Executive Summary

12DES.1 Introduction

This appendix presents a feasibility assessment of the Bay Delta Conservation Plan (BDCP) conservation measures that offset impacts of water conveyance facilities construction on terrestrial biological resources. Portions of the conservation measures that would be implemented in the 10-year near-term period and would offset impacts of water conveyance facilities construction were evaluated for their feasibility at a planning level. Conveyance facilities operations effects were not considered in this appendix. The assessment considered if suitable conditions are present within specified conservation zones to implement the applicable conservation measures within the near-term. The assessment relies on existing documents and geographic information system (GIS) data to determine whether the area of restoration and protection identified for particular conservation zones and timeframes in the impact assessment would be feasible.

12DES.2 Methods

To assess feasibility of protection, the presence of lands supporting required unprotected natural community acreage in specified conservation zones was assessed. For restoration, feasibility was assessed by evaluating the presence of lands that meet suitability criteria, including species range, soil type, land use, natural community, and land elevation. For these analyses the same GIS data were used as were utilized for preparing the BDCP and conducting the assessment of environmental consequences in the EIR/EIS. The presence of suitable conditions for protection and restoration was conducted at the conservation zone level. Feasibility of tidal marsh restoration was only assessed to the extent needed to mitigate for water conveyance construction impacts.

12DES.3 Results

Sufficient land area that is not already protected under existing agreements is present in the appropriate conservation zones and currently supports the appropriate natural communities to meet the near-term minimum protection objectives of the BDCP. Within the first 5 years of BDCP implementation, a total of 11,610 acres of lands would be protected and within the next 5 years an additional 12,785 acres would be protected. Together, these lands represent 5% of lands that are not already in conservation in the Plan Area.

In addition to the land area required for protection, sufficient land in the Plan Area meets the criteria for restoration of natural communities to meet the BDCP restoration objectives in the near-term. The land area that has suitable elevation for riparian habitat along the Sacramento River and its distributaries (e.g., Elk, Duck, and Steamboat Sloughs) is at least 5 times higher than required for restoration and additional land has suitable elevation along the Mokelumne and Cosumnes Rivers. Modeled setback levees along the San Joaquin River and its distributaries could provide 880 to 7,040 acres of additional riparian habitat, much more than the 800 acres minimum restoration objective of BDCP. However, restoration of the San Joaquin River would not commence until after year 10 and would not contribute to near-term mitigation of water conveyance impacts.

Within the near-term timeframe it would be possible to restore riparian scrub or early successional riparian forest; however, it would not be possible to replace mature riparian forest when starting restoration with seedlings. Instead, mature trees and saplings will be planted to replace every Swainson's hawk and white-tailed kite nest tree that would need to be removed, other raptor species could also benefit from this measure.

The restoration of grassland, alkali seasonal wetland complex, vernal pool complex, nontidal marsh and managed wetland to a level to meet the near-term minimum objectives of the conservation strategy would be feasible given the presence of lands meeting restoration criteria such as soil type, natural community, land use, species range, and elevation criteria.

The BDCP would provide sufficient conservation acreage to offset near-term impacts of Alternatives 1A, 4, and 9 on terrestrial biological resources. Although Alternatives 2A, 3, 5, 6A, 7, and 8 were not assessed directly, it can be inferred that the same conclusions apply to these alternatives. Alternative 1A represents the alternatives with pipeline/tunnel water conveyance facilities, i.e., Alternatives 2A, 3, 5, 6A, 7, and 8. Alternative 1B represents the alternatives with east alignment water conveyance facilities, i.e., 2B and 6B. Alternative 1C represents the alternatives with west alignment water conveyance facilities, i.e., Alternatives 2C and 6C. Alternatives 1B, 1C, 2B, 2C, 6B and 6C would require additional cultivated lands to be preserved to provide habitat for species that forage on these lands. Under Alternatives 1C, 2C, and 6C, alkali seasonal wetland complex and vernal pool crustacean habitat (alkali seasonal wetland complex and/or vernal pool complex) would need to be restored and protected in addition to what is currently in the Plan under Alternatives 1C, 2C and 6C, as described in Mitigation Measures Bio-18, Bio-27, and Bio-32.

Contents

Figure **Follows page**

Table

Acronyms and Abbreviations

BDCP	Bay Delta Conservation Plan
CM	Conservation Measure
CZ	Conservation Zone
DFG	California Department of Fish and Game
GIS	geographic information system
HCP	Habitat Conservation Plan
NCCP	Natural Communities Conservation Plan
SSURGO	Soil Survey Geographic Database
WWR	Wetlands and Water Resources

Appendix 12D
Feasibility Assessment of Conservation Measures Offsetting Water Conveyance Facilities Construction Impacts on Terrestrial Biological Resources

12D.1 Introduction

This appendix presents a feasibility assessment of the portion of the Bay Delta Conservation Plan (BDCP) conservation measures that offset impacts of water conveyance facilities construction on terrestrial biological resources. Implementation of the BDCP Conservation Strategy would involve large–scale restoration and protection of the Bay–Delta ecosystem and would contribute to the recovery of covered species. Construction of the water conveyance facilities (i.e., implementing Conservation Measure [CM]1) would impact terrestrial biological resources, but the protection and restoration resulting from implementation of the BDCP Conservation Strategy would compensate for the impacts of the construction of conveyance facilities and other impacts of implementing the Conservation Strategy, such that the BDCP would have a net beneficial effect on natural communities and covered species in the Plan Area.

The analysis presented in this appendix supplements the impact assessment of Chapter 12 of the BDCP EIR/EIS, *Terrestrial Biological Resources*. The impact assessment determines whether the implementation of the alternatives results in significant effects, for the near–term and the late long–term assessment periods. This appendix assesses whether the portion of conservation measures implemented in the 10-year near-term period that would offset impacts of conveyance facilities construction can be considered feasible at a planning level. The assessment considers if suitable conditions are present within specified conservation zones to implement the appropriate conservation measures within the near-term as identified in the BDCP. The planning–level assessment in this appendix does not consider socio-economic aspects of feasibility (e.g., availability of willing sellers of real property), and does not consider engineering feasibility of implementing the conservation measures. The assessment relies on existing documents and geographic information system (GIS) data to determine whether the area of restoration and protection identified for particular conservation zones and timeframes in the impact assessment would be feasible. Conveyance facilities operations effects were not considered in this appendix.

The feasibility of offsetting the impacts of the BDCP and the alternatives that represent major footprint differences, i.e., Alternatives 1A, 1B, 1C, 4, and 9, are assessed in this appendix. The other action alternatives considered in Chapter 12 of the EIR/EIS are not analyzed here.

Construction and operation of the water conveyance facilities (CM1) is analyzed in the EIR/EIS at a project level, while implementation of the remaining conservation measures is analyzed at a program level. Construction of the water conveyance facilities would impact natural communities and native terrestrial species. Those impacts would be offset by implementation of the other conservation measures that benefit covered terrestrial species and natural communities (CM3–CM11), although the implementation of CM3–CM11 would also contribute to the conservation of the covered and noncovered species and the benefits of CM3–CM11 to the covered and noncovered

species and natural communities would exceed those that would be needed to offset the construction effects of CM1. These conservation measures focus on the measures listed below.

- *CM3 Natural Communities Protection and Restoration*
- *CM4 Tidal Natural Communities Restoration*
- *CM5 Seasonally Inundated Floodplain Restoration*
- *CM6 Channel Margin Enhancement*
- *CM7 Riparian Natural Community Restoration*
- *CM8 Grassland Natural Community Restoration*
- *CM9 Vernal Pool and Alkali Seasonal Wetland Restoration*
- *CM10 Nontidal Marsh Restoration*
- *CM11 Natural Communities Enhancement and Management* (applies to lands in the BDCP reserve system that have been acquired for protection or restoration)

Although they could play a role in offsetting effects of water conveyance facilities construction (implementing CM1), other conservation measures were not included in the analysis because their primary focus is on aquatic habitats and species, or on the effects of restoration actions.

Section 12.3 *Environmental Consequences* of the EIR/EIS presents a separate analysis of the effects of CM1 and the natural community acreage that would need to be restored and/or protected in the near-term period to offset those effects. This appendix supplements that analysis by assessing the feasibility of that restoration and protection activity. To assess feasibility of natural community protection, the presence of lands supporting required unprotected natural community acreage in specified conservation zones was assessed. For restoration of natural communities or species habitat, the feasibility was assessed by evaluating the presence of lands that meet suitability criteria, such as species range, soil type, land use, natural community, and land elevation.

The analyses presented in this appendix focus on those terrestrial natural communities and species that could potentially be affected by construction of the water conveyance facilities. Natural communities and terrestrial species only occurring in the Suisun Marsh area (Conservation Zone [CZ] 11), including tidal brackish emergent wetland, salt marsh harvest mouse (*Reithrodontymys raviventris*), Suisun shrew, Suisun song sparrow (*Melospiza melodia maxillaris*), California clapper rail (*Rallus longirostris obsoletus*), Suisun thistle (*Cirsium hydrophilum* var. *hydrophilum*), and soft bird's beak (*Chloropyron molle* ssp. *molle*) (BDCP Appendix 2.A, *Covered Species Accounts*) are not considered. Another species that would not be affected by construction of the water conveyance facilities is the slough thistle (*Cirsium crassicaule*), which occurs south of the alternative facilities footprints that are evaluated.

12D.2 Methods

12D.2.1 Approach to Analysis of BDCP Conservation Measures

The analysis of feasibility of protection of natural communities consisted of determining the presence of unprotected lands supporting the natural community in the particular conservation zone that the protection was identified for in CM3. In some cases, the location of lands within the conservation zones was evaluated to determine if the lands occurred within a particular species' range or would be connected to existing protected habitat.

The assessment of restoration feasibility consisted of determining whether lands were present in particular conservation zones that met suitability criteria for restoration of particular natural community types. In some cases, the suitability of restoring specific habitat attributes was evaluated, based on the attributes described in the BDCP biological goals and objectives, as cited in CM3–CM11. Feasibility of tidal habitat restoration was mostly derived from models prepared for the BDCP conservation strategy and was therefore not analyzed in detail in this appendix. Existing studies and evidence from ongoing or completed restoration projects was also reviewed to determine feasibility.

In considering the feasibility of restoration, the analysis only considered the near-term period (the period from initiation of BDCP implementation until year 10). The expected level of approximate habitat development (also referred to as "habitat evolution") by year 10 was evaluated based on professional judgment, because few applicable literature references were found. The actual rate of habitat development varies by site and is dependent on climatic conditions. Plant growth rates and experience from historical vegetation analysis was considered in the assessment.

After the feasibility of implementing the conservation measures in the near-term period is evaluated, the ability to offset impacts of footprints for four differing water conveyance facilities is quantitatively reviewed in this appendix, considering direct impacts only. A more detailed analysis that also considers qualitative and indirect effects is presented in Chapter 12 of the EIR/EIS.

Permanent and temporary impacts were treated the same in considering the area of natural community needed to offset effects. The "typical" mitigation ratios used in this appendix were the same as those used in the EIR/EIS. They were used only for analytical purposes to determine whether the BDCP conservation strategy includes sufficient natural community protection and restoration to adequately offset the construction impacts of CM1 for purposes of CEQA and NEPA. These ratios reflect and are consistent with the professional judgment and scientific knowledge of the biologists who worked on chapter 12 of the EIR/EIS and the BDCP, and reflect their collective experience in environmental permitting, preparation of HCPs/NCCPs and similar natural resource management plans, and preparation of CEQA documents for state, regional, and local agencies (see EIS/EIR Chapter 12, Section 12.3.2.5 *Methods Used to Consider Mitigation*). Mitigation ratios were not used to develop the BDCP conservation strategy for purposes of complying with ESA or NCCPA; therefore, these mitigation ratios are not mentioned in BDCP Chapter 3, and would not be used to ensure plan compliance with those two statutes. Instead, compliance with ESA and NCCPA would be determined by ensuring rough proportionality between effects and conservation as a whole.

The typical mitigation ratios take into account several factors typically used during project-level evaluations.

- *The sensitivity and rarity of natural communities. More sensitive or rare communities have higher ratios.*
- *The importance of natural communities as habitat for the covered species. Communities that support more covered species have higher ratios.*
- *Threats to the natural community and the need for preservation to help alleviate those threats. Natural communities with more threats have a higher preservation ratio.*
- *The uncertainty in the success of restoration efforts, including evidence in other areas that similar restoration works. Natural communities with more uncertain restoration have a higher restoration ratio.*

The difference between the land acquisition and restoration needed to offset construction effects and that needed for the entire conservation strategy should not alone be viewed as the BDCP's contribution to recovery (i.e., contribution beyond mitigation). There are many additional components of the conservation strategy not captured in this analysis that also conserve the covered species and contribute to their recovery. For example, enhancement and management of natural communities (CM11), which involves creating specific vegetation structure or composition, would also help to conserve covered wildlife and plants. See the biological goals and objectives in Section 3.3 of the BDCP for a full description of all plan requirements that would help to conserve the covered species. The acreage targets for natural community protection and restoration are only a part of those requirements.

12D.2.2 Analysis Methods

12D.2.2.1 Analysis of Protection Feasibility

The assessment of protection feasibility was based on the description of protection of natural communities and species habitats in the Conservation Strategy of the BDCP (CM3) and the GIS data layers for natural communities and conservation zone boundaries used for preparation of the BDCP. The protected and restored lands would be assembled in the BDCP reserve system. The BDCP contains specific reserve system assembly principles (BDCP Section 3.2.4.2.1 *Reserve System Assembly Principles*). These principles were used by the authors of the BDCP to guide decisions regarding the distribution of targeted natural communities and covered species habitats among the conservation zones to ensure the greatest biological benefits. These principles include a focus of restoration and protection on the periphery of the Plan Area where future sea level rise can be accommodated; maintaining a range of contiguous ecological gradients and providing connectivity between wetland and upland communities; designing reserves to appropriately scale the ecological gradient and emphasize compatibility between restored natural communities and working landscapes (e.g., cultivated lands); design reserves of sufficient size to ensure the intended conservation benefits for the target covered species, and others. The protection feasibility assessment did not consider the assembly principles, because CM3 (BDCP Section 3.4.3) already qualitatively describes the broad opportunities for protection and restoration of natural communities and habitats of covered species in the different conservation zones, based on these principles.

Existing natural community acreage potentially available for protection was determined by calculating the acreage of natural community types outside existing conservation lands identified in the GIS layer. For some natural communities, small patches that would not contribute substantially

to BDCP preserves were disregarded. A minimum patch size of 10 acres was used for the valley/foothill riparian and grassland communities, and a minimum patch size of 1 acre was used for alkali seasonal wetland complex, vernal pool complex, and nontidal marsh (nontidal marsh = the mosaic of the nontidal freshwater perennial emergent wetland and nontidal perennial aquatic communities). For the other natural community types, no minimum patch size was used because even small fragments of these wetland types could be considered suitable for protection. Table 12D-1 shows the minimum patch sizes that were used.

Table 12D-1. Minimum Patch Sizes for Natural Community Protection

Natural Community Type	Minimum Patch Size (acres)
Tidal Perennial Aquatic	None
Tidal Freshwater Emergent Wetland	None
Valley/Foothill Riparian	10
Nontidal Marsh[a]	1
Alkali Seasonal Wetland Complex	1
Vernal Pool Complex	1
Managed Wetland	None
Other Natural Seasonal Wetland	N/A[b]
Grassland	10
Inland Dune Scrub	N/A
Cultivated Lands	None

[a] Nontidal Freshwater Perennial Emergent Wetland/Nontidal Perennial Aquatic

[b] N/A = Not applicable (no protection measures for these natural community types would be implemented that would offset water conveyance facilities construction impacts)

The total and near-term minimum BDCP protection and restoration area objectives are provided in Table 12D-2 (these acreages are the same as presented in Table 6-2 in the BDCP).

Existing Conservation Lands

The conservation lands GIS database that was used for this feasibility assessment was the same as the database used for preparation of the BDCP. The conservation lands, i.e., which are undeveloped lands subject to protection against a change in primary land use through local, state, or federal authority were derived from data sources described in Section 3.2.4.2.2 *Existing Conservation Lands* of the BDCP (BDCP Figure 3.2-14). The following source data were used.

- *Delta Land Ownership Dataset (Delta Habitat Conservation and Conveyance Program May 2013)*
- *California Protected Areas Database 1.9 (GreenInfo Network April 30, 2013)*
- *National Conservation Easement Database (Natural Resources Conservation Service September 14, 2012)*
- *Region 3 Lands (California Department of Fish and Wildlife, May 20, 2013)*
- *Region 3 Public Trust Lands (California Department of Fish and Wildlife, May 20, 2013)*
- *Protected Lands (Central Valley Joint Venture & Ducks Unlimited 2009)*

- *Wildlife Conservation Board Approved Projects (California Wildlife Conservation Board March 2009)*
- *Solano County Protected Lands Dataset (LSA Associates March 7, 2013)*
- *Public and Private Open Space Lands (many for protection of habitat) (LSA Associates 2006)*
- *San Joaquin County Multi-Species Habitat Conservation and Open Space Plan (December 20, 2011)*
- *Primary Management Area of the Suisun Marsh (San Francisco Bay Conservation and Development Commission 2011)*
- *Secondary Management Area of the Suisun Marsh (San Francisco Bay Conservation and Development Commission 2011)*
- *Suisun Marsh Conservation Lands (Chappell pers. comm.)*
- *Conservation Bank Lands (Jensen pers. comm.)*

Stone Lakes National Wildlife Refuge Plan Boundary (McDermott pers. comm.)

Table 12D-2. Total and Near-Term Minimum BDCP Protection and Restoration Area Objectives (acres)

Conservation Measure[a]	Total Requirement	Years 1 to 5	Years 6 to 10
CM3 Natural Communities Protection and Restoration			
Valley/Foothill Riparian	750	400	350
Vernal pool complex	600	200	200
Alkali seasonal wetland complex	150	0	120
Grassland	8,000	1,000	1,000
Managed wetland (salt marsh harvest mouse habitat)	1,500	500	1,000
Managed wetland (natural community)	6,600	1,400	1,900
Cultivated lands (non-rice)	48,125	7,700	7,700
Cultivated lands (rice)	500	100	100
Nontidal Marsh	50	10	15
Total Protection	**69,300**	**11,610**	**12,785**
Natural Community Restoration			
CM4 Tidal Natural Communities Restoration			
Tidal brackish emergent wetland	6,000	1,000	1,000
Tidal freshwater emergent wetland	24,000	4,425	4,425
Tidal wetland of any type and transitional uplands	35,000	4,150	4,150
Adjacent upland (for sea level rise accommodation)	10,000	500	500
Subtotal: Tidal wetland restoration	**65,000**	**9,575**	**9,575**
CM5 Seasonally Inundated Floodplain Restoration	**10,000**	**0**	**0**
CM6 Channel Margin Enhancement (miles)	**20**	**5**	**5**
CM7 Riparian Natural Community Restoration	**5,000**	**400**	**400**
CM8 Grassland Natural Community Restoration	**2,000**	**570**	**570**
CM9 Vernal Pool and Alkali Seasonal Wetland Complex Restoration			
Vernal Pool Complex	67	20	20
Alkali seasonal wetland	72	29	29
CM10 Nontidal Marsh Restoration			
Nontidal Marsh Restoration	1,200	200	200
Managed wetland	500	250	250
Total Restoration	**83,839**	**11,044**	**11,044**
Total Protection and Restoration	***153,139***	***22,654***	***23,829***

[a] For additional detail see Table 6-2 in the BDCP

Ownership information was collected and organized by county, county assessor's parcel number, management level, management agency, alias (if known), type (type of ownership), and data source attributes. Although the boundaries depicted within the data do not represent legal boundaries, they represent the best available information and were considered to be sufficiently accurate to guide development of the conservation measures for the reserve system at a landscape level.

The data layer was created by overlaying source data on top of county parcel boundary data. Parcels identified as protected lands in source datasets were then attributed with the appropriate information. The layer was then reviewed by land managers with expertise in specific geographic locations (e.g., Stone Lakes, Yolo Bypass, and Suisun Marsh).

The protection and resource management status of conservation lands was evaluated and classified based on the level of land use protection and the general level of ecological management. Each conservation land unit within the study area was assigned one of four resource management types. Three types of conservation land are protected from land use change by irrevocable means such as a conservation easement in perpetuity; or a local, state, or federal law. The fourth type consists of lands managed as open space and having some ecological value but not irrevocable protection (see BDCP Section 3.2.4.2.2 for additional detail). For the analysis in this appendix all four categories were considered "conservation lands" and therefore were not considered available for acquisition to protect natural communities or species habitat. This is a conservative approach, because the BDCP Implementation Office can purchase conservation easements to protect certain species on lands that are already protected from development (and are therefore "conservation lands"). More opportunities for protection exist than are considered in this analysis.

12D.2.2 Analysis of Restoration Feasibility

The analysis of restoration feasibility was based on the description of restoration of natural communities and species habitat in the Conservation Strategy of the BDCP (CM3–CM11), an analysis of GIS data layers, and available existing studies (see Section 2.4). The GIS data that were used to determine restoration suitability depended on the particular natural community type that was considered, as will be discussed below.

As is stated in the BDCP (Section 3.4.3.4 *Natural Communities Restoration Implementation*), restoration projects would be developed consistent with the relevant conservation measures for each natural community (CM4 through CM10). Restoration design would consider historical conditions in the Delta, based on information provided in *Sacramento-San Joaquin Delta Historic Ecology Investigation: Exploring Pattern and Process* (Whipple et al. 2012) (Figure 12D-1). The restoration feasibility assessment methods for specific natural communities are discussed in the remainder of this section and are summarized in Table 12D-3.

Table 12D-3. Criteria for Restoration Suitability Assessment

Natural Community/Land Cover Type	Criteria
Tidal Perennial Aquatic	Elevation, connection to existing tidal water, analysis conducted for the BDCP (i.e., modeled levee breaches)
Tidal Brackish Emergent Wetland	N/A[a]
Tidal Freshwater Emergent Wetland	Elevation, connection to existing tidal water, analysis conducted for the BDCP (i.e., modeled levee breaches)
Valley/Foothill Riparian	Landform(natural levees) and elevation
Nontidal marsh[b]	Cultivated lands, spatial connection to Coldani Marsh and rice fields
Alkali Seasonal Wetland Complex	Natural community (grassland/pasture), soils (alkali)
Vernal Pool Complex	Natural community (grassland/pasture), soils (clay pan or hardpan)
Managed Wetland	Greater sandhill crane winter use area, land use (grassland, pasture, cultivated land), soil (slowly draining)
Other Natural Seasonal Wetland	N/A
Grassland	Natural community (pasture, cultivated land), location (connected to preserved areas, California red-legged frog range)
Inland Dune Scrub	N/A
Cultivated Lands	N/A
Developed	N/A

[a] N/A = Not applicable (no restoration measures for these natural community or land cover types would be implemented that would offset water conveyance facilities construction impacts)
[b] Nontidal Freshwater Perennial Emergent Wetland/Nontidal Perennial Aquatic

12D.2.2.1 Tidal Natural Communities Restoration (CM4)

Tidal wetland restoration is a major focus of the BDCP. The BDCP proposes to restore at least 65,000 acres of tidal natural communities by year 40, including 24,000 acres of tidal freshwater emergent wetland, 6,000 acres of tidal brackish emergent wetland, and an additional 35,000 acres of tidal wetland of any type and transitional uplands. By year 10, 19,150 acres of tidal wetland would be restored, including 8,850 acres of tidal freshwater emergent wetland and 8,300 acres of tidal wetland of any type and transitional uplands (Table 12D-2, BDCP Table 6-2). The planned implementation of CM4 is described in BDCP Section 3.4.4.3.3, *Methods and Techniques,* and Section 3.4.4.3.4, *Siting and Design Considerations*. As part of the effects analysis of the BDCP and for the impact assessment of the EIR/EIS, the development of tidal wetlands was modeled at a number of hypothetical levee breach locations (BDCP Section 5.2.7, *Effects Analysis for Wildlife and Plants;* BDCP Appendix 3B, *Marsh Evolution*). Feasibility of tidal natural communities restoration is discussed in BDCP Section 3.4.4.2.1, *Feasibility of Tidal Restoration*.

Tidal marsh restoration would add at least an estimated 3,400 acres of tidal perennial aquatic natural community during the first 10 years after project initiation. The 3,400 acre increase is estimated, based on modeling reported in BDCP Appendix 3.B Table 5, by comparing existing Plan Area subtidal habitat to near-term subtidal habitat with the BDCP.

12D.2.2.2 Riparian Natural Community Restoration (CM7)

The BDCP proposes to restore 5,000 acres of valley/foothill riparian natural community by year 40. By year 10, 800 acres would be restored (Table 12D-2). The planned implementation of CM7 is described in BDCP Section 3.4.7.3.1, *Siting and Design Considerations* and Section 3.4.7.3.2 *Restoration Approaches*. The valley/foothill riparian natural community restoration is mainly conducted as part of tidal wetland restoration (CM4), seasonally inundated floodplain restoration (CM5), and channel margin enhancement (CM6).

The valley/foothill riparian natural community historically occurred on the natural levees along the major rivers that entered the Delta, such as the Sacramento, San Joaquin, and Mokelumne Rivers and their distributaries (Whipple et al. 2012, p. 43, pp. 68-73) (Figure 12D-1). The natural levees can still be recognized in the north and east Delta along the Sacramento River, Babel Slough, Elk Slough, Sutter Slough, Steamboat Slough, Mokelumne River, and other smaller waterways. These areas typically have sandy soils and stand out compared to the surrounding subsided historic tidal wetlands which had peat soils that have oxidized to some extent over the years.

The south Delta historically supported a mosaic of floodplain and tide lands on clay loam soils. The San Joaquin River had less pronounced natural levees, presumably as the result of less pronounced flood peaks (Whipple et al. 2012, p. 309).

As a result, the north and east Delta elevation is a suitable parameter to identify potential valley/foothill riparian restoration areas. However, the south Delta elevation was not suitable and instead the assessment of valley/foothill riparian acreage that could be restored was based on the levee setback models that were prepared for the South Delta Habitat Working Group (BDCP Appendix 5E), although it should be noted that those setbacks would not be implemented until after year 10.

GIS analysis used the tidal elevation data prepared by Wetlands and Water Resources (WWR), that was prepared for the BDCP and was based on multiple elevation data sources including DWR's 2007 1-meter LiDAR (resampled to 10 meters), DWR's 2003 Liberty Island bathymetry data resampled to 10 meters, and a 10-meter digital elevation model developed by URS based on IFSAR land data and USGS bathymetry data (Figure 12D-2). Tidal elevation zone classes were then established based on Siegel (2007). Natural levee landforms were identified along water courses in the north and east Delta that conformed to the Transitional Habitat 1 and 2 zones (10–15 feet above mean tide level in the north and east Delta). Historical riparian vegetation mapping for the 1800s (Whipple et al. 2012) was used to determine the historical extent of natural levees supporting riparian vegetation. The historical riparian bands were generally somewhat wider than the elevation band that was mapped by WWR, indicating that the use of the Transitional Habitat elevation zones resulted in a conservative estimate of riparian habitat suitability.

No literature sources were found that describe the growth rate of a valley/foothill riparian natural community in the Plan Area after planting. Age to maturity of Fremont cottonwood (*Populus fremontii*), one of the fastest growing riparian species, was listed as 5–10 years (Braatne et al. 1996). For this analysis, the minimum time to develop riparian scrub habitat values was assumed to be 5 years after planting or passive establishment, and the minimum time to develop early successional riparian forest was assumed to be 10–20 years. The actual duration of riparian forest development would depend on the species composition and site conditions. Early successional riparian stands dominated by black willow (*Salix gooddingii*) and Fremont cottonwood could develop in 10 years. It could take several more decades to develop late successional riparian forest dominated by Valley

oak (*Quercus lobata*). The development time for mid-successional riparian forest would be somewhere in between. When assessing the feasibility of habitat for a particular covered or noncovered wildlife species, the assumed duration of habitat development required was based on the habitat needs of the species.

12D.2.2.3 Grassland Natural Community Restoration (CM8)

Under *CM8 Grassland Natural Community Restoration*, the BDCP Implementation Office would restore 2,000 acres of grassland natural community in CZs 1, 8, and/or 11, and other zones as needed to achieve the biological goals and objectives for covered species. Actions under CM8 would be phased, with 570 acres restored by year 5, 1,140 acres (cumulatively) restored by year 10 and 2,000 acres (cumulatively) restored by year 25 of BDCP implementation (Table 12D-2). BDCP Section 3.4.8.2.1, *Grassland Restoration Approach*, Section 3.4.8.2.2 *Siting and Design Considerations*, and Section 3.4.8.2.3, *Restoration Techniques* describe the grassland restoration methods.

Restoring grassland consists of converting nongrassland areas (e.g., ruderal and cultivated lands) to grassland. Rather than completely eliminating nonnatives, grassland restoration focuses on increasing native biodiversity by planting natives, controlling or removing nonnative invasive species, and improving native wildlife habitat functions by increasing habitat extent and connectivity.

Restoration would be prioritized where it improves connectivity and increases the habitat functions of existing grassland plant and wildlife habitats, including linking or providing wildlife movement corridors to larger habitat areas immediately outside of the Plan Area or providing upland refugia for wildlife adjacent to emergent wetland and riparian natural communities. The most strategically important areas are listed below (BDCP Section 3.4.8.2.2. *Siting and Design Considerations*).

- *Areas where restoration would connect small patches of grasslands in CZs 1 and 11 with larger expanses of grassland in the Jepson Prairie area.*
- *Areas where restoration would connect grasslands in CZ 8 to other high-quality grassland habitat to the west and southwest of the Plan Area, and support the conservation areas assembled for the East Contra Costa County Habitat Conservation Plan/Natural Communities Conservation Plan (HCP/NCCP) and the San Joaquin County Multi-Species Habitat Conservation and Open Space Plan.*
- *Uplands adjacent to restored tidal brackish emergent wetlands in Suisun Marsh, to provide refugia for salt marsh harvest mouse and other wildlife.*
- *Areas adjacent to riparian brush rabbit and riparian woodrat (Neotoma fuscipes riparia) habitat along the upper margins of restored floodplains that are expected to be flooded infrequently, and along the outside edges of levees adjacent to floodplain restoration.*
- *Areas adjacent to restored freshwater emergent wetland (CM10 Nontidal Marsh Restoration) to provide basking sites and upland refugia for giant garter snake (Thamnophis gigas) (see BDCP Giant Garter Snake Objective GGS1.2 in BDCP Section, 3.3.5.28.3 Species Specific Goals and Objectives).*

The BDCP does not identify key uncertainties or research needs in connection with CM8. There is high confidence that this conservation measure would be effective as planned.

The GIS analysis focused on availability of cultivated and ruderal lands to be converted to grassland. Ruderal lands were mapped as grassland natural community in the GIS database used for impact

assessment in the EIR/EIS, however the ruderal lands could be identified using the attributes from the original California Department of Fish and Game (DFG) GIS (Hickson and Keeler-Wolf 2007). Because of the abundance of cultivated lands, the availability of land was not a concern; however, opportunities to make strategic connections to conserved grassland areas outside the Plan Area (e.g., Jepson Prairie, East Contra Costa County HCP/NCCP lands) were assessed with GIS.

12D.2.2.4 Alkali Seasonal Wetland Complex Restoration (CM9)

Under *CM9 Vernal Pool and Alkali Seasonal Wetland Complex Restoration*, the BDCP Implementation Office would restore vernal pool complex and alkali seasonal wetland complex in CZs 1, 8, and/or 11 to achieve no net loss of vernal pool and alkali seasonal wetland acreage from BDCP covered activities. BDCP Section 3.4.9.3.1, *Restoration Actions*, Section 3.4.9.3.2, *Siting Criteria*, and Section 3.4.9.3.3, *Restoration Techniques* describe the restoration methods.

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

Feasibility of alkali seasonal wetland restoration was assessed by mapping alkaline soils in CZs 1, 8 and 11, and identifying those areas where grasslands occur that were drained and leveled to be used as pasture. Historical aerial photographs from 1937 (California Department of Fish and Game 2012a) were reviewed to determine which of these areas had alkali seasonal wetland signatures. Suitable soils were based on correlating CNDDB (California Department of Fish and Game 2012b) occurrences of San Joaquin spearscale (*Atriplex joaquiniana*), an alkali-loving plant, with soil mapping units of the Soil Survey Geographic Database (SSURGO) GIS data (Natural Resources Conservation Service 2012a), and ICF staff field observations.

The following soil series were considered suitable for restoration of alkaline seasonal wetlands in the Plan Area: Alviso, Antioch, Marcuse, Omni, Pescadero, Reyes, Riz, Solano, Sycamore, and Willows (Attachment A). The Sycamore, Willows, and the Altamont-San Ysidro-San Benito Complex soil mapping units could be suitable for either alkali seasonal wetland or vernal pool restoration (Attachment A).

12D.2.2.5 Vernal Pool Complex Restoration (CM9)

The biological goals and objectives for vernal pool complex are the same as for alkali seasonal wetlands. Under *CM9 Vernal Pool and Alkali Seasonal Wetland Complex Restoration*, the BDCP Implementation Office would restore vernal pool complex and alkali seasonal wetland complex in CZs 1, 8, and/or 11 to achieve no net loss of vernal pool acreage from BDCP covered activities. BDCP Section 3.4.9.3.1, *Restoration Actions*, Section 3.4.9.3.2, *Siting Criteria*, and Section 3.4.9.3.3, *Restoration Techniques* describe the restoration methods.

As with alkali seasonal wetlands, remnant natural vernal and swale topography would be restored by excavating or recontouring historical vernal pools and swales to natural topography (and bathymetry) based on their characteristic visual signatures on historical aerial photographs, other historical data, and the arrangement and bathymetry of vernal pools at a reference site.

Soil series suitable for vernal pool restoration, i.e., soils underlain by an impervious subsoil layer (i.e., clay pan or hard pan) were identified based on Smith and Verrill (1998), SSURGO GIS data

(Natural Resources Conservation Services 2012a), and ICF staff field observations. Soil series with the potential for vernal pool restoration in the Plan Area are Galt, Hillgate, Jahant, San Joaquin, San Ysidro, Sycamore, and Willows (Attachment A). The Sycamore, Willows, and the Altamont-San Ysidro-San Benito Complex soil mapping units could be suitable for either alkali seasonal wetland or vernal pool restoration (Attachment A).

Areas with these soil types within CZs 1, 8, and 11 where grassland occurred that had been leveled and/or drained to be used as pasture were identified as areas that could potentially be restored to vernal pool complex. Aerial photographs of 1937 (California Department of Fish and Game 2012a) were reviewed to help identify areas with historical vernal pool signatures.

12D.2.2.6 Nontidal Marsh Restoration (CM10)

Under *CM10 Nontidal Marsh Restoration*, the BDCP Implementation Office would restore 1,200 acres of nontidal marsh[1] in CZs 2, 4, and/or 5 by year 40. CM10 actions would be phased, with 200 acres restored by year 5, and cumulatively 400 acres by year 10, 600 acres by year 20, and 1,200 acres by year 40 (Table 12D-2). BDCP Section 3.4.10.2.1, *Restoration Actions*, and Section 3.4.10.2.2, *Siting and Design Considerations* describe the restoration methods.

The primary purpose of CM10 is to create additional foraging and breeding habitat for giant garter snake, western pond turtle, and other native wildlife and plant species. Nontidal marsh restoration will also increase the abundance and distribution of associated covered and other native species, improve connectivity among habitat areas in and adjacent to the Plan Area, improve genetic interchange among native nontidal freshwater emergent wetland species' populations, and contribute to the long-term conservation of giant garter snake and other native species. Specifically, of the at least 1,200 acres of nontidal marsh created under Objective NFEW/NPANC1.1, at least 600 acres of aquatic habitat for the giant garter snake that is connected to the 1,500 acres of rice land or equivalent-value habitat will be created. Connections will be created from the White Slough giant garter snake population to other areas in the giant garter snake's historical range in the Stone Lakes vicinity by protecting, restoring, and/or creating at least 1,500 acres of rice land or equivalent-value habitat (e.g., perennial wetland) for the giant garter snake in Conservation Zones 4 and/or 5 (Objective GGS 1.4).

Existing cultivated lands would be converted to nontidal marsh in areas where hydrology and soils are suitable. Restoration may include creating wetland topography by site grading or creation of depressions to hold water. Grading would establish an elevation gradient to support open water and perennial aquatic habitat intermixed with shallower marsh habitat.

Shallow water bodies with stagnant or slow moving water that are less than 4-5 feet deep are readily colonized by tules (*Schoenoplectus* spp.) and cattails (*Typha* spp.) creating nontidal marsh. Nontidal marsh is a common feature of unmaintained ditches and ponds in the Delta. Given the abundance of cultivated lands that could be converted to nontidal marsh and managed wetlands and the relative ease of creating these natural communities in the Delta, a quantitative GIS analysis of opportunities to create nontidal marsh and managed wetlands was not deemed necessary. However, given the importance of establishing connectivity between giant garter snake populations as part of

[1] Nontidal marsh is a mosaic of the tidal freshwater emergent wetland and tidal perennial aquatic natural communities.

CM 10, maps of natural communities, aerial photography and known giant garter snake population occurrences were inspected visually to assess qualitatively whether sufficient land suitable for restoration to nontidal marsh is available to reach the connectivity objectives.

12D.2.2.7 Managed Wetland Creation (CM10)

CM10 provides for the creation of 500 acres of managed wetlands for greater sandhill crane (*Grus canadensis tabida*) roosting habitat in the greater sandhill crane Winter Use Area in CZs 3, 4, 5, or 6 by year 10 (250 acres during years 1 through 5 and 250 acres during years 6 through 10). BDCP Section 3.4.10.2.1, *Restoration Actions*, and Section 3.4.10.2.2, *Siting and Design Considerations*, describe the restoration methods.

Managed wetlands would be created by converting cultivated lands to managed wetlands. Nearly level (i.e., 2% slope or less) cultivated lands with slowly or very slowly permeable soils would be most suitable for conversion to wetlands. Such soils generally would be silty clay or clay to the surface or be underlain by a subsurface restrictive layer (i.e., a duripan). Appropriate hydrology would be created by building low levees, dikes, or berms around these areas and flooding them. The wetlands usually would be flooded in the fall to provide habitat for wintering waterfowl, and drained in spring or summer, although semi-permanent and permanent wetlands may also be created. Undesirable plant species would be controlled by disking or active water management. Desirable species with high nutrient content for waterfowl may be seeded. Areas of cultivated land with suitable soils for managed wetland creation are relatively abundant in the Delta, especially in the north, central, and west Delta.

12D.2.3 Existing Studies

The following existing studies were used to support assessment of the feasibility of restoration of natural communities in the Plan Area.

- *Sacramento-San Joaquin Delta Historical Ecology Investigation: Exploring Pattern and Process. (Whipple et al. 2012).*
- *BDCP South Delta Habitat and Flood Corridor Planning Corridor Description and Assessment Document (BDCP Appendix 5E).*
- *North Delta Flood Control and Ecosystem Restoration Project Final Environmental Impact Report (California Department of Water Resources 2010).*
- *Draft Environmental Impact Report Dutch Slough Tidal Marsh Restoration Project (California Department of Water Resources 2008b); Revised Conceptual Restoration Plan for the Dutch Slough Tidal Marsh Restoration Project (ESA PWA 2011).*
- *Conservation Strategy for Stage 2 Implementation. Sacramento-San Joaquin Delta Ecological Management Zone. Ecosystem Restoration Program (California Department of Fish and Game et al. 2010).*
- *Ecosystem Restoration Program Plan Year 12 Annual Report (California Department of Fish and Game et al. 2012).*

12D.3 Results

12D.3.1 Near-Term Protection and Restoration Evaluation

This section describes the BDCP's biological objectives for protection (CM3) and restoration (CM3–CM10), and compares them with the existing acreage in the Plan Area that would be suitable for implementing the objectives.

12D.3.1.1 Natural Communities Protection (CM3)

The area of natural community types that is not in conservation lands (i.e., not on lands conserved in perpetuity) was calculated for each conservation zone (Table 12D-4). These acreages were compared with the protection of natural communities as required under CM3.

Valley/Foothill Riparian

BDCP objective VFRNC1.2 is to protect at least 750 acres of existing valley/foothill riparian natural community in CZ 7 within the near-term implementation period (BDCP Table 3.4.3-6). CZ 7 supports 1,876 acres of the valley/foothill riparian natural community that is not conserved (Table 12D-4). The 750-acre BDCP protection objective represents 40.0% of the existing valley/foothill riparian natural community in CZ 7 in patches of at least 10 acres.

Table 12D-4. Natural Community Acreages on Non-Conservation Lands by Conservation Zone

	Conservation Zone											
Natural Community	CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8	CZ 9	CZ 10	CZ 11	Total
Tidal Perennial Aquatic	921	1,456	4,905	456	18,601	13,132	2,305	1,175	1,439	531	83	45,003
Tidal Freshwater Emergent Wetland	279	73	147	84	1,279	1,276	83	101	144	315	148	3,929
Valley/Foothill Riparian[a]	53	322	1,420	480	743	1,977	1,876	82	75	55	498	7,580
Grassland[a]	3,522	1,530	4,762	1,325	3,042	11,392	4,667	3,121	3,302	2,014	12,213	50,889
Alkali Seasonal Wetland Complex[b]	224	70	0	0	0	34	12	155	20	104	165	784
Vernal Pool Complex[b]	3,551	7	0	3	0	0	0	544	122	1	747	4,975
Other Natural Seasonal Wetland	0	5	0	6	0	0	15	0	0	0	24	50
Nontidal Marsh[b]	327	355	686	140	389	1,659	750	145	133	64	61	4,709
Cultivated Lands (non-rice)	38,867	16,233	66,264	28,018	60,637	62,396	95,902	24,745	19,527	655	1,445	414,688
Cultivated Lands (rice)	0	2,465	0	0	1,719	1,097	0	0	0	0	0	5,280
Managed Wetland	715	710	117	38	620	2,538	64	40	33	615	223	5,714
Total	**48,459**	**23,226**	**78,300**	**30,549**	**87,029**	**95,501**	**105,673**	**30,107**	**24,796**	**4,354**	**15,607**	**543,602**

[a] Lands with minimum patch size of 10 acres only

[b] Lands with minimum patch size of 1 acre only

Grassland

BDCP objective GNC1.1 is to protect at least 8,000 acres of grassland with at least 2,000 acres protected in CZ 1, at least 1,000 acres in CZ 8, at least 2,000 acres protected in CZ 11, and the remainder distributed among CZs 1, 2, 4, 5, 7, 8, and 11. These acreages are compared to the available grassland in the Plan Area in Table 12D-5. BDCP grassland objectives would protect at least 16.4% to 56.8% of grassland that is not currently conserved in CZs 1, 8 and 11. Overall, 27.2% of grassland that is not conserved would be protected by the BDCP Implementation Office in the identified CZs (Table 12D-5).

Of the 8,000 acres that would be protected, 1,000 acres would be protected within the first 5 years of implementation and an additional 1,000 acres would be protected within the next 5 years (Table 12D-2). Based on the presence of 29,419 acres of grassland that is not in conservation lands in the identified CZs, it can be concluded that sufficient grassland exists to implement the near-term conservation objectives of the BDCP.

Table 12D-5. Comparison of Acreages of BDCP Long-Term Protection Objectives with Grassland Present in the Conservation Zones

	Conservation Zone				
	CZ 1	CZ 8	CZ 11	CZs 2,4,5,7 and Remainder of CZs1, 8, and 11	Total of CZs 1,2,4,5,7,8, and 11
Protection	2,000	1,000	2,000	3,000	8,000
Present[a]	3,522	3,121	12,213	24,419	29,419
Percentage	56.8	32.0	16.4	12.3	27.2

[a] Non-conservation lands only

To protect upland habitat for California red-legged frog (*Rana draytonii*), the 1,000 acres to be protected in CZ 8 would be selected in the area to the west of Byron Highway (BDCP Section 3.3.5.30.2, *Applicable Natural Community Goals and Objectives*). Of the 3,522 acres of grassland not in conservation lands in CZ 8, 1,877 acres are located to the west of Byron Highway (Figure 12D-3). The Implementation Office would need to protect 53.3% of these lands to meet the BDCP California red-legged frog objective.

Alkali Seasonal Wetland Complex

BDCP objective ASWNC1.1 is to protect at least 150 acres of alkali seasonal wetland in CZs 1, 8, and/or 11 among a mosaic of protected grasslands and vernal pool complex. The acreage of alkali seasonal wetlands in CZs 1, 8, and 11 that is not in conservation lands and with a minimum patch size of 1 acre is 544 acres (Table 12D-4). The 150-acre BDCP protection goal would compose 27.6% of the existing alkali seasonal wetlands in the CZs 1, 8, and 11.

Within 10 years of the start of implementation of the BDCP, 120 acres of alkali seasonal wetland would be protected (Table 12D-2). This area represents 22.1% of the existing alkali seasonal wetland acreage that is not conserved in CZs 1, 8, and 11.

Vernal Pool Complex

BDCP objective VPNC1.1 is to protect at least 600 acres of existing vernal pool complex in CZs 1, 8, and 11, primarily in core vernal pool recovery areas identified in the vernal pool recovery plan (U.S. Fish and Wildlife Service 2005).

CZs 1, 8, and 11 include a total of 4,842 acres of vernal pool complex that is not in conservation lands (Table 12D-4). The 600-acre BDCP protection objective constitutes 12.4% of the existing vernal pool complex area. The total area of vernal pool complex that is not in conservation lands within the core vernal pool recovery areas within CZs 1, 8, and 11 is 3,224 acres. This area constitutes 67% of existing vernal pool complex in CZs 1, 8, and 11 that is not conserved.

Within 5 years of the start of implementation of the BDCP, 200 acres of vernal pool complex would be protected and an additional 200 acres would be protected between years 5 and 10 (Table 12D-2). This area represents 8.3% of the existing vernal pool complex area that is not in conservation lands.

Nontidal Marsh

Nontidal marsh would be protected for tricolored blackbird breeding habitat (BDCP, Section 3.3.5.23, *Tricolored Blackbird*). BDCP objective TRBL1.1 aims to protect and manage at least 50 acres of occupied or recently occupied (within the last 15 years) tricolored blackbird nesting habitat located within 5 miles of high-value foraging habitat in CZs 1, 2, 8, or 11. The area of nontidal marsh that is not on conservation lands ranges from 61 in CZ 11 to 355 acres in CZ 2 (Table 12D-4). The 50-acres BDCP protection objective would represent 82.0% to 14.1% of these CZs, respectively.

Within 5 years of the start of implementation of the BDCP, 10 acres of nontidal marsh would be protected and an additional 15 acres would be protected between years 5 and 10 (Table 12D-2). The 25-acre area to be protected by year 10 represents between 7.0% and 41.0% of the existing nontidal marsh area that is not in conservation lands.

Cultivated Lands

Cultivated lands would be protected to provide habitat for covered and other native wildlife species. BDCP objective CLNC1.1 aims to protect at least 48,125 acres of non-rice cultivated lands that provide suitable habitat for covered and other native wildlife species (BDCP Section 3.3.5.19, *Greater Sandhill Crane*). This objective represents 11.6% of the total available non-rice cultivated land that is not in conservation (Table 12D-4).

During the first 5 years of BDCP implementation, 7,700 acres of non-rice cultivated lands would be protected and an additional 7,700 acres would be protected between years 5 and 10 (Table 12D-2). The 15,400 acres to be protected by year 10 of implementation represents 3.7% of the existing 414,688 acres of non-rice cultivated land that is not in conservation.

Under the BDCP, 1,500 acres of giant garter snake habitat would be "protected, restored and/or created" connected to the White Slough giant garter snake population (BDCP, Section 3.3.5.28, *Giant Garter Snake*, Objective GGS1.4). This habitat can be "rice land or equivalent-value habitat (e.g., nontidal marsh)" for the giant garter snake, and should be in CZs 4 and/or 5. All or a portion of the 1,500 acres may consist of tidal freshwater emergent wetland and may overlap with the 24,000 acres of tidally restored freshwater emergent wetland, if it meets specific giant garter snake habitat criteria.

No rice land was mapped in CZ 4 (Table 12D-4). Rice lands on Brack Tract and Canal Ranch in CZ 5 total 1,115 acres and could be connected to giant garter snake populations to the north by additional restoration and protection of nontidal marsh. This area represents 65% of the rice land in CZ 5. The remaining 604 acres of rice land in CZ 5 occurs on subsided land in Bouldin Island that is not considered suitable to establish connected giant garter snake habitat.

During the first 5 years of BDCP implementation, 150 acres of rice land or the equivalent would be protected and an additional 150 acres would be protected between years 5 and 10 (Table 12D-2). The 300 acres to be protected by year 10 of implementation would (if no equivalent habitat would be protected) represent 27% of the existing rice land in CZ 5 that is suitable to connect giant garter snake populations.

Managed Wetland

BDCP objective MWNC1.1is to protect and enhance at least 6,500 acres of managed wetland and at least 1,500 acres of that are in the Grizzly Island Marsh Complex (U.S. Fish and Wildlife Service 2010). Within the Grizzly Island Marsh Complex, 1 acre of managed wetland is not on conservation lands (Table 12D-6). However, for these lands, that are in part in private ownership, but that are considered conservation lands because they are included in the Suisun Marsh Protection Plan, further protection and enhancement of habitat values can be realized by purchasing conservation easements and modifying the management regime. The 1,500-acre objective for managed wetland protection represents 5.3% of the Grizzly Island Marsh Complex managed wetlands.

Table 12D-6. Acreages of Lands by Natural Community and Conservation Status in the Grizzly Island Marsh Complex

	Conservation Lands	Non-Conservation Lands	Total
Tidal Perennial Aquatic	1,962	7	1,969
Tidal Brackish Emergent Wetland	2,885	5	2,890
Valley/Foothill Riparian	8	5	13
Grassland	1,825	1,577	3,402
Alkali Seasonal Wetland Complex	34	0	34
Vernal Pool Complex	69	0	69
Nontidal Marsh	11	0	11
Managed Wetland	28,245	1	28,246
Other Natural Seasonal Wetland	36	0	36
Total	35,076	1,595	36,671

Note: 255 acres of cultivated lands and 674 acres of developed lands are not included.

Natural Community Protection Totals

The total natural community and habitat acreage (including cultivated lands) to be protected under the BDCP would be at least 69,300 acres during the first 40 years of BDCP implementation (Table 12D-2), or 13% of the 543,602 acres of lands in the Plan Area that are not in conservation and meet the minimum patch sizes listed in Table 12D-1.

Within the first 5 years of BDCP implementation a total of 11,610 acres of lands would be protected, and within the next 5 years an additional 12,785 acres would be protected. Together these lands represent 5% of lands not in conservation in the Plan Area.

Management and habitat enhancement are an important part of "protection" as is described in BDCP Section 3.4.11, *Conservation Measure 11 Natural Communities Enhancement and Management.* The protected and restored lands would constitute a reserve system of connected natural communities and covered species habitats that are managed to optimize habitat values and that are enhanced consistent with the biological goals and objectives of the BDCP. For example, invasive plant species would be reduced to benefit native plants and ground squirrel populations would be managed to benefit California tiger salamander (*Ambystoma californiense*). The habitat value of protected lands is on the whole expected to increase substantially.

12D.3.1.2 Natural Communities and Covered Species Habitat Restoration (CM3–CM10)

Tidal Freshwater Emergent Wetland Restoration (CM4)

As is described in Section 2.2.2.1, assessment of the feasibility of tidal freshwater emergent wetland restoration required to offset conveyance facilities construction impacts, ranging from 1 (Alternative 1C) to 184 acres (Alternative 9), is much smaller than the 8,850 acres of tidal freshwater emergent wetland that would be restored by year 10. Mitigating for the impacts of conveyance construction would be feasible in the near-term, assuming the "typical" mitigation ratios used in the EIR/EIS.

At this time, several hundred acres of tidal freshwater emergent wetland have been restored in and around the Plan Area (BDCP Table 3.4.3.5), demonstrating feasibility of the approach. Several large-scale tidal marsh restoration projects are in the design phase. The Dutch Slough Project in the west Delta would restore 570 acres from irrigated pasture to tidal marsh (California Department of Water Resources 2008b; ESA PWA 2011) and the Lower Yolo Restoration Project in the north Delta would restore 1,170 acres of tidal marsh (State and Federal Contractors Water Agency 2011). The McCormack-Williamson Tract Flood Control and Ecosystem Restoration Project would restore 250 acres of tidal marsh (California Department of Fish and Game et al. 2012). Additional assessment of feasibility of tidal natural communities restoration is discussed in BDCP Section 3.4.4.2.1, *Feasibility of Tidal Restoration*.

Given the small impacts relative to the proposed restoration and the analyses presented in the BDCP that model the tidal wetland development, no additional feasibility assessment was considered necessary for the tidal freshwater emergent wetland and tidal perennial aquatic natural communities.

Seasonally Inundated Floodplain Restoration (CM5)

Seasonally inundated floodplain would not be restored until after year 10; however, some discussion is provided in Section 3.1.2.4.

Channel Margin Enhancement (CM6)

Under *CM6 Channel Margin Enhancement*, 20 miles of valley/foothill riparian, marsh, and mudflat natural communities would be restored along stream channels. By year 5, 5 miles of channel margin

would be restored and by year 10 an additional 5 miles. These acreages would contribute to the natural community and species habitats objectives of the BDCP. The contribution of this conservation measure to offsetting conveyance facilities construction impacts cannot be assessed, because no acreage objectives are included in CM6.

Valley/Foothill Riparian Restoration (CM7)

The valley/foothill riparian natural community would be restored primarily in association with tidal marsh restoration (CM4), floodplain restoration (CM5) and channel margin enhancement (CM6). By year 5, 400 acres of the valley/foothill riparian natural community habitat would be restored and, cumulatively, 800 acres would be restored by year 10 (Table 12D-2). Floodplain restoration would not be implemented until after year 10, and would therefore not be responsible for the initial 800 acres of restored valley/foothill riparian community.

Valley/foothill riparian natural community restoration would be designed to meet the requirements of covered species. These species have differing canopy structure or species composition requirements. Specific minimum acreage objectives are provided for the various riparian habitat types for year 15 or year 40 (BDCP Table 3.4.7-1), however no specific objectives for particular structural types or species composition have been identified for year 10.

By year 15, 1,000 acres of early- to mid-successional valley/foothill riparian natural community would be established, including at least 300 acres of dense riparian scrub and ecotonal habitat for the riparian brush rabbit (*Sylvilagus bachmani riparius*).

Within 10–20 years of initiation of restoration it would be possible to establish riparian scrub and early successional riparian forest. The duration of development into forest stands would depend on site conditions. The riparian scrub would include elderberry (*Sambucus* spec.) to provide habitat for the valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*).

Early successional riparian forest is typically dominated by Fremont cottonwood, Goodding's black willow, and a number of other willow species (*Salix* spp.). Its canopy structure is typically relatively simple with one tree, shrub and herb layer. It takes the dominant tree, Fremont cottonwood, approximately 10 years to reach maturity (Braatne et al. 1996). However, it would take additional time for Fremont cottonwood to develop branches that can support raptor nests. Development of mid-successional (or mixed) riparian forest takes at least 20-30 years, depending on site conditions. In addition to the species described above it would include additional dominant tree species, including western sycamore (*Platanus racemosa*), and Valley oak. It may also have a small tree layer, which may include boxelder (*Acer negundo*) and Oregon ash (*Fraxinus latifolia*). This mid-successional stage develops over time into a Valley oak-dominated late successional riparian forest that may also include western sycamore, and occasional Fremont cottonwood.

The hydrology of Sacramento and San Joaquin Rivers and their tributaries has been dramatically altered because of the construction of major dams in the 1940s to 60s. The ecologically most important change has been the reduction of the frequency of 5- to 10-year interval floods. These intermediate frequency floods are responsible for most of the scour and deposition of sediment and channel migration. As a result, the natural disturbance of riparian vegetation has been reduced, such that although the successional process proceeds, the cycle is not reset as frequently and as widespread as would have happened in a natural river system (California Department of Water Resources 2012; Jones & Stokes 1998). Hence, to maintain early- and mid-successional riparian forest and riparian scrub would require active management by the BDCP Implementation Office.

A total of 500 acres of restored valley/foothill riparian natural community would be maintained in mature riparian forest. Of this area, at least 300 acres would be maintained in habitat suitable for the riparian woodrat. The mature forest needs to have an overstory of tall trees, large patches of dense shrub understory, a midstory of small trees, tall shrubs and or vines that connects understory and canopy, and high-ground refugia from flooding and sea level rise (BDCP Section 3.4.7.3.1).

Habitat needs for western yellow-billed cuckoo (*Coccyzus americanus occidentalis*) would be considered when designing riparian restoration projects to maintain at least 500 acres of mature riparian forest in CZ 4 or 7, intermixed with early- to mid-successional riparian vegetation in large blocks with a minimum patch size of at least 50 acres and minimum width of 100 meters (Objectives VFRNC2.3 and VFRNC2.4). Riparian plant species would provide greater than 40% canopy closure, with a mean canopy height of approximately 7 to 10 meters (BDCP Section 3.4.7.3.1).

Historically, the Delta supported vast areas of valley/foothill riparian vegetation, mostly on the natural levees lining the Sacramento, San Joaquin, Mokelumne and Cosumnes Rivers. These areas occurred in various successional stages, depending on the time since the last scouring flood disturbance had occurred. The north Delta natural levees supported approximately 33,500 aces of riparian forest and approximately 3,000 acres of willow scrub during the early 1800s (Whipple et al. 2012, p. 277) (Figure 12D-1). Today, elevated lands (i.e., 10–15 feet above mean tide level, Figure 12D-2) along the Sacramento River and its distributaries (e.g., Babel Slough, Elk Slough, Sutter Slough, Georgiana Slough) support approximately 430 acres of riparian habitat, which occurs as small patches or narrow strips of trees or shrubs. Of these 430 acres, 209 acres are dominated by Valley oak, 72 acres are white alder (*Alnus rhombifolia*), 39 acres are cottonwood-willow tree stands, 94 acres are riparian scrub, and 16 acres are invasive plants. This same area supports 4,300 acres of agricultural land, presumably including lands that could potentially be restored to riparian habitat.

Restoration of McCormack-Williamson Tract along the Mokelumne River alone is expected to result in 350 acres of valley/foothill riparian natural community, including 250 acres of riparian forest and 100 acres of riparian scrub (California Department of Water Resources 2010; California Department of Fish and Game et al. 2012).

The south Delta (CZ 7) historically supported approximately 8,000 acres of valley/foothill riparian natural community, with 6,200 acres of forest and 1,800 acres of scrub (Whipple et al. 2012, p. 358). Today, that same area supports 2,800 acres of valley/foothill riparian natural community (Whipple et al. 2012, p. 358). Setting back levees and restoring floodplains in CZ 7 would provide substantial restored valley/foothill riparian natural community acreage. The South Delta Habitat Working Group assessed floodplain restoration in six corridor segments of the San Joaquin River and its distributaries in the Delta (BDCP Appendix 5E). The current valley/foothill riparian natural community area in the corridors ranges from 168 to 1,176 acres. The additional valley/foothill riparian natural community acreage that would result from floodplain restoration would result in 880–7,040 additional acres of valley/foothill riparian area per corridor, according to ESA PWA's models. If all corridors would be restored this would result in almost 16,000 acres of additional valley/foothill riparian natural community. As was noted above, these habitat acreages would not be restored until after year 10.

Implementing 400 acres of riparian habitat restoration by year 5 and 800 acres (cumulatively) in association with tidal habitat restoration (CM4) and channel margin enhancement (CM5) would be feasible, in the sense that sufficient suitable land area is available in the Delta. Riparian scrub can be

established within 5 years of planting and a form of early successional riparian forest (e.g., forest dominated by willows and cottonwood) can be established within 10 years. The trees in that forest would not yet be suitable nest trees for raptors or other large birds. It would take another 20 or more years to establish mature riparian forest described in BDCP Section 3.4.7, *Conservation Measure 7 Riparian Natural Community Restoration*.

Swainson's hawk and white-tailed kite require tall trees for nesting (e.g., 20 feet or taller). If it would be necessary to remove trees that could be used by these species for nesting, native riparian tree saplings will be planted and native mature riparian trees will be transplanted (Avoidance and Minimization Measure [AMM] 18, BDCP Appendix 3C, Section 3.C.2.1.18.2, *Nesting Habitat Replacement*) into the preserve system to replace these species. At least 5 sapling trees (five gallon container size) will be planted within the BDCP reserve system for every tree suitable for Swainson's hawk and white-tailed kite nesting anticipated to be removed by construction during the near-term period. Of the replacement trees planted, a variety of native tree species will be planted to provide trees with differing growth rates, maturation, and life span.

In addition, 5 mature native trees (at least 20 feet in height) will be planted for every 125 acres of construction footprint in which more than 50% of suitable nest trees (20 feet or taller) within the 125 acre block are removed (AMM 18, BDCP Appendix 3C, Section 3.C.2.1.18.2, *Nesting Habitat Replacement*). Replacement mature trees can be either nursery trees or can be transplanted trees scheduled to be removed by construction. To determine the number of replacement trees required, a grid of 125 acre blocks will be placed over each component of project footprint in which trees are to be removed. Raptor species other than Swainson's hawk or white-tailed kite, and species nesting in rookeries (e.g., cormorants and egrets) would potentially also benefit from the nesting habitat that would be provided by planted mature trees.

Habitat needs for species dependent on riparian scrub, such as valley elderberry longhorn beetle and riparian brush rabbit could be met within 10 years of planting riparian habitat.

Grassland Communities Restoration (CM8)

CZs 1, 8, and 11 have thousands of acres of cultivated lands that could be restored to grassland. However, several parts of these conservation zones are most promising for connection to conserved lands inside and outside the Plan Area. These areas include the agricultural lands to the west of Byron Highway in CZ 8 which would connect to grasslands protected under the East Contra Costa County HCP/NCCP and could provide upland habitat for the California red-legged frog. Other examples are the pastures and agricultural areas in the Cache Slough area, especially those north of Barker Slough. Pastures could be restored to annual grassland, alkali seasonal wetland complexes and vernal pool complexes in the Cache Slough area. Lastly, in CZ 11 pastures and turf farms south of Fairfield could be restored to grassland. As the BDCP states, there is great confidence that successful grassland restoration as defined under CM8 would be feasible.

Vernal Pool and Alkali Seasonal Wetland Complex Restoration (CM9)

The area of vernal pool and alkali seasonal wetland complexes that would be restored depends on the wetted area that would be affected by implementation of the BDCP. The wetted acreage would be replaced by restored wetted acreage of the same type (vernal pool or alkali seasonal wetland) at a ratio of 1:1 (if replacement occurs before the impact occurs), or at 1.5:1 if replacement occurs concurrently with the impact. No more than 10 acres of wetted vernal pool area and 10 acres of wetted alkali seasonal wetland area may be impacted by BDCP activities during the 50-year permit

term. No more than 5 acres of wetted vernal pool area and 5 acres of wetted alkali seasonal wetland acreage may be impacted during the near-term period.

No more than 10 wetted acres of vernal pools may be affected indirectly (where an activity encroaches within 250 feet of a vernal pool) during the near-term, and no more than 20 wetted acres may be indirectly affected by BDCP activities during the 50-year permit term.

At the time of preparation of the EIR/EIS, the wetted area of vernal pools or alkali seasonal wetlands that would be affected was unknown. Only the affected area of vernal pool complex or alkali seasonal wetland complex is known. The complexes include clusters of wetted vernal pool or alkali seasonal wetland areas with surrounding uplands.

A total of 7,150 acres of grassland is underlain by soils potentially suitable for alkali seasonal wetland complex restoration in CZs 1, 8, and 11 (Table 12D-7). In addition there are 929 acres of soil types that could support both vernal pools and alkali seasonal wetland complexes. A total of 234 acres of grassland in CZ11 were mapped as pasture by DFG (Hickson and Keeler-Wolf 2007), indicating that historical topographic relief may have been leveled. Approximately 38% of the grassland on soils potentially suitable for alkali seasonal wetland restoration (3,093 acres) occurs on conservation lands (Table 12D-7). One can assume that 10%–20% of the complexes consist of wetted area to estimate the potential to restore wetted acreage.

In CZs 1, 8, and 11, a total of 1,002 acres of grassland occurs that is underlain by soils potentially suitable for vernal pool complex restoration (Table 12D-7). In addition there are 929 acres of soil types that could support both vernal pools and alkali seasonal wetland complexes. Of the grasslands potentially suitable for restoration of vernal pool complexes, 38% are on conservation lands (738 acres). There is no absolute distinction between the potential to restore vernal pool complexes and alkali seasonal wetland complexes. These types of seasonal wetlands frequently occur as a mosaic, and some vernal pools support alkali-loving vegetation.

Considering that alkali seasonal wetland complexes and vernal pool complexes may contain approximately 10%–20% wetted area, potentially 808 to 1,616 acres of alkali seasonal wetland could be restored and 193 to 386 acres of vernal pool could be restored in CZs 1, 8 and 11 (including 93 to 186 acres that could be restored to either natural community).

Table 12D-7. Acreage of Grasslands with Soils Potentially Suitable for Alkali Seasonal Wetland or Vernal Pool Restoration by Conservation Zone and Conservation Status

	Conservation Zone			
	CZ 1	CZ 8	CZ 11	Total
Conservation Lands				
Alkali Seasonal Wetland Soils	339	209	2,252	2,801
Vernal Pool Soils	103	329	14	446
Alkali Seasonal Wetland and Vernal Pool Soils	0	0	292	292
Total	**442**	**539**	**2,558**	**3,539**
Non-Conservation Lands				
Alkali Seasonal Wetland Soils	702	883	2,764	4,349
Vernal Pool Soils	215	319	21	556
Alkali Seasonal Wetland and Vernal Pool Soils	276	0	361	637
Total	**1,193**	**1,203**	**3,146**	**5,542**
All Lands				
Alkali Seasonal Wetland Soils	1,041	1,093	5,016	7,150
Vernal Pool Soils	318	649	35	1,002
Alkali Seasonal Wetland and Vernal Pool Soils	276	0	653	929
Total	**1,635**	**1,742**	**5,704**	**9,080**

Managed Wetlands (CM10)

Numerous managed wetlands have been created for waterfowl habitat in or around the Plan Area, e.g., Stone Lakes National Wildlife Refuge, Vic Fazio Yolo Wildlife Area, Grizzly Island Wildlife Area, White Slough Wildlife Area, and private duck clubs. See also BDCP Table 3.4.3 5 for examples of nontidal marsh projects implemented in and around the Plan Area.

Within the 314,700-acre greater sandhill crane winter use area, 62% of the area (196,434 acres) is grassland, pasture or non-rice cultivated land (excluding vineyards and orchards) on soil types that are potentially suitable for managed wetland creation (Table 12D-8). A total of 19% of that area (37,435 acres) is in conservation lands. Numerous opportunities exist to create managed wetland in this area.

Table 12D-8. Grassland and Agricultural Land Use in the Greater Sandhill Crane Winter Use Area

	Grassland	Pasture	Other Cultivated Lands	Rice	Vineyard	Orchard	Total
Conservation Land	**6,208**	**6,424**	**24,803**	0	577	83	38,096
Non-conservation Land	**16,160**	**5,299**	**137,540**	2,248	21,534	8,230	191,011
Total	**22,368**	**11,723**	**162,344**	2,248	22,111	8,313	229,107

Note: Lands most suitable for managed wetland creation are shown in bold.

12D.3.2 Alternatives Evaluation

12D.3.2.1 Introduction

This section evaluates whether near-term protection and restoration proposed in CM3–CM11 would offset impacts of water conveyance facilities construction on terrestrial natural communities and species habitat. The five water conveyance construction corridors included in the EIR/EIS have been evaluated, using the construction footprints represented by Alternatives 1A (pipeline/tunnel, five intakes), 1B (east alignment, five intakes), 1C (west alignment, five intakes), 4 (modified pipeline/tunnel alignment, three intakes) and 9 (through Delta corridors option). The other alternatives included in the EIR/EIS use these same corridors with minor or no modifications in construction footprint. Section 12.3, *Environmental Consequences*, of the EIR/EIS discusses the impacts of conveyance facilities construction on terrestrial natural communities and species in detail. That section also assesses whether implementing CM3–CM11 in the near-term would offset the conveyance facilities construction (CM1) such that the net effect on terrestrial biological resources would not be adverse. In other words, Section 12.3 determines whether the impacts of CM1 would be mitigated by the near-term implementation of the Conservation Strategy to a less-than-significant level. This evaluation was made assuming "typical" mitigation ratios for protection and restoration would be sufficient to indicate whether impacts would be less than significant.

The analysis presented in this section determines whether the near-term protection and restoration discussed in Section 3.1, would be sufficient to provide feasible mitigation of CM1 impacts at the ratios presented in the EIR/EIS, assuming that CM3–CM11 would be implemented to meet the BDCP's biological goals and objectives and would be subject to the BDCP's avoidance and minimization measures that would reduce effects of implementing the conservation measures on covered species.

This section also considers to what extent restored natural communities and species habitat would be replacing habitat values lost through the conveyance facilities construction impacts. For that analysis, it is assumed that all restoration would be initiated at the beginning of the implementation period. That is, where Table 12D-2 shows that 400 acres of valley/foothill riparian habitat would be restored in the year 1–5 period and 400 acres in the year 6–10 period, it is assumed that by year 10, 400 acres of foothill/riparian is 10 years old (e.g., riparian scrub/early successional forest) and 400 acres is 5 years old (e.g., riparian scrub). The importance of any time lags between impacted habitat values and their replacement through restoration is further discussed in Section 12.3, *Environmental Consequences*, of the EIR/EIS and additional mitigation beyond implementing CM3–CM11 may be required to offset any temporal loss of habitat value.

12D.3.2.2 Alternative 1A–Dual Conveyance with Pipeline/Tunnel and Intakes 1–5 (15,000 cfs; Operational Scenario A)

Natural Communities

Table 12D-9 compares the conveyance facilities impacts on natural communities and cultivated land under Alternative 1A with the net change in conserved natural communities resulting from implementing the conservation strategy in the near-term period. Restoration would result in an increase in natural community area. Protection is assumed to result in a substantial increase in habitat value, because protected lands would be selected to increase habitat connectivity, would be enhanced to meet BDCP biological goals and objectives, and would be protected as habitat in

perpetuity. In addition, EIR/EIS Section 12.3, *Environmental Consequences*, describes that the impacted natural communities tend to have small patch sizes, are generally highly fragmented, and tend to have limited habitat values due to the prevalence of invasive species and management practices that are not conducive to maintaining habitat values for covered species.

The results of the analysis for Alternative 1A are presented as follows in Tables 12D-9 –12D-13 . Temporary and permanent conveyance facilities impacts are combined; that is, temporary impacts are treated as if they were permanent (Column 2: "Conveyance Facilities Impact"). Near-term impacts from implementation of restoration actions are provided (Column 3, "Near-Term Restoration Impact"). They are subtracted from the near-term restoration target to provide a net near-term change in area for the natural community (Column 6: "Net Near-Term Restoration Area Change"). The "typical" mitigation ratios used in the EIR/EIS (Columns 8: "Restoration Ratio" and 9: "Protection Ratio") are then applied to the impacts, to provide the near-term restoration and protection required to mitigate for the conveyance facilities impacts (Columns 10: "Near-Term Restoration Requirement" and 11: "Near-Term Protection Requirement"). Those requirements are then subsequently compared to the restoration and protection the BDCP calls for (Columns 12: "Difference of Near-Term Area Change and Restoration Requirement" and 13: "Difference of Near-Term Protection and Protection Requirement"), which are then combined to provide the overall conservation difference (Column 14: "Overall Conservation Difference").

In all but one case, the BDCP conservation acreage under Alternative 1A substantially exceeds the acreage required to offset construction impacts (Table 12D-9). In the case of managed wetlands, the conveyance facilities construction would affect 85 acres of managed wetlands, and restoration would cause a loss of 5,786 acres. Considering BDCP near-term protection (and enhancement), there would be a net loss of 2,651 acres of managed wetlands in the first ten years. However, managed wetland acreage is mostly lost as the result of restoration of tidal freshwater emergent wetland, which would increase by 8,831 acres. As is described in EIR/EIS Section 3.2, *Environmental Consequences*, this conversion to native natural community and enhancement of existing managed wetland to provide better foraging habitat would result in a net benefit to native species and therefore the loss of managed wetland is not considered an adverse effect and is less-than-significant.

As is discussed in Section 3.1.1, there are sufficient areas in the specified conservation zones that are currently not conservation lands to provide opportunities for near-term protection by the Implementation Office. There is also sufficient land that could potentially be restored to provide sufficient restoration acreage (Section 3.1.2).

1 **Table 12D-9. Water Conveyance Facilities Construction Impacts on Natural Communities and Cultivated Lands Compared with Planned BDCP Near-Term Restoration and Protection under Alternative 1A**

Alternative 1A	Near-Term Impacts (acres)			BDCP Near-Term Conservation			Evaluation of BDCP Near-Term Conservation Relative to Water Conveyance Facilities Impact						
Natural Community	Conveyance Facilities Impact (acres)	Near-Term Restoration Impact (acres)	Total Near-Term Impact (acres)	Near-Term BDCP Restoration (acres)	Net Near-Term Restoration Area (acres)	Near-Term BDCP Protection (acres)	Restoration Ratio	Protection Ratio	Near-Term Restoration Requirement (acres)	Near-Term Protection Requirement (acres)	Difference of Near-Term Area Change and Restoration Requirement (acres)	Difference of Near-Term Protection and Protection Requirement (acres)	Overall Conservation Difference (acres)
Tidal Perennial Aquatic	180	30	210	3,400	3,370	0	1	0	180	0	3,190	0	3,190
Tidal Freshwater Emergent Wetland	12	7	19	8,850	8,843	0	1	0	12	0	8,831	0	8,831
Valley/Foothill Riparian	86	475	561	800	325	750	1	1	86	86	239	664	902
Grassland	578	1,127	1,692	1,140	26	2,000	0	2	0	1,155	26	845	871
Alkali Seasonal Wetland Complex	0	58	58	58	0	120	1	2	0	0	0	120	120
Vernal Pool Complex[a] (direct/indirect)	3/12	64	67/12	40	-24	400	1	2	3	30	-27	370	343
Other Natural Seasonal Wetland	0	0	0	0	0	0	1	2	0	0	0	0	0
Nontidal Marsh[b]	22	135	157	400	265	25	1	1	22	22	243	3	245
Managed Wetland	85	5,786	5,871	320	-5,466	2,900	0	1	0	85	-5,466	2,815	-2,651
Cultivated Lands (non-rice)	6,027	8,636	14,662	0	-8,636	15,400	0	1	0	6,027	-8,636	9,373	738
Cultivated Lands (rice + "rice or equivalent")	1	84	85	0	-84	900	0	1	0	1	-84	899	815

Notes:

[a] Impact of restoration on vernal pool complex is based on maximum allowable loss of wetted area.

[b] Nontidal marsh = nontidal freshwater perennial emergent wetland + nontidal perennial aquatic.

2

Species Habitat

On an acre-for-acre basis, the habitat value of restored and protected (and enhanced) natural communities in the near-term would be greater than the value of the affected lands, as described above. Restoration, enhancement and management would be implemented to benefit the covered species and generally would also benefit noncovered species.

As was described in Section 3.1.2.4, it will not be feasible to restore mid- to late successional valley/foothill riparian forest within the near-term (10-year) timeframe when starting with seedlings. However, mature trees and tree saplings will be planted to replace Swainson's hawk and white-tailed kite nest trees (AMM 18). Other raptors would also benefit from the planted mature trees.

The largest habitat area that would be affected by construction of the conveyance facilities would be non-rice cultivated land. Under Alternative 1A, 6,027 acres of cultivated lands would be lost due to construction of the water conveyance facility and 8,636 acres would be lost due to near-term restoration, resulting in an overall loss of 14,662 acres in the near-term (Table 12D-9). This land provides, depending on the crop type, foraging habitat for several covered species, including for example Swainson's hawk (*Buteo swainsoni*) (e.g., alfalfa), and greater sandhill crane (e.g., grain crops) and a suite of other species. The conservation strategy would protect and enhance 15,400 acres of cultivated lands which would mitigate the effects of water conveyance facilities construction and offset the effects of restoration on cultivated land. The protected area would be 738 acres larger than the area affected. The total area of cultivated land in the plan area is 476,269 acres. Sufficient cultivated land exists in the Plan Area to achieve the required protection.

12D.3.2.3 Alternative 1B—Dual Conveyance with East Alignment and Intakes 1–5 (15,000 cfs; Operational Scenario A)

Natural Communities

Water conveyance facilities construction under Alternative 1B would have similar but generally larger effects on terrestrial natural communities when compared to Alternative 1A (Table 12D-10). Similar to Alternative 1A, under 1B overall conservation far exceeds the acreage required to mitigate for conveyance facilities construction impacts.

Table 12D-10 shows that the BDCP conservation acreage substantially exceeds the acreage required to offset construction impacts for all natural communities, except managed wetlands. In the case of managed wetlands, the conveyance facilities construction would affect 24 acres of managed wetlands, and restoration would cause a loss of 5,786 acres. Considering BDCP near-term protection (and enhancement), there would be a net loss of 2,590 acres of managed wetlands in the first ten years. However, managed wetland acreage is mostly lost as the result of restoration of tidal freshwater emergent wetland, which would increase by 8,843 acres. As is described in EIR/EIS Section 3.2, *Environmental Consequences*, this would result in a net benefit to native species and therefore the loss of managed wetland is not considered an adverse effect and is less-than-significant.

As is discussed in Section 3.1.1, there are sufficient areas in the specified conservation zones that are currently not conservation lands to provide opportunities for near-term protection by the Implementation Office. There is also sufficient land that could potentially be restored to provide

sufficient restoration acreage (Section 3.1.2). The near-term implementation of CM3–CM11 is considered feasible, as was discussed in Section 3.1.

Species Habitat

Implementation of the BDCP Conservation Strategy would restore and protect sufficient natural community acreage to mitigate for conveyance facilities construction effects in the near-term, as discussed under Alternative 1A. Details are provided in Section 12.3, *Environmental Consequences* of the EIR/EIS.

Under Alternative 1B, 20,378 acres of cultivated lands would be lost due to construction of the water conveyance facility and 8,636 acres would be lost due to near-term restoration, resulting in an overall loss of 29,014 acres in the near-term (Table 12D-10). The conservation strategy would protect and enhance 15,400 acres of cultivated lands to mitigate the effects of conveyance facilities construction and offset the effects of restoration on cultivated land. The protected area would be 13,614 acres less than the area affected. Additional conservation of foraging habitat for Swainson's hawk, white tailed kite and other species that forage on cultivated land would be required to fully compensate for the effect of restoration and conveyance facility construction.

Table 12D-10. Water Conveyance Facilities Construction Impacts on Natural Communities and Cultivated Lands Compared with Planned BDCP Near-Term Restoration and Protection under Alternative 1B

Alternative 1B	Near-Term Impacts (acres)			BDCP Near-Term Conservation			Evaluation of BDCP Near-Term Conservation Relative to Water Conveyance Facilities Impact						
Natural Community	Conveyance Facilities Impact (acres)	Near-Term Restoration Impact (acres)	Total Near-Term Impact (acres)	Near-Term BDCP Restora-tion (acres)	Net Near-Term Restoration Area (acres)	Near-Term BDCP Protection (acres)	Restoration Ratio	Protection Ratio	Near-Term Restoration Requirement (acres)	Near-Term Protection Requirement (acres)	Difference of Near-Term Area Change and Restoration Requirement (acres)	Difference of Near-Term Protection and Protection Requirement (acres)	Overall Conservation Difference (acres)
Tidal Perennial Aquatic	178	30	208	3,400	3,370	0	1	0	178	0	3,192	0	3,192
Tidal Freshwater Emergent Wetland	19	7	26	8,850	8,843	0	1	0	19	0	8,824	0	8,824
Valley/Foothill Riparian	91	475	566	800	325	750	1	1	91	91	234	659	894
Grassland	758	1,127	1,872	1,140	26	2,000	0	2	0	1,515	26	485	511
Alkali Seasonal Wetland Complex	0	58	58	58	0	120	1	2	0	0	0	120	120
Vernal Pool Complex[a] (direct/indirect)	4/15	63	67/15	40	-23	400	1	2	4	38	-27	335	331
Other Natural Seasonal Wetland	0	0	0	0	0	0	1	2	0	0	0	0	0
Nontidal Marsh[b]	35	135	171	400	264	25	1	1	35	35	229	-10	218
Managed Wetland	24	5,786	5,810	320	-5,466	2,900	0	1	0	24	-5,466	2,876	-2,590
Cultivated Lands (non-rice)	20,378	8,636	29,014	0	-8,636	15,400	0	1	0	20,378	-8,636	-4,978	-13,614
Cultivated Lands (rice + "rice or equivalent")	59	84	143	0	-84	900	0	1	0	59	-84	841	757

Notes:

[a] Impact of restoration on vernal pool complex is based on maximum allowable loss of wetted area.

[b] Nontidal marsh = nontidal freshwater perennial emergent wetland + nontidal perennial aquatic.

12D.3.2.4 Alternative 1C—Dual Conveyance with West Alignment and Intakes W1–W5 (15,000 cfs; Operational Scenario A)

Natural communities

Water conveyance facilities construction under Alternative 1C would have similar but generally larger effects on terrestrial natural communities when compared to Alternative 1A (Table 12D-10). Similar to Alternative 1A, under 1C overall conservation far exceeds the acreage required to mitigate for conveyance facilities construction impacts.

In the near-term timeframe, 22 acres of alkali seasonal wetland complex would be removed by construction of the water conveyance facilities. The near-term effect of restoration would be removal of 58 acres of alkali seasonal wetland complex, which is equal to the area that of 58 acres that would be restored. So, no net restoration acreage gain would result in the near-term. Mitigation Measure Bio-18 would reduce the effect of implementing of Alternative 1C on the alkali seasonal wetland complex natural community to less than significant. It would require 40 acres of additional restoration of alkali seasonal wetland complex and 40 acres of additional protection in the near-term. Analysis of lands potentially suitable for alkali seasonal wetland complex restoration (Table 12D-7) and protection (Table 12D-4) shows that sufficient land area would be available.

Under Alternative 1C, 4 acres of other seasonal wetlands would be removed. The Plan does not include specific conservation measures to restore or protect this natural community, and Mitigation Measure Bio-27 would therefore be implemented to restore an additional 4 acres and protect an additional 8 acres of seasonal wetland (e.g., alkali seasonal wetland complex or vernal pool complex) to reduce the effect of Alternative 1C on this natural community to less than significant. Sufficient opportunities should exist to accomplish this in the Plan Area.

The conveyance facilities construction would affect 145 acres of managed wetlands, and restoration would cause a loss of 5,786 acres. Considering BDCP near-term protection (and enhancement), there would be a net loss of 2,711 acres of managed wetlands in the first ten years. However, managed wetland acreage is mostly lost as the result of restoration of tidal freshwater emergent wetland, which would increase by 8,824 acres. As is described in EIR/EIS Section 3.2, *Environmental Consequences*, this would result in a net benefit to native species and therefore the loss of managed wetland is not considered an adverse effect and is less-than-significant.

Species Habitat

Implementation of the conservation strategy would restore and protect sufficient natural community acreage to mitigate for these effects in the near-term, with the exception of vernal pool crustacean habitat. The total wetted acreage of vernal pool habitat directly affected by the water conveyance facilities (affected vernal pools and affected alkali seasonal wetland in CZ8) adds to 12.2 acres. Avoidance and Mitigation Measure 12 states that “no more than 10 wetted acres of vernal pool crustacean habitat will be removed throughout the permit term”. Additional vernal pool habitat restoration will be required at a ratio of 1:1 or 1.5:1, depending on the timing of impacts relative to planned BDCP restoration, as described under Mitigation Measure Bio-32 in Chapter 12. Sufficient opportunity would be available in the plan area for this mitigation (Table 12D-7). Details are provided in EIR/EIS Section 12.3, *Environmental Consequences*.

Under Alternative 1C, 15,554 acres of cultivated lands would be lost due to construction of the water conveyance facility and 8,636 acres would be lost due to near-term restoration, resulting in an overall loss of 24,189 acres in the near-term (Table 12D-11). The conservation strategy would protect and enhance 15,400 acres of cultivated lands to mitigate the effects of conveyance facilities construction and offset the effects of restoration on cultivated land in the near-term. The protected non-rice cultivated lands area would be 2,711 acres less than the area affected. Additional conservation of foraging habitat for Swainson's hawk, white tailed kite and other species that forage on cultivated land would be required to fully compensate for the effect of restoration and conveyance facility construction.

Table 12D-11. Water Conveyance Facilities Construction Impacts on Natural Communities and Cultivated Lands Compared with Planned BDCP Near-Term Restoration and Protection under Alternative 1C

Alternative 1C	Near-Term Impacts (acres)			BDCP Near-Term Conservation			Evaluation of BDCP Near-Term Conservation Relative to Water Conveyance Facilities Impact						
Natural Community	Conveyance Facilities Impact (acres)	Near-Term Restoration Impact (acres)	Total Near-Term Impact (acres)	Near-Term BDCP Restoration (acres)	Net Near-Term Restoration Area (acres)	Near-Term BDCP Protection (acres)	Restoration Ratio	Protection Ratio	Near-Term Restoration Requirement (acres)	Near-Term Protection Requirement (acres)	Difference of Near-Term Area Change and Restoration Requirement (acres)	Difference of Near-Term Protection and Protection Requirement (acres)	Overall Conservation Difference (acres)
Tidal Perennial Aquatic	143	30	173	3,400	3,370	0	1	0	143	0	3,227	0	3,227
Tidal Freshwater Emergent Wetland	1	7	8	8,850	8,843	0	1	0	1	0	8,842	0	8,842
Valley/Foothill Riparian	127	475	602	800	325	750	1	1	127	127	198	623	822
Grassland	678	1,127	1,792	1,140	26	2,000	0	2	0	1,357	26	643	669
Alkali Seasonal Wetland Complex	22	58	80	58	0	120	1	2	22	43	-22	77	55
Vernal Pool Complex[a] (direct/indirect)	66/56	1	67/56	40	39	400	1	2	66	244	-27	156	129
Other Natural Seasonal Wetland	4	0	4	0	0	0	1	2	4	8	-4	-8	-12
Nontidal Marsh[b]	47	135	183	400	264	25	1	1	47	47	217	-22	194
Managed Wetland	145	5,786	5,931	320	-5,466	2,900	0	1	0	145	-5,466	2,755	-2,711
Cultivated Lands (non-rice)	15,554	8,636	24,189	0	-8,636	15,400	0	1	0	15,554	-8,636	-154	-8,789
Cultivated Lands (rice + "rice or equivalent")	0	84	84	0	-84	900	0	1	0	0	-84	900	816

Notes:

[a] Impact of restoration on vernal pool complex is based on maximum allowable loss of wetted area.

[b] Nontidal marsh = nontidal freshwater perennial emergent wetland + nontidal perennial aquatic.

12D.3.2.5 Alternative 4—Dual Conveyance with Pipeline/Tunnel and Intakes 2, 3, and 5 (9,000 cfs; Operational Scenario H)

Natural Communities

Water conveyance facilities construction under Alternative 4 would have similar effects on terrestrial natural communities when compared to Alternative 1A (Table 12D-12). Implementation of the Conservation Strategy would restore and protect sufficient natural community acreage to mitigate for these effects in the near-term. Under Alternative 4, an area of 2,101 acres of Clifton Court Forebay would be dredged. Effects on terrestrial species of this in-water activity would be limited. Details are provided in Section 12.3, *Environmental Consequences*, of the EIR/EIS.

The conveyance facilities construction would affect 35 acres of managed wetlands, and restoration would cause a loss of 5,786 acres. Considering BDCP near-term protection (and enhancement), there would be a net loss of 2,601 acres of managed wetlands in the first ten years. However, managed wetland acreage is mostly affected by restoration of tidal freshwater emergent wetland, which would increase by 8,824 acres. As is described in EIR/EIS Section 3.2, *Environmental Consequences*, this would result in a net benefit to native species and therefore the loss of managed wetland is not considered an adverse effect and is less-than-significant.

Species Habitat

Implementation of the conservation strategy would restore and protect sufficient natural community acreage to mitigate for on species habitat in the near-term. Details are provided in EIR/EIS Section 12.3, *Environmental Consequences*.

Under Alternative 4, 5,983 acres of non-rice cultivated lands would be lost due to construction of the water conveyance facility and 8,636 acres would be lost due to near-term restoration, resulting in an overall loss of 14,619 acres in the near-term (Table 12D-12). The conservation strategy would protect and enhance 15,400 acres of cultivated lands to mitigate the effects of conveyance facilities construction and offset the effects of restoration on cultivated land in the near-term. The protected area would be 781 acres larger than the area affected.

1 **Table 12D-12. Water Conveyance Facilities Construction Impacts on Natural Communities and Cultivated Lands Compared with Planned BDCP Near-Term Restoration and Protection under Alternative 4**

Alternative 4	Near-Term Impacts (acres)			BDCP Near-Term Conservation			Evaluation of BDCP Near-Term Conservation Relative to Water Conveyance Facilities Impacts						
Natural Community	Conveyance Facilities Impact (acres)	Near-Term Restoration Impact (acres)	Total Near-Term Impact (acres)	Near-Term BDCP Restoration (acres)	Net Near-Term Restoration Area (acres)	Near-Term BDCP Protection (acres)	Restoration Ratio	Protection Ratio	Near-Term Restoration Requirement (acres)	Near-Term Protection Requirement (acres)	Difference of Near-Term Area Change and Restoration Requirement (acres)	Difference of Near-Term Protection and Protection Requirement (acres)	Overall Conservation Difference (acres)
Tidal Perennial Aquatic[a]	178	30	208	3,400	3,370	0	1	0	178	0	3,192	0	3,192
Tidal Freshwater Emergent Wetland	16	7	23	8,850	8,843	0	1	0	16	0	8,827	0	8,827
Valley/Foothill Riparian	64	475	539	800	325	750	1	1	64	64	261	686	947
Grassland	618	1,127	1,732	1,140	26	2,000	0	2	0	1,236	26	764	790
Alkali Seasonal Wetland Complex	2	58	60	58	0	120	1	2	2	4	-2	116	114
Vernal Pool Complex[b] (direct/indirect)	31/35	36	67/35	40	4	400	1	2	31	132	-27	268	241
Other Natural Seasonal Wetland	0	0	0	0	0	0	1	2	0	0	0	0	0
Nontidal Marsh[c]	71	135	207	400	264	25	1	1	71	71	193	-46	147
Managed Wetland	35	5,786	5,821	320	-5,466	2,900	0	1	0	35	-5,466	2,865	-2,601
Cultivated Lands (non-rice)	5,983	8,636	14,619	0	-8,636	15,400	0	1	0	5,983	-8,636	9,417	781
Cultivated Lands (rice + "rice or equivalent")	0	84	84	0	-84	900	0	1	0	0	-84	900	816

Notes:

[a] Dredging of Clifton Court Forebay (2,101 acres) is not included.

[b] Impact of restoration on vernal pool complex is based on maximum allowable loss of wetted area.

[c] Nontidal marsh = nontidal freshwater perennial emergent wetland + nontidal perennial aquatic.

12D.3.2.6 Alternative 9—Through Delta/Separate Corridors (15,000 cfs; Operational Scenario G)

Natural communities

Tidal habitat impacts and a portion of the effects on the riparian natural community are caused in part by temporary dredging impacts (Table 12D-13). The overall conservation of tidal habitat far exceeds what would be required for mitigation.

The conveyance facilities construction would affect 32 acres of managed wetlands, and restoration would cause a loss of 5,786 acres. Considering BDCP near-term protection (and enhancement), there would be a net loss of 2,598 acres of managed wetlands in the first ten years. However, managed wetland acreage is mostly affected by restoration of tidal freshwater emergent wetland, which would increase by 8,659 acres. As is described in EIR/EIS Section 3.2, Environmental Consequences, this would result in a net benefit to native species and therefore the loss of managed wetland is not considered an adverse effect and is less-than-significant.

Species Habitat

Implementation of the conservation strategy would restore and protect sufficient natural community acreage to mitigate for species habitat effects in the near-term. Details are provided in EIR/EIS Section 12.3, *Environmental Consequences*.

Under Alternative 9, 2,750 acres of non-rice cultivated lands would be lost due to construction of the water conveyance facility and 8,636 acres would be lost due to near-term restoration, resulting in an overall loss of 11,386 acres in the near-term (Table 12D-13). The conservation strategy would protect and enhance 15,400 acres of cultivated lands to mitigate the effects of conveyance facilities construction and offset the effects of restoration on cultivated land in the near-term. The protected area would be 4,014 acres larger than the area affected.

Table 12D-13. Water Conveyance Facilities Construction Impacts on Natural Communities and Cultivated Lands Compared with Planned BDCP Near-Term Restoration and Protection under Alternative 9

Alternative 9	Near-Term Impacts (acres)			BDCP Near-Term Conservation			Evaluation of BDCP Near-Term Conservation Relative to Water Conveyance Facilities Impacts						
Natural Community	Conveyance Facilities Impact (acres)	Near-Term Restoration Impact (acres)	Total Near-Term Impact (acres)	Near-Term BDCP Restora-tion (acres)	Net Near-Term Restoration Area (acres)	Near-Term BDCP Protection (acres)	Restoration Ratio	Protection Ratio	Near-Term Restoration Requirement (acres)	Near-Term Protection Requirement (acres)	Difference of Near-Term Area Change and Restoration Requirement (acres)	Difference of Near-Term Protection and Protection Requirement (acres)	Overall Conservation Difference (acres)
Tidal Perennial Aquatic[a]	675	30	705	3,400	3,370	0	1	0	675	0	2,695	0	2,695
Tidal Freshwater Emergent Wetland	184	7	191	8,850	8,843	0	1	0	184	0	8,659	0	8,659
Valley/Foothill Riparian	310	475	785	800	325	750	1	1	310	310	15	440	455
Grassland	426	1,127	1,553	1,140	13	2,000	0	2	0	852	13	1,148	1,161
Alkali Seasonal Wetland Complex	0	58	58	58	0	120	1	2	0	0	0	120	120
Vernal Pool Complex[b] (direct / indirect)	0/0	67	67/0	40	-27	400	1	2	0	0	-27	400	373
Other Natural Seasonal Wetland	0	0	0	0	0	0	1	2	0	0	0	0	0
Nontidal Marsh[c]	25	135	161	400	264	25	1	1	25	25	239	0	239
Managed Wetland	32	5,786	5,818	320	-5,466	2,900	0	1	0	32	-5,466	2,868	-2,598
Cultivated Lands (non-rice)	2,750	8,636	11,386	0	-8,636	15,400	0	1	0	2,750	-8,636	12,650	4,014
Cultivated Lands (rice + "rice or equivalent")	0	84	84	0	-84	900	0	1	0	0	-84	900	816

Notes:

[a] Dredging of 345 acres of waterways is not included.

[b] Impact of restoration on vernal pool complex is based on maximum allowable loss of wetted area.

[b] Nontidal marsh = nontidal freshwater perennial emergent wetland + nontidal perennial aquatic.

12D.4 Conclusions

12D.4.1 Natural Community Protection

The total natural community and habitat acreage (including cultivated lands) to be protected under the BDCP would be at least 69,300 acres during the first 40 years of BDCP implementation or 14% of the 498,600 acres of lands in the Plan Area that are not in conservation and meet minimum assumed patch sizes.

Within the first 5 years of BDCP implementation a total of 11,610 acres of lands would be protected, and within the next 5 years an additional 12,785 acres would be protected. Combined, these lands represent 5% of lands not in conservation in the Plan Area.

Sufficient land area that is not conserved is present in the appropriate conservation zones and supporting the appropriate natural communities to meet the near-term minimum protection objectives of the BDCP.

12D.4.2 Natural Community Restoration

Sufficient land meeting restoration suitability criteria is present in the Plan Area in the appropriate BDCP-specified conservation zones to meet the near-term BDCP restoration requirements.

Historic natural levees along the Sacramento River and its distributaries would provide five times the habitat area needed to meet valley/foothill riparian habitat restoration requirements. Modeled levee setbacks along the San Joaquin River and its distributaries would provide one to almost nine times the habitat area needed to meet riparian restoration requirements, depending on which corridors would be restored. However, those setbacks would not be implemented until after the near-term period.

Within the near-term timeframe, it would be possible to restore riparian scrub or early successional riparian forest; however, it would take several decades to replace mature riparian forest. However, mature nest trees (20 feet or taller) would be replaced by mature transplanted trees and tree saplings to quickly provide nesting habitat for raptors.

12D.4.3 Evaluation of Conveyance Alternatives

The BDCP would provide sufficient conservation acreage to offset near-term effects of Alternatives 1A, 2A, 3, 4, 5, 6A, 7, 8, and 9, but insufficient cultivated land would be protected (and enhanced) under Alternatives 1B, 1C, 2B, 2C, 6B and 6C to offset loss of habitat for species that use cultivated lands for foraging. Alkali seasonal wetland complex and vernal pool crustacean habitat (alkali seasonal wetland complex and/or vernal pool complex) would need to be restored and protected in addition to what is currently in the Plan under Alternatives 1C, 2C and 6C, as described in Mitigation Measures Bio-18, Bio-27, and Bio-32.

12D.5 References

12D.5.1 Literature Cited

Braatne, J. H., S. B. Rood and P. E. Heilman. 1996. Life History, Ecology and Conservation of Riparian Cottonwoods in North America. Pages 57–58 in R. F. Stettler, H. D. Bradshaw, Jr., P. E. Heilman and T. M. Hinckley (eds.), *Biology of Populus and its Implications for Management and Conservation*. Ottawa, Ontario, Canada: NRC Research Press.

California Department of Fish and Game. 2012b. *California Natural Diversity Data Base*. Sacramento, CA.

California Department of Fish and Game, U. S. Fish and Wildlife Service, and NOAA Fisheries Service. 2010. *Conservation Strategy for Stage 2 Implementation. Sacramento-San Joaquin Delta Ecological Management Zone. Ecosystem Restoration Program*. Sacramento, CA. Available: <https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=6501>.

———. 2012. *Ecosystem Restoration Program Plan Year 12 Annual Report*. Sacramento, CA. Available: <https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=46367>.

California Department of Water Resources 2008b. *Draft Environmental Impact Report Dutch Slough Tidal Marsh Restoration Project*. Sacramento, CA. Available: <http://www.water.ca.gov/floodsafe/fessro/environmental/dee/dutch_deir.cfm>

California Department of Water Resources. 2010. *North Delta Flood Control and Ecosystem Restoration Project Final Environmental Impact Report*. October. Sacramento, CA.

———. 2012. *Status and Trends of the Riparian and Riverine Ecosystems of the Systemwide Planning Area*. Public Draft Central Valley Flood Protection Plan, Attachment 9B. Sacramento, CA. Available: <http://www.water.ca.gov/cvfmp/docs/Att9B_StatusTrends_20120127.pdf>.

Conservation Biology Institute, Defenders of Wildlife, Ducks Unlimited, NatureServe, and the Trust for Public Land. 2011. *National Conservation Easement Database*. Volume 1. Available: <http://app.databasin.org/app/pages/datasetPage.jsp?id=d85fb27b3b8f440ca2aeee2fc6f930bd>.

EDAW. 2007. *Lower Sherman Island Wildlife Area Land Management Plan*. Final. Prepared for California Department of Fish and Game. Sacramento, CA.

ESA PWA. 2011. *Dutch Slough Tidal Marsh Restoration Revised Conceptual Plan*. Prepared for California Department of Water Resources, Reclamation District 2137, and California State Coastal Conservancy. San Francisco, CA.

Hickson, D. and T. Keeler-Wolf. 2007. *Vegetation and Land Use Classification and Map of the Sacramento-San Joaquin River Delta*. Prepared by Vegetation Classification and Mapping Program, California Department of Fish and Game. Prepared for Bay Delta Region California Department of Fish and Game. Sacramento, CA.

Jones & Stokes Associates. 1998. *Historical Riparian Habitat Conditions of the San Joaquin River—Friant Dam to the Merced River*. Prepared for San Joaquin River Riparian Habitat Restoration Program, U.S. Bureau of Reclamation, Fresno, CA.

Siegel, S. W. 2007. *Foundation Concepts and Some Initial Activities to Restore Ecosystem Functions to the California Delta*. First draft. December 14. Sacramento, CA. Prepared for the Delta Vision Blue Ribbon Task Force. Available: <http://www.delta.ca.gov/res/docs/meetings/2008/012408_item_29.pdf >.

Smith, D. W. and W. L. Verrill. 1998. Vernal Pool-Soil-Landform Relationships in the Central Valley, California. Pages 15–23 in C. W. Witham, E. T. Bauder, D. Belk, W. R. Ferren Jr., and R. Ornduff (eds), *Ecology, Conservation, and Management of Vernal Pool Ecosystems – Proceedings from a 1996 Conference*. Sacramento, CA: California Native Plant Society.

State and Federal Contractors Water Agency. 2011. Notice of Preparation Lower Yolo Restoration Project. Sacramento, CA. Available: <http://archive.deltacouncil.ca.gov/docs/correspondence/3_2011/other_correspondence/SFCWA_030211.pdf>

U.S. Fish and Wildlife Service. 2005. *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon*. Sacramento, CA. Available: <http://www.fws.gov/sacramento/es/recovery_plans/vp_recovery_plan_links.htm>.

———. 2010. *Draft Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California*. Sacramento, CA. Available: <http://ecos.fws.gov/docs/recovery_plan/TMRP_Intro_1.pdf>.

Whipple A. A., R. M. Grossinger, D. Rankin, B. Stanford, R. A. Askevold. 2012. *Sacramento-San Joaquin Delta Historic Ecology Investigation: Exploring Pattern and Process*. August. A Report of San Francisco Estuary Institute Aquatic Science Center's Historical Ecology Program, Publication #672, San Francisco Estuary Institute-Aquatic Science Center, Richmond, CA. Prepared for the California Department of Fish and Game and Ecosystem Restoration Program.

12D.5.2 GIS Data Sets

California Department of Fish and Game. 2012a. Base_Remote_Sensing/Sacramento_Delta_1937 (ImageServer). Available: <http://imaps.dfg.ca.gov/ArcGIS/rest/services/Base_Remote_Sensing/Sacramento_Delta_1937/ImageServer >.

California Department of Fish and Wildlife. 2013. Region 3 Lands. May 20, 2013. Available: <http://ftp.dfg.ca.gov/Public/R3_BDR/R3_GIS/Land_ownership/CDFW_Lands_R3/>

———. 2013. Region 3 Public Trust Lands. May 20, 2013. Available: http://ftp.dfg.ca.gov/Public/R3_BDR/R3_GIS/Land_ownership/R3_Public-Trust-Lands/

———. California Department of Fish and Wildlife. Suisun Regions. Received November 11, 2011.

California Department of Forestry and Fire protection. May 2009. :24,000 County Boundaries.

California Department of Water Resources. July 2004. Delta Islands.

California Wildlife Conservation Board. 2009. Wildlife Conservation Board (WCB) Approved Projects GIS Dataset.

Central Valley Joint Venture and Ducks Unlimited. 2009. Protected Lands.

Delta Habitat Conservation and Conveyance Program. Delta Land Ownership Dataset. Received May 2013.

Environmental Systems Research Institute. April 1, 2008. U.S. and Canada Streets Cartographic.

GreenInfo Network. 2013. California Protected Areas Database (CPAD) 1.9. April 30, 2013. Available: < http://www.calands.org/>.

Jensen, Carl. March 6, 2013. Personal Communication and Google Earth file. Landscape Architect. ICF International. Conservation Bank Lands.

LSA Associates. 2006. Public and Private Open Space Lands.

———. Solano HCP Open Space/Conserved Lands. Received March 7, 2013.

Natural Resources Conservation Service, United States Department of Agriculture. Soil Survey Geographic (SSURGO) Database for Sacramento–San Joaquin River Delta, California. Available: <http://www.arcgis.com/apps/OnePane/basicviewer/index.html?appid=a23eb436f6ec4ad6982000dbaddea5ea> Accessed 10/19/2012.

National Conservation Easement Database (NCED). September 14, 2012. Available: <http://conservationeasement.us/easements/download_data>.

San Joaquin Council of Governments. December 20, 2011. San Joaquin County Multi-Species Habitat Conservation and Open Space Plan Preserves.

San Francisco Bay Conservation and Development Commission. 2011. Primary Management Area of the Suisun Marsh.

———. 2011. Secondary Management Area of the Suisun Marsh.

U. S. Fish and Wildlife Service. 2002. Core Areas of Vernal Pool Recovery Plan. April 2002.

12D.5.3 Personal Communications

Chappell, Steven. 2013. Executive Director of the Suisun Resource Conservation District. Suisun Marsh Conservation Lands .Meeting with Kasey Allen, GIS Analyst, ICF International. February 6, 2013.

Ivey, Gary. 2013. Research Associate. West Coast Crane Working Group, International Crane Foundation. Electronic mail message with Greater Sandhill Crane Use Area. April 2013.

Jensen, Carl. 2013. Senior Landscape Architect. ICF International. Meeting with Kasey Allen, GIS Analyst, ICF International. March 6, 2013.

McDermott, Bart. 2013. Refuge Manager, Stone Lakes Notional Wildlife Refuge. Telephone conversation with Rebecca Sloan of ICF International. July 1, 2013.

Attachment A
Soil Mapping Units Suitable for Vernal Pool and Alkali Seasonal Wetland Restoration

Table 12D-A1. Soil Mapping Units Suitable for Vernal Pool and Alkali Seasonal Wetland Restoration

Soil Mapping Unit	Alkali Seasonal Wetland	Vernal Pool	Comments
Altamont-San Ysidro-San Benito complex, 2% to 9% slopes	X	X	
Alviso silty clay loam	X		
Antioch Loam, 0 to 2% slopes	X		
Antioch-San Ysidro complex, 0 to 2% slopes	X		
Antioch-San Ysidro complex, 2% to 9% slopes	X		
Antioch-San Ysidro complex, thick surface, 0 to 2% slopes	X		Deep excavation would be required
Antioch-San Ysidro complex, thick surface, 2% to 9% slopes	X		Deep excavation would be required
Durixeralfs-Galt complex, 0 to 2% slopes		X	
Galt clay, 0 to 2% slopes		X	
Galt clay, 2% to 5% slopes		X	
Galt clay, leveled, 0 to 1% slopes		X	
Galt-Urban land complex, 0 to 2% slopes		X	
Hillgate loam, 0 to 2% slopes		X	
Jahant loam, 0 to 2% slopes		X	
Marcuse clay	X		
Marcuse clay, strongly alkali	X		
Marcuse sand	X		
Omni clay loam	X		
Omni silty clay	X		
Omni silty clay loam	X		
Pescadero clay	X		
Pescadero clay loam	X		
Pescadero clay loam, partially drained, 0 to 2% slopes	X		
Pescadero silty clay	X		
Pescadero soils, flooded	X		
Reyes silty clay	X		
Riz loam	X		
Riz loam, flooded	X		
San Joaquin complex, 0 to 1% slopes		X	
San Joaquin loam, 0 to 2% slopes		X	
San Joaquin silt loam, 0 to 3% slopes		X	
San Joaquin silt loam, leveled, 0 to 1% slopes		X	

Soil Mapping Unit	Alkali Seasonal Wetland	Vernal Pool	Comments
San Joaquin-Durixeralfs complex, 0 to 1% slopes		X	
San Joaquin-Galt complex, 0 to 3% slopes		X	
San Joaquin-Galt complex, leveled, 0 to 1% slopes		X	
San Joaquin-Urban land complex, 0 to 2% slopes		X	
San Ysidro loam		X	
San Ysidro sandy loam, 0 to 2% slopes		X	Existing wetlands probably occur only on Antioch soil inclusions in depressions. Vernal pool (but not alkali seasonal wetland) restoration may be possible in the map unit
San Ysidro sandy loam, 2% to 5% slopes		X	Existing wetlands probably occur only on Antioch soil inclusions in depressions. Vernal pool (but not alkali seasonal wetland) restoration may be possible in the map unit
San Ysidro sandy loam, thick surface, 0 to 2% slopes		X	Existing wetlands probably occur only on Antioch soil inclusions in depressions. Vernal pool (but not alkali seasonal wetland) restoration may be possible in the map unit
Solano fine sandy loam	X		
Solano loam	X		
Solano loam, dark surface variant	X		
Solano loam, strongly alkali	X		
Solano-Pescadero complex	X		
Sycamore complex	X	X	
Sycamore complex, drained	X	X	
Sycamore complex, flooded	X	X	
Sycamore complex, occasionally flooded	X	X	
Sycamore silt loam	X	X	
Sycamore silt loam, drained	X	X	
Sycamore silt loam, flooded	X	X	
Sycamore silty clay loam	X	X	
Sycamore silty clay loam, clay substratum	X	X	
Sycamore silty clay loam, drained	X	X	
Sycamore silty clay loam, saline	X	X	
Willows clay	X	X	
Willows clay, partially drained, 0 to 2% slopes	X	X	
Willows silty clay loam	X	X	
Willows soils, flooded	X	X	
Xerarents-San Joaquin complex, 0 to 1% slopes	X		

1