portion of Humboldt County	Shrubland, open grasslands, fields, and alpine meadows with friable soils	**None**; no suitable habitat at the Project site	No	**None**; no suitable grassland habitat will be created

Common name Scientific name	Query sources	Status[a] Federal/ State	Distribution in California	Habitat association	Likelihood to occur[b,c] at the Project site under current conditions	Restoration enhances conditions for species?	Likelihood to occur in the Project site under post-restoration conditions
California ringtail *Bassariscus astutus raptor*	Zeiner et al. 1990b	–/SFP	Widely distributed, though greatest abundance in northern California and Sierra Nevada foothills	Mixture of forest and shrub habitats in association with rocky areas or riparian habitats, low to middle elevations	**Low to Moderate**; very little is known about this species in this region; may occur in riparian trees at the Project site, though there is a lack of connectivity to other riparian areas	Yes, riparian forest habitat enhanced	**Low to Moderate**; as restoration and habitat connectivity increases, likelihood for occurrence could increase

[a] Status codes:

Federal
FE = Listed as endangered under the federal Endangered Species Act
FT = Listed as threatened under the federal Endangered Species Act
FC = Federal candidate species
FSC = Federal Species of Concern

State
SE = Listed as Endangered under the California Endangered Species Act
ST = Listed as Threatened under the California Endangered Species Act
SSC = California Species of Special Concern
SFP = CDFW Fully Protected species

[b] Likelihood for wildlife species to occur at the Project site:

- None: the project area is outside the species' known range and/or the species' required habitat is lacking from the project area.
- Low: the species' known range overlaps with the project region but not the project area, and/or the species' required habitat is of very low quality or quantity in the project area; documented sightings of the species in the Project region are rare, if any.
- Moderate: The species' known distribution or elevation range overlaps with the project area and the species' required habitat occurs in the project area; there is also a reasonable chance for the species to occur based on frequency of documented sightings in the Project region.
- High: The species has been documented in the project area and/or its required habitat occurs in the project area, is of high quality, and documented sightings of the species in the Project region are common.

[c] Likelihood for fish species to occur at the Project site:

- Low: Suitable habitat may occur at the Project site but the known distribution or migratory pathway of one or more life stages is unlikely to overlap with the Project site or access to suitable habitat is poor/infrequent; there are no documented occurrences of the species/life stage at the Project site.
- Moderate: The species' known distribution or migratory pathway overlaps with the Project site, access to suitable habitat is reasonably likely/frequent, and suitable habitat occurs or is believed to occur at the Project site; documented occurrences of one or more life stage at the Project site may be rare, if any, but there is a reasonable likelihood for one or more life stages to occur based on migratory pathways, distribution, and access to suitable habitat at the Project site.
- High: Suitable habitat for one or more life stages occurs at the Project site and one or more life stages are frequently documented at the Project site.