Appendix 5.J

Effects on Natural Communities, Wildlife, and Plants

Appendix 5.J
Effects on Natural Communities, Wildlife, and Plants

Contents

Tables

Page

Figures

Figures appear at the end of Appendix

Attachments

Appendix 5.J
Effects on Natural Communities, Wildlife, and Plants

The tables in this appendix support the effects analysis for natural communities and covered wildlife and plant species. The calculations in the tables are presented in summary form in Chapter 5, *Effects Analysis*. The methods are further discussed in Section 5.2, *Methods*.

- Table 5.J-1 presents the methods used and assumptions applied to arrive at quantitative estimates of natural community and species habitat effects, as presented in Section 5.4, *Effects on Natural Communities*, and Section 5.6, *Effects on Wildlife and Plants*.
- Table 5.J-2 indicates the types of effects expected to result from each covered activity, these types of effects correspond with subsections of the effects analysis for each covered wildlife and plant species in Chapter 5. Table 5.J-2 also indicates which conservation measures would be involved for each covered activity.
- Table 5.J-3 provides the key assumptions related to effects of tidal restoration on covered species, based on the species' habitat requirements and the characteristics of the tidal natural community expected to be restored in a particular area (e.g., high tidal marsh, middle tidal marsh, or subtidal). Modifications resulting from tidal restoration are expected to either result in habitat loss, conversion from one habitat type to another (e.g., from primary to secondary habitat), or no change, depending on the existing conditions relative to expected future conditions based on RMA and ESAPWA modeling (Appendix 3.B, *BDCP Tidal Habitat Evolution Assessment*).
- Table 5.J-4 and Table 5.J-5 provide the distances that were applied to arrive at indirect effect acreages for wildlife and plant species, respectively. These indirect effects are described in Section 5.6, *Effects on Wildlife and Plants.*
- Table 5.J-6, Table 5.J-7, and Table 5.J-8 provide the acres of effect expected to result from each covered activity type for natural communities, wildlife, and plants, respectively. These tables provide a breakdown of tidal natural community restoration by elevation zone (e.g., high tidal brackish marsh, middle tidal brackish marsh, low tidal brackish marsh, and subtidal). These tables provide the basis for the quantitative analyses provided in Section 5.4, *Effects on Natural Communities*, and Section 5.6, *Effects on Wildlife and Plants*, for permanent habitat loss and conversion, and for temporary habitat loss.

Table 5.J-1. Quantitative Effects Analysis Methods and Assumptions

Activity/Impact Mechanism	Method of Impact Estimation	Key Assumptions[1] for Purposes of Analysis
CM1 Water Facilities and Operation		
Conveyance facilities construction/ permanent removal of natural communities and habitat	• GIS layer for construction footprint was overlain on natural community and habitat GIS layers.	• Construction of the forebay, intakes, permanent access roads, and shafts result in permanent removal of natural communities and species habitats located within construction footprint.
Reusable tunnel material/ permanent removal of natural communities and habitat	• GIS layer for footprint of reusable tunnel material areas was overlain on natural community and habitat GIS layers. • Where AMMs in Appendix 3.C, *Avoidance and Minimization Measures*, require minimization of the reusable tunnel material footprint or avoidance of a natural community or species habitat, this requirement was factored into the impact estimation for the natural community or species.	• For the purposes of impact analysis, it is assumed reusable tunnel material areas will not be returned pre-project conditions unless required under an AMM. • The final footprint for the reusable tunnel material will be reduced and will meet avoidance and minimization requirements in the AMMs.
Conveyance facilities/ temporary removal of natural communities and habitat	• GIS layer for footprint of staging areas, intake pipelines, and barge unloading facilities was overlain on natural community and habitat GIS layers.	• Staging areas, intake pipelines, and barge unloading facilities result in temporary impacts on natural communities and species habitats located in the construction footprint of these features. • Affected areas will return to their pre-impact condition following completion of activities (restoration to occur within a year following completion of construction). • Subsurface segments of the tunnel/pipeline have no effects on biological resources.
Borrow/spoil area / temporary loss of natural communities and habitat	• GIS layer for footprint of borrow/spoils area was overlain on natural community and habitat GIS layers. • The affected areas will be restored to their former state over the term of the BDCP, but not within the time frame typically characterized as *temporary loss*. Characterizing this effect as *permanent loss* would not be accurate.	• Borrow and spoil sites will be reclaimed to their former state over the term of the BDCP, except that cultivated lands will be reclaimed as grasslands if return to cultivated state is not feasible. • Borrow/spoil areas are areas that will initially be used for borrow, and will be used for spoils later. • Restoration to occur within a year following completion of construction.

Activity/Impact Mechanism	**Method of Impact Estimation**	**Key Assumptions[1] for Purposes of Analysis**
CM2 Yolo Bypass Fisheries Enhancement		
Construction/ permanent removal of natural communities and habitat	• GIS layer for footprint of activities resulting in permanent loss (see *Assumptions*) was overlain on natural community and habitat GIS layers.	• Permanent loss of natural communities and habitat will result from Fremont Weir improvements, Putah Creek realignment activities, Lisbon Weir and fish crossing improvements, and Sacramento Weir improvements.
Construction/ temporary removal of natural communities and habitat	• GIS layer for footprint of activities resulting in permanent loss (see Assumption) was overlain on natural community and habitat GIS layers.	• Temporary loss of natural communities and habitat will result from construction areas associated with Fremont Weir improvements, Putah Creek realignment activities, Lisbon Weir and fish crossing improvements, and Sacramento Weir improvements.
Operation/periodic inundation from flooding in Yolo Bypass	• Compared inundation areas under existing and proposed Fremont Weir flows for seven proposed flow scenarios under the MIKE21 model (see Appendix 5.C, Attachment 5C.E, *BDCP Effects Analysis: 2D Hydrodynamic Modeling of the Fremont Weir Diversion Structure*, for description of the model) (1,000-cfs notch flow to 6,000-cfs notch flow, with two different baseline flow scenarios for 6,000 cfs). For each of these seven scenarios, the GIS footprint for the difference between existing and proposed flows were overlain on GIS layers for natural communities and modeled covered species habitat. Figures 5.J-1 through 5.J-7 show the footprint of the difference between existing and proposed conditions for each flow scenario. Results from all seven scenarios are presented in Chapter 5, *Effects Analysis,* for each natural community and covered species affected.	• Fremont Weir will be operated as described in Conservation Measure 2.

Activity/Impact Mechanism	**Method of Impact Estimation**	**Key Assumptions[1] for Purposes of Analysis**
CM4 Tidal Natural Communities Restoration		
Inundation/ permanent loss of natural communities and species habitat	• GIS layer for hypothetical tidal restoration footprint[1] (see Appendix 3.B, *BDCP Tidal Habitat Evolution Assessment,* for a description of the tidal restoration hypothetical), including only those areas below EHW elevation, was overlain on natural community and species modeled habitat GIS layers. • Exceptions: ○ Natural communities:_The tidal perennial aquatic natural community was not treated as lost as a result of inundation. Tidal brackish emergent wetland and tidal freshwater emergent wetland natural communities were considered lost for those areas below MLLW + 1 foot. ○ Species: See Table 5.J-3.	• BDCP is not responsible for the long-term effects of sea level rise on natural communities. • All tidally inundated areas below EHW elevation within the hypothetical footprint, based on tidal restoration model, will result in permanent natural community loss, except for to tidal perennial aquatic and tidal emergent wetland natural communities. • All tidally inundated areas below EHW elevation within the hypothetical footprint, based on tidal restoration model, will result in permanent habitat loss for all species except as described in Table 5.J-3*.*
Inundation/ permanent loss of tidal wetland natural communities and species habitat	• GIS data for tidal brackish emergent wetland and tidal freshwater emergent wetland communities was overlain on hypothetical tidal restoration footprint[1] (see Appendix 3.B, *BDCP Tidal Habitat Evolution Assessment*, for a description of the tidal restoration hypothetical), including only those areas below EHW elevation, to determine permanent loss and habitat conversion (e.g., conversion from primary habitat to secondary habitat). • See Table 5.J-3 for description of species methods.	• BDCP is not responsible for the long-term effects of sea level rise on tidal wetland natural communities. • All existing tidal aquatic and tidal emergent wetland within the hypothetical footprint below MLLW + 1-foot elevation will be permanently lost. • See Table 5.J-3 for description of assumptions made in regard to permanent loss or conversion for individual covered species.
Inundation/ permanent loss of western pond turtle aquatic habitat	• National Hydrologic Database (NHD) GIS data was used to determine the relative percentage of suitable and unsuitable western pond turtle aquatic habitat in artificial water features such as agricultural ditches and canals.	• The visual signature of emergent wetland in the aerial photo indicates perennial water. • The percent cover of suitable habitat within randomly selected grids within each ROA are representative of the entire ROA (see Appendix 2.A, *Covered Species Accounts*, Section 2.A.29, for a more specific description of this method). • Of all NHD stream miles within the Plan Area, 35% are suitable (Laura Patterson pers. comm. 2012)

[1] The spatial data received from ESAPWA was processed in two ways to prepare it for intersection with natural community and species models: 1.) existing tidal wetlands were removed using a "subtraction" tool in ArcGIS and 2.) the sea level rise accommodation area and upland polygons were removed.

Activity/Impact Mechanism	Method of Impact Estimation	Key Assumptions[1] for Purposes of Analysis
Riparian restoration within ROAs, natural community permanent loss	• All natural community (cultivated land or grassland) loss was applied as permanent habitat loss for a species if cultivated lands or grasslands are major components of the species model and the species distribution overlaps geographically with the ROAs. • Permanent cultivated lands and grassland loss was applied to the foraging habitat value classes for the greater sandhill crane and Swainson's hawk (Tables 5.6-5 and 5.6-6, respectively).	• 971 acres of riparian restoration will occur as a component of tidal restoration, including 18 acres in Cache Slough ROA, 14 acres in West Delta ROA, and 939 acres in South Delta ROA. • All riparian restoration will occur on existing cultivated land, except for 11 acres in Cache Slough ROA (Conservation Zones 1 and 2) which will occur on existing grassland. • The loss of cultivated land natural community type (e.g., rice, corn, etc.) will occur in proportion to the existing distribution of types within each conservation zone.
CM5 Seasonally Inundated Floodplain Restoration		
Seasonal flooding—periodic inundation of natural communities and habitat	• Calculation of effects based on hypothetical floodplain restoration designs. • GIS layer for hypothetical floodplain restoration was overlain on natural community and species habitat layers.	• All areas between setback levees will be subject to periodic inundation from seasonal flooding.
Levee construction—permanent removal of natural communities and habitat	• Calculation of effects based on hypothetical floodplain restoration designs. • GIS layer of hypothetical footprint for floodplain levees overlain on natural community species habitat models.	• Floodplain restoration includes an average 1,500-foot setback to levees, with appropriate as-needed grading and lowering of the land elevation to achieve average inundation and intervals noted above. • Floodplain restoration will take place in areas with the greatest potential for restoration, primarily in Conservation Zone 7.
Levee construction—temporary removal of natural communities and habitat	• Calculation of effects based on hypothetical floodplain restoration designs. • GIS layer of hypothetical footprint for floodplain levees overlain on natural community species habitat models and buffered 100 feet on each side of the levee footprint.	• Temporary work area of 100 feet on either side of the setback levee base.

Activity/Impact Mechanism	Method of Impact Estimation	Key Assumptions[1] for Purposes of Analysis
CM7 Riparian Natural Community Restoration		
Permanent loss of natural communities and habitat	• The 3,992-acre permanent loss was applied to a species if cultivated lands or grassland are a major component of the species model and the species distribution overlaps geographically with the hypothetical floodplain restoration footprint. • Permanent cultivated lands and grassland natural communities loss was applied to the foraging habitat value classes for the greater sandhill crane and Swainson's hawk (see Tables 5.6-5 and 5.6-6, respectively).	• Riparian restoration in seasonally inundated floodplain will convert up to 3,593 acres of cultivated lands in Conservation Zone 7 and 399 acres of grassland in Conservation Zone 7. • The loss of cultivated land natural community type (e.g., rice, corn, etc.) will occur in proportion to the existing distribution of types within each conservation zone.
CM8 Grassland Natural Community Restoration		
Permanent loss of natural communities and habitat	• The 2,000-acre permanent loss was applied to a species if cultivated lands are a major component of the species model and the species distribution overlaps geographically with the hypothetical floodplain restoration footprint. • Permanent cultivated lands natural community loss was applied to the foraging habitat value classes for the greater sandhill crane and Swainson's hawk (see Tables 5.6-5 and 5.6-6, respectively).	• All grassland restoration will require the conversion of cultivated lands to grassland. • 70% of grassland restoration (1,400 acres) will occur in Conservation Zones 1, 8, and 11, 30% (600 acres) in Conservation Zones 2, 4, 5, and 7; restoration acres are thereafter split equally between conservation zones. • The loss of cultivated land natural community type (e.g., rice, corn, etc.) will occur in proportion to the existing distribution of types within each conservation zone.
CM10 Nontidal Marsh Restoration		
Permanent loss of natural communities and habitat	• Includes 1,200 acres of nontidal freshwater emergent wetland and nontidal freshwater perennial aquatic restoration and 500 acres of managed wetland restoration, plus additional restoration that may be necessary to meet giant garter snake objectives. • The 1,950-acre permanent loss was applied to a species if cultivated lands are a major component of the species model and the species distribution overlaps geographically with the hypothetical floodplain restoration footprint. • Permanent cultivated lands natural community loss was applied to the foraging habitat value classes for the greater sandhill crane and Swainson's hawk (see Tables 5.6-5 and 5.6-6, respectively).	• All nontidal marsh restoration will require the conversion of cultivated lands to nontidal marsh • 600 acres of nontidal marsh restoration will occur in Conservation Zone 2, 675 acres in Conservation Zone 4 and 675 acres in Conservation Zone 5 • The loss of cultivated land natural community type (e.g., rice, corn, etc.) will occur in proportion to the existing distribution of types within each conservation zone.

Activity/Impact Mechanism	Method of Impact Estimation	Key Assumptions[1] for Purposes of Analysis
CM11 Natural Community Enhancement and Management		
Construction/Permanent loss of natural communities and habitat	• The 50-acre grassland loss was applied to permanent habitat loss for a species if grassland is a major component of the species model and the species distribution overlaps geographically with Conservation Zone 1, 4, 5,6, 7, 8, and 11.	• LLT Permanent loss was distributed by conservation zones accordingly: 15.5 acres in Conservation Zone 1, 1 acre in Conservation Zone 4, 1.5 acres in Conservation Zone 5, 1.5 acres in Conservation Zone 6, 6.5 acres in Conservation Zone 7, 7.5 acres in Conservation Zone 8, and 16.5 acres in Conservation Zone 11.
CM18 Conservation Hatcheries Facilities		
Construction/Permanent loss of natural communities and habitat	• The 35-acre grassland loss was applied to permanent habitat loss for a species if grassland is a major component of the species model and the species distribution overlaps geographically with Conservation Zone 1.	• Permanent loss of 35 acres of grasslands will result from hatchery construction in Conservation Zone 1.

[1] This table of impact analysis methods and key assumptions is not intended to be all inclusive of all covered activities. Rather, this table shows how effects were calculated for covered activities that have effects significant enough to be estimated. Minor activities described in Chapter 4, *Covered Activities and Associated Actions*, are covered under the BDCP even though they may not appear in this table. Also, the assumptions made are for the purposes of analysis only and reflect reasonable worst case assumptions for covered activities. Actual footprints of activities may be less than or greater than that assumed and would still fall within the limits of the permits because impacts are within the total range evaluated.

cfs = cubic feet per second; GIS = geographic information systems; EHW = extremely high water; NHD = National Hydrology Dataset; MLLW = mean lower low water; ROA = restoration opportunity area.

Table 5.J-2. Covered Activities, Effect Types, and Associated Conservation Measures

Covered Activity	Effect Type								Relevant CM
			Construction-Related Effects						
	Permanent Loss/ Conversion	Periodic Inundation	Temporary Loss	Long-Term Loss (Borrow and Spoil)	Injury or Mortality	Temporary Indirect (Adjacent to Activity)	Permanent Indirect (Adjacent to Activity)	Other Indirect	
Conveyance Facility Construction and Operation									
Conveyance facility construction	X		X	X	X	X			CM1
Transmission line construction	X		X		X	X			CM1
Conveyance facility operation								X	CM1
Conveyance facility maintenance						X	X		CM1
Fremont Weir/Yolo Bypass Improvements									
Fisheries enhancement construction	X		X		X	X			CM2
Fisheries enhancement facility maintenance							X		CM2
Yolo Bypass operations		X							CM2
Tidal Restoration									
Grading, levee breaching, and resulting tidal inundation	X				X			X	CM4
Riparian restoration	X								CM4, CM7
Floodplain Restoration									
Levee construction	X		X		X	X			CM5
Restoration activities resulting in seasonal flooding		X			X				CM5
Riparian restoration	X								CM5, CM7
Nontidal Marsh Restoration									
Marsh restoration	X				X	X			CM10
Conservation Hatcheries Facilities									
Facilities construction	X				X	X			
Facilities operation and maintenance						X			
Natural Community and Habitat Enhancement and Management									
Enhancement and management			X		X	X			CM11

1 **Table 5.J-3. Key Assumptions Related to Tidal Restoration Effects on Covered Species Habitat**

Habitat	Suisun					Delta			
	High Tidal Marsh	Middle Tidal Marsh	Low Tidal Marsh	Intertidal Mudflat	Subtidal	Ecotone	Intertidal Mudflat	Tidal Freshwater Marsh	Subtidal
Mammals									
Salt marsh harvest mouse									
Tidal brackish emergent wetland primary	No loss	No loss	Conversion to low value	Loss	Loss	N/A	N/A	N/A	N/A
Tidal brackish emergent wetland secondary	No loss	No loss	No loss	Loss	Loss	N/A	N/A	N/A	N/A
Upland secondary	Conversion to primary	Conversion to primary	No loss	Loss	Loss	N/A	N/A	N/A	N/A
Managed wetland—wetland primary low, long-term conservation value	Conversion to higher value	Conversion to higher value	Conversion to secondary	Loss	Loss	N/A	N/A	N/A	N/A
Managed wetland—wetland secondary low, long-term conservation value	Conversion to higher value primary	Conversion to higher value primary	Conversion to higher value secondary	Loss	Loss	N/A	N/A	N/A	N/A
Managed wetland—upland low, long-term conservation value	Conservation to higher value primary	Conversion to higher value primary	Conservation to higher value secondary	Loss	Loss	N/A	N/A	N/A	N/A
Suisun shrew									
Primary habitat	No loss	No loss	Loss	Loss	Loss	N/A	N/A	N/A	N/A
Secondary habitat	Conversion to primary	Conversion to primary	No loss	Loss	Loss	N/A	N/A	N/A	N/A

Habitat	Suisun					Delta			
	High Tidal Marsh	Middle Tidal Marsh	Low Tidal Marsh	Intertidal Mudflat	Subtidal	Ecotone	Intertidal Mudflat	Tidal Freshwater Marsh	Subtidal
Birds									
California black rail									
Primary habitat	No loss	No loss	Conversion to secondary	Loss	Loss	Conversion to secondary	Loss	No loss	Loss
Secondary habitat	Conversion to primary	Conversion to primary	No loss	Loss	Loss	No loss	Loss	Conversion to primary	loss
California clapper rail									
Primary habitat	No loss	No loss	Conversion to secondary	Loss	loss	N/A	N/A	N/A	N/A
Secondary habitat	Conversion to primary	Conversion to primary	No loss	Loss	Loss	N/A	N/A	N/A	N/A
Greater sandhill crane									
Roosting and foraging habitat	N/A	N/A	N/A	N/A	N/A	Partial loss	N/A	Partial loss	Loss
Foraging habitat	N/A	N/A	N/A	N/A	N/A	Partial loss	N/A	Partial loss	Loss
Least Bell's vireo									
Nesting and migratory habitat	Loss	Loss	Loss	Loss	Loss	No loss	Loss	Loss	Loss
Suisun song sparrow									
Primary habitat	No loss	No loss	Conversion to secondary	Loss	Loss	N/A	N/A	N/A	N/A
Secondary habitat	Conversion to primary	Conversion to primary	No loss	Loss	Loss	N/A	N/A	N/A	N/A
Swainson's hawk									
Foraging habitat	Loss	Loss	Loss	Loss	Loss	Partial loss	Loss	Loss	Loss
Nesting habitat	N/A	N/A	N/A	N/A	N/A	No loss	N/A	N/A	N/A

Habitat	Suisun					Delta			
	High Tidal Marsh	Middle Tidal Marsh	Low Tidal Marsh	Intertidal Mudflat	Subtidal	Ecotone	Intertidal Mudflat	Tidal Freshwater Marsh	Subtidal
Tricolored blackbird									
Breeding habitat—ag foraging	Partial loss	N/A	N/A	N/A	N/A	Partial loss	N/A	Conversion to nonbreeding roosting habitat	loss
Breeding habitat—foraging	Loss	Conversion to nonbreeding roosting habitat (portion with bulrush)	Conversion to nonbreeding roosting habitat	Loss	Loss	Loss	Loss	Conversion to nonbreeding roosting habitat	Loss
Breeding habitat—nesting	Loss	N/A	N/A	N/A	Loss	Loss	Loss	Conversion to nonbreeding roosting habitat	Loss
Nonbreeding habitat—foraging ag	Loss	N/A	N/A	N/A	N/A	Loss	Loss	Conversion to nonbreeding roosting habitat	Loss
Nonbreeding habitat—roosting	Loss	Partial loss	No loss	Loss	Loss	Loss	Loss	No loss	Loss
Nonbreeding habitat—foraging	Loss	N/A	Conversion to nonbreeding roosting habitat	Loss	Loss	Loss	Loss	Conversion to nonbreeding roosting habitat	Loss
Western yellow-billed cuckoo									
Breeding habitat	Loss	Loss	Loss	Loss	Loss	No loss	Loss	Loss	Loss
Migratory habitat	Loss	Loss	Loss	Loss	Loss	No loss	Loss	Loss	Loss

Habitat	Suisun					Delta			
	High Tidal Marsh	Middle Tidal Marsh	Low Tidal Marsh	Intertidal Mudflat	Subtidal	Ecotone	Intertidal Mudflat	Tidal Freshwater Marsh	Subtidal
White-tailed kite									
Breeding habitat	N/A	N/A	Loss	Loss	Loss	No loss	N/A	Loss	loss
Foraging habitat	No loss	Partial loss	Loss	Loss	Loss	No loss	Loss	Loss	loss
Yellow-breasted chat									
Primary nesting and migratory habitat	Loss	Loss	Loss	Loss	Loss	No loss	Loss	Loss	Loss
Secondary nesting and migratory habitat	Loss	Loss	Loss	Loss	Loss	No loss	Loss	Loss	Loss
Suisun Marsh/upper Yolo Bypass nest and migratory habitat	Loss	Loss	Loss	Loss	Loss	No loss	Loss	Loss	Loss
Reptiles									
Giant garter snake									
Aquatic-tidal	N/A	N/A	N/A	N/A	N/A	Loss	Loss	No loss	No loss
Aquatic-nontidal	N/A	N/A	N/A	N/A	N/A	Loss	Loss	Partial loss	Partial loss
Western pond turtle									
Aquatic habitat	Loss	No loss	No loss	No Loss	No loss	No loss	No loss	No loss	No loss
Upland nesting and overwintering	Loss	Loss	Loss	Loss	Loss	Loss	Loss	Loss	Loss
Upland nesting and overwintering—NHD	Loss	Loss	Loss	Loss	Loss	Loss	Loss	Loss	Loss
Invertebrates									
Valley elderberry longhorn beetle									
Riparian vegetation	Loss	Loss	Loss	Loss	Loss	No loss	Loss	Loss	Loss

Habitat	Suisun					Delta			
	High Tidal Marsh	**Middle Tidal Marsh**	**Low Tidal Marsh**	**Intertidal Mudflat**	**Subtidal**	**Ecotone**	**Intertidal Mudflat**	**Tidal Freshwater Marsh**	**Subtidal**
Nonriparian channels and grasslands	Loss	Los	Loss	Loss	Loss	Loss	Loss	Loss	Loss
Plants									
Delta button celery									
All	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Delta mudwort									
All	No loss	No loss	No loss	No loss	Partial, only Subtidal 2 and 3 is loss	No loss	No loss	No loss	Partial, only Subtidal 2 and 3 is loss
Mason's lilaeopsis									
All	No loss	No loss	No loss	No loss	Partial, only Subtidal 2 and 3 is loss	No loss	No loss	No loss	Partial, only Subtidal 2 and 3 is loss
Delta tule pea									
All	No loss	No loss	No loss	Loss	Loss	No loss	Loss	No loss	Loss
Suisun Marsh aster									
All	No loss	No loss	No loss	Loss	Loss	No loss	Loss	No loss	Loss
Side-flowering skullcap									
All	N/A	N/A	N/A	N/A	N/A	Loss	No loss	No loss	Partial, subtidal 2 and 3 are loss
Soft bird's-beak									
All	No loss	No loss	Loss	Loss	Loss	N/A	N/A	N/A	N/A
Suisun thistle									
All	No loss	No loss	Loss	Loss	Loss	N/A	N/A	N/A	N/A

1 **Table 5.J-4. Indirect Effect Distances from Covered Activity, Wildlife**

Covered Species and Habitat Type	Area of Effect Extending from Disturbance Locations into Modeled Species' Habitats				
	100 Feet	250 Feet	500 Feet	1,300 Feet	2,600 Feet
Mammals					
Riparian brush rabbit		X			
Riparian woodrat		X			
Salt marsh harvest mouse	X				
San Joaquin kit fox[1]		X			
Suisun shrew	X				
Birds					
California black rail			X		
California clapper rail			X		
Greater sandhill crane[2]				X	
Least Bell's vireo			X		
Suisun song sparrow[3]			X		
Swainson's hawk (foraging habitat)[4]	X (0 feet)				
Swainson's hawk (nesting sites)[3]			X (600 feet)		
Tricolored blackbird (nesting colonies)[3]				X	
Tricolored blackbird (foraging habitat)[4]	X (0 feet)				
Western burrowing owl[5]			X		
Western yellow-billed cuckoo[3,6]			X		
White-tailed kite (nesting sites)[3]			X (600 feet)		
White-tailed kite (foraging habitat)[4]	X (0 feet)				
Yellow-breasted chat[2]			X		
Reptiles					
Giant garter snake[7]		X (200 feet)			
Western pond turtle[7]		X (200 feet)			
Amphibians					
California red-legged frog[7]			X		

Covered Species and Habitat Type	Area of Effect Extending from Disturbance Locations into Modeled Species' Habitats				
	100 Feet	250 Feet	500 Feet	1,300 Feet	2,600 Feet
California tiger salamander[7]			X		
Invertebrates					
Valley elderberry longhorn beetle[8]	X				
California linderiella[9]		X			
Conservancy fairy shrimp[9]		X			
Longhorn fairy shrimp[9]		X			
Midvalley fairy shrimp[9]		X			
Vernal pool fairy shrimp[9]		X			
Vernal pool tadpole shrimp[9]		X			

[1] This distance applies to all occupied kit fox dens.

[2] A detailed analysis of potential indirect effects on greater sandhill crane is provided in Attachment 5J.D, *Indirect Effects of the Construction of the BDCP Conveyance Facility on Sandhill Crane*.

[3] Many covered bird species are sensitive to noise, lighting, and line-of-sight disturbances during the nesting season. For example, construction activity that is within 1,300 feet of a marsh identified as potential tricolored blackbird nesting habitat can result in the loss of this habitat function due to human disturbances and avoidance of the site by tricolored blackbirds. Construction-related activities can also result in the abandonment of nesting sites by tricolored blackbirds, yellow-breasted chats, and other birds if appropriate distances from breeding sites are not maintained.

[4] For some species, habitat use in the immediate vicinity of construction activities is reduced due to long-term, but temporary, disturbances from excavation and related activities, noise, and human presence. For example, tricolored blackbirds, greater sandhill cranes, Swainson's hawks, and white-tailed kites may avoid suitable foraging habitat that is near construction activities.

[5] Buffer distances for burrowing owls are applicable to the breeding and non-breeding seasons.

[6] Yellow-billed cuckoo was detected at one location during 2009. While nesting was not confirmed, this disturbance distance applies to any site found to be occupied by this species.

[7] Habitat function and value for most covered species decreases with proximity to ground disturbances or sources of visual or noise disturbance. For reptiles and amphibians that use upland habitats for nesting or aestivation, ground disturbances distant from aquatic habitats may also have affects. A 500-foot buffer is generally sufficient to avoid direct disturbances to occupied wetland habitats (e.g., ponds, creeks, pools) and most adjacent upland sites; however, where aquatic habitats are found to be occupied by California red-legged frog, California tiger salamander, giant garter snake, or western pond turtle occur, care should be taken to determine the potential for movement corridors that might extend beyond the 500-foot buffer. Where aquatic habitats are found to be occupied by any of these species, the buffer will be expanded to incorporate additional features (e.g., watersheds, drainages, or other possible movement corridors) that have a greater likelihood of supporting occupied upland habitat.

[8] 100 feet is the standard distance recommended by the U.S. Fish and Wildlife Service to avoid direct and indirect effects on elderberry shrubs.

[9] Vernal pool invertebrates can be affected by construction-related runoff into vernal pool habitats. A distance of 250 feet is often used to avoid impacts when there may be a hydrologic connection to the pool; however, potential impacts on occupied pools that are subject to construction-related runoff regardless of the distance should be avoided.

1 **Table 5.J-5. Indirect Effect Distances from Covered Activity, Plants**

Covered Species and Habitat Type	Area of Effect Extending from Disturbance Locations into Modeled Species' Habitats				
	100 feet	250 feet	500 feet	1,300 feet	2,600 feet
Plants					
Brittlescale		X			
Heartscale		X			
San Joaquin spearscale		X			
Carquinez goldenbush		X			
Delta button celery		X			
Delta mudwort		X			
Mason's lilaeopsis		X			
Delta tule pea		X			
Suisun Marsh aster		X			
Slough thistle		X			
Soft bird's-beak		X			
Suisun thistle		X			
Vernal Pool Plants					
Alkali milk-vetch		X			
Legenere		X			
Heckard's peppergrass		X			
Boggs Lake hedge-hyssop		X			
Dwarf downingia		X			

Table 5.J-6. Near Term Natural Communities Loss by Covered Activity

Maximum Allowable Habitat Loss by Covered Activity[1,2,3]															
		CM4 Tidal Natural Communities Restoration													
		Construction and Inundation[8] in Suisun Marsh							Construction and Inundation[8] in the Delta						Plan Area Total
Natural Community	Total Existing Modeled Habitat in the Plan Area[2]	High Tidal Brackish Marsh	Mid Tidal Brackish Marsh	Low Tidal Brackish Marsh	Intertidal mudflat	Subtidal 1	Subtidal 2	Subtidal 3	Ecotone	Intertidal Mudflat	Tidal Freshwater Marsh	Subtidal 1	Subtidal 2	Subtidal 3	Permanent [8,9,10]
Tidal Perennial Aquatic	86,263	0	0	1	0	0	0	0	1	1	11	0.00	0.00	0.00	14
Tidal Mudflat[14]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tidal Brackish Emergent Wetland[15]	8,501	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tidal Freshwater Emergent Wetland[15]	8,856	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Valley/Foothill Riparian	17,644	0	0	0	0	0	0	0	0	0	286	6	4	2	298
Grassland	76,315	0	0	1	0	0	0	0	39	3	345	37	16	6	448
Alkali Seasonal Wetland Complex	3,723	0	0	0	0	0	0	0	3	0	10	0	0	0	13
Vernal Pool Complex	11,284	0	0	1	0	0	0	0	24	0	3	0	0	0	28 [18,19]
Other Natural Seasonal Wetland	276	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nontidal Freshwater Perennial Emergent Wetland	1,385	0	0	0	0	0	0	0	0	0	38	0	1	0	40
Nontidal Perennial Aquatic	5,489	0	0	0	0	0	0	0	5	2	19	8	0	0	34
Managed Wetland	70,698	88	0	1,569	1,099	1,183	42	0	223	141	1,339	26	7	2	5,718
Inland Dune Scrub	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cultivated Lands	481,909	0	0	0	0	0	0	0	482	13	3,494	1,386	432	71	5,878
Total	**772,364**	**88**	**0**	**1,572**	**1,099**	**1,183**	**42**	**0**	**778**	**159**	**5,544**	**1,465**	**460**	**81**	**12,471**

1 **Table 5.J-6. Near Term Natural Communities Loss by Covered Activity (cont'd)**

Natural Community	Total Existing Modeled Habitat in the Plan Area[2]	Maximum Allowable Habitat Loss by Covered Activity[1,2,3]																
		CM1 Water Facilities and Operation				CM2 Yolo Bypass Fisheries Enhancement		CM5 Seasonally Inundated Floodplain Restoration		CM7 Riparian Natural Community Restoration			CM10 Nontidal Marsh Natural Community Restoration	CM11 Natural Community Enhancement and Management	CM18 Conservation Hatcheries			
		Tunnel/Pipeline/Conveyance Facilities Construction				Fremont Weir and Yolo Bypass Improvements		Levee Construction		Riparian Restoration as Part of Tidal Natural Communities Restoration	Riparian Restoration as Part of Seasonal Floodplain Restoration	CM8 Grassland Restoration	Construction and Inundation	Construction of Recreational-Related Facilities	Construction	Maximum Allowable Habitat Loss		
		Permanent[4,20]	Permanent Reusable Tunnel Material[5]	Temporary (Borrow and Spoil)[4,6,20]	Temporary[4]	Permanent[7]	Temporary[7]	Permanent[11]	Temporary[11]	Permanent	Permanent[12]	Permanent[13]	Permanent[13]	Permanent	Permanent[13]	Permanent[16]	Temporary (Borrow and Spoil)[16]	Temporary[16]
Tidal Perennial Aquatic	86,263	178	0	0	2,101	8	11	0	0	0	0	0	0	0	0	200	0	2,112
Tidal Mudflat[14]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tidal Brackish Emergent Wetland[15]	8,501	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tidal Freshwater Emergent Wetland[15]	8,856	5	1	0	10	6	0	0	0	0	0	0	0	0	0	12	0	10
Valley/Foothill Riparian	17,644	16	18	1	29	89	88	0	0	0	0	0	0	0	0	420	1	116
Grassland	76,315	211	249	0	158	388	239	0	0	4	0	0	0	13	35	1,349	0	397
Alkali Seasonal Wetland Complex	3,723	0	0	0	0 [17]	45	0	0	0	0	0	0	0	0	0	58	0	0
Vernal Pool Complex	11,284	15 [18]	0	0	0 [17,18,19]	0	0	0	0	0	0	0	0	0	0	43	0	0
Other Natural Seasonal Wetland	276	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nontidal Freshwater Perennial Emergent Wetland	1,385	1	1	0	5	25	1	0	0	0	0	0	0	0	0	67	0	6
Nontidal Perennial Aquatic	5,489	2	55	0	7	24	12	0	0	0	0	0	0	0	0	115	0	18
Managed Wetland	70,698	7	0	0	28	24	44	0	0	0	0	0	0	0	0	5,750	0	72
Inland Dune Scrub	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cultivated Lands	481,909	1,448	3,140	199	1,196	629	363	0	0	10	0	1,140	700	0	0	12,945	199	1,559
Total	**772,364**	**1,885**	**3,465**	**200**	**3,533**	**1,238**	**757**	**0**	**0**	**14**	**0**	**1,140**	**700**	**13**	**35**	**20,961**	**200**	**4,290**

N/A = Not available.

1 The following covered activities and associated federal actions (listed here by the header/category as described in Chapter 4, *Covered Activities and Associated Federal Actions*) are assumed not to have footprint impacts on natural communities or species habitat: Operations and Maintenance of Existing SWP Facilities; Power Generation Water Use - Mirant Delta, LLC activities; Activities to Reduce Contaminants; Activities to Reduce Predators and Other Sources of Direct Mortality; Monitoring and Research Programs; Emergency Actions; CVP Operations and Maintenance; and Joint Federal and Nonfederal Actions.

2 Existing habitat and habitat loss are estimated using natural community models created from detailed vegetation mapping, See Chapter 2, Section 2.3 for a complete description of mapping methods. Effects on natural communities will be tracked during implementation through on-the-ground surveys performed by qualified biologists.

3 See Table 5.J.1, *Quantitative Effects Analysis Methods and Assumptions*, in Appendix 5.J, *Effects on Natural Communities, Wildlife, and Plants*, for a description methods and assumptions relevant to estimating natural community loss by covered activity type and Table 5.J.3, *Key Assumptions Related to Tidal Restoration Effects on Covered Species Habitat*, for a list of assumptions used to determine permanent loss or conversion as a result of inundation caused by tidal restoration.

4 Permanent and temporary effects assessed under CM1 Water Facilities and Operation are associated with construction of the following conveyance-related facilities: forebay, intake facilities, permanent access roads, shaft locations, and transmission lines. See Chapter 4, Covered Activities and Associated Federal Actions, Section 4.1.3.1, Tunnel/Pipeline Facility Construction and Operations, for a complete description of all activities assessed under CM1.

5 This represents the maximum area potentially necessary for storing reusable tunnel material. This material will likely be moved to other sites for use in levee build-up and restoration, and the affected area will likely be restored. While this effect is categorized as permanent, because there is no assurance that the material will eventually be moved, the effect will likely be temporary. Furthermore, the amount of storage area needed for reusable tunnel material is flexible (based on height of storage piles and other factors) and the footprint used in the effects analysis is based on a worst case scenario: the actual area to be affected by reusable tunnel material storage will likely be less than the estimated acreage.

6 Borrow/Spoil Area: Borrow: a location from where construction material, such as sand or clay, will be taken. Spoil: area where construction by-products, such as removed earth, will be placed and stored. Borrow/spoil: an area that will originally be used for borrow and then later be used for spoil. While these impacts are considered "temporary", because affected lands will be restored when conveyance facility construction is complete, for the purposes of determining net effects, impacts are considered "permanent".

Maximum Allowable Habitat Loss by Covered Activity[1,2,3]																		
		CM1 Water Facilities and Operation				CM2 Yolo Bypass Fisheries Enhancement		CM5 Seasonally Inundated Floodplain Restoration		CM7 Riparian Natural Community Restoration			CM10 Nontidal Marsh Natural Community Restoration	CM11 Natural Community Enhancement and Management	CM18 Conservation Hatcheries			
		Tunnel/Pipeline/Conveyance Facilities Construction				Fremont Weir and Yolo Bypass Improvements		Levee Construction		Riparian Restoration as Part of Tidal Natural Communities Restoration	Riparian Restoration as Part of Seasonal Floodplain Restoration	CM8 Grassland Restoration	Construction and Inundation	Construction of Recreational-Related Facilities	Construction	Maximum Allowable Habitat Loss		
Natural Community	Total Existing Modeled Habitat in the Plan Area[2]	Permanent[4,20]	Permanent Reusable Tunnel Material[5]	Temporary (Borrow and Spoil)[4,6,20]	Temporary[4]	Permanent[7]	Temporary[7]	Permanent[11]	Temporary[11]	Permanent	Permanent[12]	Permanent[13]	Permanent[13]	Permanent	Permanent[13]	Permanent[16]	Temporary (Borrow and Spoil)[16]	Temporary[16]

7 Permanent and temporary effects assessed under CM2 Yolo Bypass Fisheries Enhancement include activities associated with Fremont Weir improvements, Putah Creek realignment activities, Lisbon weir and fish crossing improvements, and Sacramento Weir improvements.

8 Inundation is tidal flooding of existing wetland habitat as a result of tidal restoration actions. Inundation can cause permanent loss of habitat from either the removal of habitat or the conversion of one habitat type to another. See Table 5.J.1, *Quantitative Effects Analysis Methods and Assumptions*, in Appendix 5.J, for a description of relevant assumptions. All construction is assumed to occur within the inundation footprint.

9 Permanent loss calculations are based on hypothetical tidal restoration designs and include those areas modeled by ESAPWA (Appendix 3.B, *BDCP Tidal Habitat Evolution Assessment*) to be below extreme high water elevation. See Table 5.J.1 in Appendix 5.J, for methods and assumptions used to apply the hypothetical footprint to determine effects.

10 Tidal restoration is expected to include riparian restoration where elevations are favorable. Permanent loss from riparian restoration was determined by non-GIS methods. See Table 5.J.1, in Appendix 5.J, for a complete list of methods and assumptions.

11 Calculation of effects based on hypothetical floodplain restoration designs. See Table 5.J.1 in Appendix 5.J, for details.

12 Based on restoration design assumptions described in Appendix 5.E, *Habitat Restoration*, and effects analysis assumptions detailed in Table 5.J.1 in Appendix 5.J.

13 Permanent loss was determined based on non-GIS methods described in Table 5.J.1 in Appendix 5.J.

14 Tidal mudflat features were not mapped in the BDCP vegetation layer.

15 Effects on tidal wetland communities are based on hypothetical tidal restoration designs and include those areas modeled by ESAPWA (Appendix 3.B, *BDCP Tidal Habitat Evolution Assessment*) to be below MLLW in Suisun and MLLW + 1 ft. in the rest of the Delta. See Table 5.J-1 for methods and assumptions used to apply the hypothetical footprint to determine effects.

16 Totals may not sum due to rounding.

17 Loss reduced to zero. Although the temporary powerline footprint overlaps with 2 acres of alkali seasonal wetland complex and 16 acres of vernal pool complex in Conservation Zone 8, AMM30 requires that wetted acres of alkali seasonal wetlands and vernal pools be avoided during temporary powerline installation.

18 Of the 11,284 acres of vernal pool complex natural community, 2,576 acres are considered "degraded". Of the original (some impacts subsequently reduced, see footnotes 17 and 19) 15 acres of permanent loss (CM1), 0 acres of temporary loss (CM1), and 28 acres of permanent loss (CM4), 7 acres, 2 acres, and 370 acres of loss are to degraded vernal pool complex, respectively.

19 Total permanent loss reduced from 201 acres (CM4) to 28 acres. This reduction is based on a 10-acre cap for total loss of wetted acres, assuming 15% density of vernal pools in the area affected. Acreage of vernal pool complex loss may be higher if actual vernal pool density is lower. The maximum acreage loss is based on loss of wetted acres and not total vernal pool complex acreage.

20 Current proposed transmission line alignment extends outside the Plan Area, although final alignment is unknown. Acreage loss associated with transmission line construction outside the Plan Area is included in this column. Plan Area will be adjusted if needed for final plan when transmission line alignment is further designed.

Table 5.J-7. Early Long-Term Natural Communities Loss by Covered Activity

Natural Community	Total Existing Modeled Habitat in the Plan Area[2]	Maximum Allowable Habitat Loss by Covered Activity[1,2,3]													
		CM4 Tidal Natural Communities Restoration													
		Construction and Inundation[8] in Suisun Marsh							Construction and Inundation[8] in the Delta						Plan Area Total
		High Tidal Brackish Marsh	Mid Tidal Brackish Marsh	Low Tidal Brackish Marsh	Intertidal Mudflat	Subtidal 1	Subtidal 2	Subtidal 3	Ecotone	Intertidal Mudflat	Tidal Freshwater Marsh	Subtidal 1	Subtidal 2	Subtidal 3	Permanent[8,9,10]
Tidal Perennial Aquatic	86,263	0	0	1	0	0	0	0	1	1	13	0	0	0	16
Tidal Mudflat[14]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tidal Brackish Emergent Wetland[15]	8,501	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Tidal Freshwater Emergent Wetland[15]	8,856	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Valley/Foothill Riparian	17,644	0	0	0	0	0	0	0	0	0	389	7	5	2	403
Grassland	76,315	0	0	1	0	0	0	0	32	3	632	39	17	6	732
Alkali Seasonal Wetland Complex	3,723	0	0	0	0	0	0	0	0	0	13	0	0	0	13
Vernal Pool Complex	11,284	0	0	0	0	0	0	0	26	0	26	0	0	0	53 [18,19]
Other Natural Seasonal Wetland	276	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nontidal Freshwater Perennial Emergent Wetland	1,385	0	0	0	0	0	0	0	0	0	50	0	1	0	51
Nontidal Perennial Aquatic	5,489	0	0	0	0	0	0	0	6	0	51	10	1	0	68
Managed Wetland	70,698	56	112	1,783	1,628	1,765	69	0	232	0	1,479	161	14	2	7,301
Inland Dune Scrub	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cultivated Lands	481,909	0	0	0	0	0	0	0	823	207	7,104	2,365	829	95	11,423
Total	**772,364**	**57**	**113**	**1,786**	**1,630**	**1,765**	**69**	**0**	**1,121**	**211**	**9,757**	**2,584**	**866**	**105**	**20,062**

Table 5.J-7. Early Long-Term Natural Communities Loss by Covered Activity (cont'd)

		Maximum Allowable Habitat Loss by Covered Activity[1,2,3]																
		CM1 Water Facilities and Operation				CM2 Yolo Bypass Fisheries Enhancement		CM5 Seasonally Inundated Floodplain Restoration		CM7 Riparian Natural Community Restoration			CM10 Nontidal Marsh Natural Community Restoration	CM11 Natural Community Enhancement and Management	CM18 Conservation Hatcheries			
		Tunnel/Pipeline/Conveyance Facilities Construction				Fremont Weir and Yolo Bypass Improvements		Levee Construction		Riparian Restoration as Part of Tidal Natural Communities Restoration	Riparian Restoration as Part of Seasonal Floodplain Restoration	CM8 Grassland Restoration	Construction and Inundation	Construction of Recreational-Related Facilities	Construction	Maximum Allowable Habitat Loss		
Natural Community	Total Existing Modeled Habitat in the Plan Area[2]	Permanent[4,20]	Permanent Reusable Tunnel Material[5]	Temporary (Borrow and Spoil)[4,6,20]	Temporary[4]	Permanent[7]	Temporary[7]	Permanent[11]	Temporary[11]	Permanent	Permanent[12]	Permanent[13]	Permanent[13]	Permanent	Permanent[13]	Permanent[16]	Temporary (Borrow and Spoil)[16]	Temporary[16]
Tidal Perennial Aquatic	86,263	178	0	0	2,101	8	11	0	0	0	0	0	0	0	0	202	0	2,112
Tidal Mudflat[14]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tidal Brackish Emergent Wetland[15]	8,501	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Tidal Freshwater Emergent Wetland[15]	8,856	5	1	0	10	6	0	0	0	0	0	0	0	0	0	12	0	10
Valley/Foothill Riparian	17,644	16	18	1	29	89	88	6	6	0	0	0	0	0	0	532	1	123
Grassland	76,315	211	249	0	158	388	239	11	12	7	0	0	0	20	35	1,653	0	409
Alkali Seasonal Wetland Complex	3,723	0	0	0	0 [17]	45	0	0	0	0	0	0	0	0	0	59	0	0
Vernal Pool Complex	11,284	15 [18]	0	0	0 [17,18,19]	0	0	0	0	0	0	0	0	0	0	68	0	0
Other Natural Seasonal Wetland	276	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nontidal Freshwater Perennial Emergent Wetland	1,385	1	1	0	5	25	1	0	0	0	0	0	0	0	0	78	0	6
Nontidal Perennial Aquatic	5,489	2	55	0	7	24	12	19	8	0	0	0	0	0	0	168	0	27
Managed Wetland	70,698	7	0	0	28	24	44	0	0	0	0	0	0	0	0	7,332	0	72
Inland Dune Scrub	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cultivated Lands	481,909	1,448	3,140	199	1,196	629	363	252	153	19	0	1,480	1,000	0	0	19,392	199	1,711
Total	**772,364**	**1,885**	**3,465**	**200**	**3,533**	**1,238**	**757**	**288**	**180**	**26**	**0**	**1,480**	**1,000**	**20**	**35**	**29,498**	**200**	**4,470**

N/A = Not available.

[1] The following covered activities and associated federal actions (listed here by the header/category as described in Chapter 4, Covered Activities and Associated Federal Actions) are assumed not to have footprint impacts on natural communities or species habitat: Operations and Maintenance of Existing SWP Facilities; Power Generation Water Use - Mirant Delta, LLC activities; Activities to Reduce Contaminants; Activities to Reduce Predators and Other Sources of Direct Mortality; Monitoring and Research Programs; Emergency Actions; CVP Operations and Maintenance; and Joint Federal and Nonfederal Actions.

[2] Existing habitat and habitat loss are estimated using natural community models created from detailed vegetation mapping, See Chapter 2, Existing Ecological Conditions, Section 2.3, for a complete description of mapping methods. Effects on natural communities will be tracked during implementation through on-the-ground surveys performed by qualified biologists.

[3] See Table 5.J.1, *Quantitative Effects Analysis Methods and Assumptions*, in Appendix 5.J, *Effects on Natural Communities, Wildlife, and Plants*, for a description methods and assumptions relevant to estimating natural community loss by covered activity type and Table 5.J.3, *Key Assumptions Related to Tidal Restoration Effects on Covered Species Habitat*, for a list of assumptions used to determine permanent loss or conversion as a result of inundation caused by tidal restoration.

[4] Permanent and temporary effects assessed under CM1 Water Facilities and Operation are associated with construction of the following conveyance-related facilities: forebay, intake facilities, permanent access roads, shaft locations, and transmission lines. See Chapter 4, Covered Activities and Associated Federal Actions, Section 4.1.3.1, Tunnel/Pipeline Facility Construction and Operations, for a complete description of all activities assessed under CM1.

[5] This represents the maximum area potentially necessary for storing reusable tunnel material. This material will likely be moved to other sites for use in levee build-up and restoration, and the affected area will likely be restored. While this effect is categorized as

Maximum Allowable Habitat Loss by Covered Activity[1,2,3]																		
		CM1 Water Facilities and Operation				CM2 Yolo Bypass Fisheries Enhancement		CM5 Seasonally Inundated Floodplain Restoration		CM7 Riparian Natural Community Restoration			CM10 Nontidal Marsh Natural Community Restoration	CM11 Natural Community Enhancement and Management	CM18 Conservation Hatcheries			
		Tunnel/Pipeline/Conveyance Facilities Construction				Fremont Weir and Yolo Bypass Improvements		Levee Construction		Riparian Restoration as Part of Tidal Natural Communities Restoration	Riparian Restoration as Part of Seasonal Floodplain Restoration	CM8 Grassland Restoration	Construction and Inundation	Construction of Recreational-Related Facilities	Construction	Maximum Allowable Habitat Loss		
Natural Community	Total Existing Modeled Habitat in the Plan Area[2]	Permanent[4,20]	Permanent Reusable Tunnel Material[5]	Temporary (Borrow and Spoil)[4,6,20]	Temporary[4]	Permanent[7]	Temporary[7]	Permanent[11]	Temporary[11]	Permanent	Permanent[12]	Permanent[13]	Permanent[13]	Permanent	Permanent[13]	Permanent[16]	Temporary (Borrow and Spoil)[16]	Temporary[16]

permanent, because there is no assurance that the material will eventually be moved, the effect will likely be temporary. Furthermore, the amount of storage area needed for reusable tunnel material is flexible (based on height of storage piles and other factors) and the footprint used in the effects analysis is based on a worst case scenario: the actual area to be affected by reusable tunnel material storage will likely be less than the estimated acreage.

6 Borrow/Spoil Area: Borrow: a location from where construction material, such as sand or clay, will be taken. Spoil: area where construction by-products, such as removed earth, will be placed and stored. Borrow/spoil: an area that will originally be used for borrow and then later be used for spoil. While these impacts are considered "temporary", because affected lands will be restored when conveyance facility construction is complete, for the purposes of determining net effects, impacts are considered "permanent".

7 Permanent and temporary effects assessed under CM2 Yolo Bypass Fisheries Enhancement include activities associated with Fremont Weir improvements, Putah Creek realignment activities, Lisbon weir and fish crossing improvements, and Sacramento Weir improvements.

8 Inundation is tidal flooding of existing wetland habitat as a result of tidal restoration actions. Inundation can cause permanent loss of habitat from either the removal of habitat or the conversion of one habitat type to another. See Table 5.J.1, *Quantitative Effects Analysis Methods and Assumptions*, in Appendix 5.J, for a description of relevant assumptions. All construction is assumed to occur within the inundation footprint.

9 Permanent loss calculations are based on hypothetical tidal restoration designs and include those areas modeled by ESAPWA (Appendix 3.B, *BDCP Tidal Habitat Evolution Assessment*) to be below extreme high water elevation. See Table 5.J.1 in Appendix 5.J, for methods and assumptions used to apply the hypothetical footprint to determine effects.

10 Tidal restoration is expected to include riparian restoration where elevations are favorable. Permanent loss from riparian restoration was determined by non-GIS methods. See Table 5.J.1, in Appendix 5.J, for a complete list of methods and assumptions.

11 Calculation of effects based on hypothetical floodplain restoration designs. See Table 5.J.1 in Appendix 5.J, for details.

12 Based on restoration design assumptions described in Appendix 5.E, *Habitat Restoration*, and effects analysis assumptions detailed in Table 5.J.1 in Appendix 5.J.

13 Permanent loss was determined based on non-GIS methods described in Table 5.J.1 in Appendix 5.J.

14 Tidal mudflat features were not mapped in the BDCP vegetation layer.

15 Effects on tidal wetland communities are based on hypothetical tidal restoration designs and include those areas modeled by ESAPWA (Appendix 3.B, *BDCP Tidal Habitat Evolution Assessment*) to be below MLLW in Suisun and MLLW + 1 ft. in the rest of the Delta. See Table 5.J-1 for methods and assumptions used to apply the hypothetical footprint to determine effects.

16 Totals may not sum due to rounding.

17 Loss reduced to zero. Although the temporary powerline footprint overlaps with 2 acres of alkali seasonal wetland complex and 16 acres of vernal pool complex in Conservation Zone 8, AMM30 requires that wetted acres of alkali seasonal wetlands and vernal pools be avoided during temporary powerline installation.

18 Of the 11,284 acres of vernal pool complex natural community, 2,576 acres are considered "degraded". Of the original (some impacts subsequently reduced, see footnotes 17 and 19) 15 acres of permanent loss (CM1), 0 acres of temporary loss (CM1), and 28 acres of permanent loss (CM4), 7 acres, 2 acres, and 370 acres of loss are to degraded vernal pool complex, respectively.

19 Total permanent loss reduced from 201 acres (CM4) to 28 acres. This reduction is based on a 10-acre cap for total loss of wetted acres, assuming 15% density of vernal pools in the area affected. Acreage of vernal pool complex loss may be higher if actual vernal pool density is lower. The maximum acreage loss is based on loss of wetted acres and not total vernal pool complex acreage.

20 Current proposed transmission line alignment extends outside the Plan Area, although final alignment is unknown. Acreage loss associated with transmission line construction outside the Plan Area is included in this column. Plan Area will be adjusted if needed for final plan when transmission line alignment is further designed.

Table 5.J-8. Late Long-Term Natural Communities Loss by Covered Activity

Maximum Allowable Habitat Loss by Covered Activity[1,2,3]															
		CM4 Tidal Natural Communities Restoration													
		Construction and Inundation[8] in Suisun Marsh							Construction and Inundation[8] in the Delta						Plan Area Total
Natural Community	Total Existing Modeled Habitat in the Plan Area[2]	High Tidal Brackish Marsh	Mid Tidal Brackish Marsh	Low Tidal Brackish Marsh	Intertidal Mudflat	Subtidal 1	Subtidal 2	Subtidal 3	Ecotone	Intertidal Mudflat	Tidal Freshwater Marsh	Subtidal 1	Subtidal 2	Subtidal 3	Permanent [8,9,10]
Tidal Perennial Aquatic	86,263	0	0	1	0	0	0	0	1	1	14	0	0	0	18
Tidal Mudflat[14]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tidal Brackish Emergent Wetland[15]	8,501	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Tidal Freshwater Emergent Wetland[15]	8,856	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Valley/Foothill Riparian	17,644	0	0	0	0	0	0	0	0	0	490	25	28	8	552
Grassland	76,315	1	0	1	0	1	0	0	74	3	881	61	65	35	1,122
Alkali Seasonal Wetland Complex	3,723	0	0	0	0	0	0	0	2	0	25	0	0	0	27
Vernal Pool Complex	11,284 [18]	0	0	1	0	0	0	0	9	0	41	1	0	0	52 [18,19]
Other Natural Seasonal Wetland	276	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nontidal Freshwater Perennial Emergent Wetland	1,385	0	0	0	0	0	0	0	7	0	81	7	3	2	99
Nontidal Perennial Aquatic	5,489	0	0	0	0	0	0	0	25	0	94	23	38	10	189
Managed Wetland	70,698	68	71	2,499	1,756	6,493	644	1	137	0	1,882	157	30	9	13,746
Inland Dune Scrub	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cultivated Lands	481,909	2	0	0	0	0	0	0	1,437	1	18,707	7,316	8,982	3,120	39,565
Total	**772,364**	**71**	**72**	**2,503**	**1,757**	**6,494**	**644**	**1**	**1,693**	**4**	**22,214**	**7,589**	**9,146**	**3,184**	**55,373**

Table 5.J-8. Late Long-Term Natural Communities Loss by Covered Activity (cont'd)

		Maximum Allowable Habitat Loss by Covered Activity[1,2,3]																
		CM1 Water Facilities and Operation				CM2 Yolo Bypass Fisheries Enhancement		CM5 Seasonally Inundated Floodplain Restoration		CM7 Riparian Natural Community Restoration			CM10 Nontidal Marsh Natural Community Restoration	CM11 Natural Community Enhancement and Management	CM18 Conservation Hatcheries			
		Tunnel/Pipeline/Conveyance Facilities Construction				Fremont Weir and Yolo Bypass Improvements		Levee Construction		Riparian Restoration as Part of Tidal Natural Communities Restoration	Riparian Restoration as Part of Seasonal Floodplain Restoration	CM8 Grassland Restoration	Construction and Inundation	Construction of Recreational-Related Facilities	Construction	Maximum Allowable Habitat Loss		
Natural Community	Total Existing Modeled Habitat in the Plan Area[2]	Permanent[4,20]	Permanent Reusable Tunnel Material[5]	Temporary (Borrow and Spoil)[4,6,20]	Temporary[4]	Permanent[7]	Temporary[7]	Permanent[11]	Temporary[11]	Permanent	Permanent[12]	Permanent[13]	Permanent[13]	Permanent	Permanent[13]	Permanent[16]	Temporary (Borrow and Spoil)[16]	Temporary[16]
Tidal Perennial Aquatic	86,263	178	0	0	2,101	8	11	2	5	0	0	0	0	0	0	207	0	2,116
Tidal Mudflat[14]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tidal Brackish Emergent Wetland[15]	8,501	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Tidal Freshwater Emergent Wetland[15]	8,856	5	1	0	10	6	0	1	1	0	0	0	0	0	0	13	0	11
Valley/Foothill Riparian	17,644	16	18	1	29	89	88	43	35	0	0	0	0	0	0	717	1	151
Grassland	76,315	211	249	0	158	388	239	51	34	11	399	0	0	50	35	2,517	0	431
Alkali Seasonal Wetland Complex	3,723	0	0	0	0 [17]	45	0	0	0	0	0	0	0	0	0	72	0	0
Vernal Pool Complex	11,284 [18]	15 [18]	0	0	0 [17,18,19]	0	0	0	0	0	0	0	0	0	0	67	0	0
Other Natural Seasonal Wetland	276	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nontidal Freshwater Perennial Emergent Wetland	1,385	1	1	0	5	25	1	0	0	0	0	0	0	0	0	127	0	6
Nontidal Perennial Aquatic	5,489	2	55	0	7	24	12	28	16	0	0	0	0	0	0	299	0	34
Managed Wetland	70,698	7	0	0	28	24	44	0	0	0	0	0	0	0	0	13,778	0	72
Inland Dune Scrub	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cultivated Lands	481,909	1,448	3,140	199	1,196	629	363	2,087	1,194	960	3,593	2,000	1,950	0	0	55,372	199	2,753
Total	**772,364**	**1,885**	**3,465**	**200**	**3,533**	**1,238**	**757**	**2,212**	**1,285**	**971**	**3,991**	**2,000**	**1,950**	**50**	**35**	**73,170**	**200**	**5,575**

N/A = Not available.

1 The following covered activities and associated federal actions (listed here by the header/category as described in Chapter 4, Covered Activities and Associated Federal Actions) are assumed not to have footprint impacts on natural communities or species habitat: Operations and Maintenance of Existing SWP Facilities; Power Generation Water Use - Mirant Delta, LLC activities; Activities to Reduce Contaminants; Activities to Reduce Predators and Other Sources of Direct Mortality; Monitoring and Research Programs; Emergency Actions; CVP Operations and Maintenance; and Joint Federal and Nonfederal Actions.

2 Existing habitat and habitat loss are estimated using natural community models created from detailed vegetation mapping, See Chapter 2, Existing Ecological Conditions, Section 2.3, for a complete description of mapping methods. Effects on natural communities will be tracked during implementation through on-the-ground surveys performed by qualified biologists.

3 See Table 5.J.1, *Quantitative Effects Analysis Methods and Assumptions*, in Appendix 5.J, *Effects on Natural Communities, Wildlife, and Plants*, for a description methods and assumptions relevant to estimating natural community loss by covered activity type and Table 5.J.3, *Key Assumptions Related to Tidal Restoration Effects on Covered Species Habitat*, for a list of assumptions used to determine permanent loss or conversion as a result of inundation caused by tidal restoration.

4 Permanent and temporary effects assessed under CM1 Water Facilities and Operation are associated with construction of the following conveyance-related facilities: forebay, intake facilities, permanent access roads, shaft locations, and transmission lines. See Chapter 4, Covered Activities and Associated Federal Actions, Section 4.1.3.1, Tunnel/Pipeline Facility Construction and Operations, for a complete description of all activities assessed under CM1.

5 This represents the maximum area potentially necessary for storing reusable tunnel material. This material will likely be moved to other sites for use in levee build-up and restoration, and the affected area will likely be restored. While this effect is categorized as

Maximum Allowable Habitat Loss by Covered Activity[1,2,3]																		
		CM1 Water Facilities and Operation				CM2 Yolo Bypass Fisheries Enhancement		CM5 Seasonally Inundated Floodplain Restoration		CM7 Riparian Natural Community Restoration			CM10 Nontidal Marsh Natural Community Restoration	CM11 Natural Community Enhancement and Management	CM18 Conservation Hatcheries			
		Tunnel/Pipeline/Conveyance Facilities Construction				Fremont Weir and Yolo Bypass Improvements		Levee Construction		Riparian Restoration as Part of Tidal Natural Communities Restoration	Riparian Restoration as Part of Seasonal Floodplain Restoration	CM8 Grassland Restoration	Construction and Inundation	Construction of Recreational-Related Facilities	Construction	Maximum Allowable Habitat Loss		
Natural Community	Total Existing Modeled Habitat in the Plan Area[2]	Permanent[4,20]	Permanent Reusable Tunnel Material[5]	Temporary (Borrow and Spoil)[4,6,20]	Temporary[4]	Permanent[7]	Temporary[7]	Permanent[11]	Temporary[11]	Permanent	Permanent[12]	Permanent[13]	Permanent[13]	Permanent	Permanent[13]	Permanent[16]	Temporary (Borrow and Spoil)[16]	Temporary[16]

permanent, because there is no assurance that the material will eventually be moved, the effect will likely be temporary. Furthermore, the amount of storage area needed for reusable tunnel material is flexible (based on height of storage piles and other factors) and the footprint used in the effects analysis is based on a worst case scenario: the actual area to be affected by reusable tunnel material storage will likely be less than the estimated acreage.

6 Borrow/Spoil Area: Borrow: a location from where construction material, such as sand or clay, will be taken. Spoil: area where construction by-products, such as removed earth, will be placed and stored. Borrow/spoil: an area that will originally be used for borrow and then later be used for spoil. While these impacts are considered "temporary", because affected lands will be restored when conveyance facility construction is complete, for the purposes of determining net effects, impacts are considered "permanent".

7 Permanent and temporary effects assessed under CM2 Yolo Bypass Fisheries Enhancement include activities associated with Fremont Weir improvements, Putah Creek realignment activities, Lisbon weir and fish crossing improvements, and Sacramento Weir improvements.

8 Inundation is tidal flooding of existing wetland habitat as a result of tidal restoration actions. Inundation can cause permanent loss of habitat from either the removal of habitat or the conversion of one habitat type to another. See Table 5.J.1, *Quantitative Effects Analysis Methods and Assumptions*, in Appendix 5.J, for a description of relevant assumptions. All construction is assumed to occur within the inundation footprint.

9 Permanent loss calculations are based on hypothetical tidal restoration designs and include those areas modeled by ESAPWA (Appendix 3.B, *BDCP Tidal Habitat Evolution Assessment*) to be below extreme high water elevation. See Table 5.J.1 in Appendix 5.J, for methods and assumptions used to apply the hypothetical footprint to determine effects.

10 Tidal restoration is expected to include riparian restoration where elevations are favorable. Permanent loss from riparian restoration was determined by non-GIS methods. See Table 5.J.1, in Appendix 5.J, for a complete list of methods and assumptions.

11 Calculation of effects based on hypothetical floodplain restoration designs. See Table 5.J.1 in Appendix 5.J, for details.

12 Based on restoration design assumptions described in Appendix 5.E, *Habitat Restoration*, and effects analysis assumptions detailed in Table 5.J.1 in Appendix 5.J.

13 Permanent loss was determined based on non-GIS methods described in Table 5.J.1 in Appendix 5.J.

14 Tidal mudflat features were not mapped in the BDCP vegetation layer.

15 Effects on tidal wetland communities are based on hypothetical tidal restoration designs and include those areas modeled by ESAPWA (Appendix 3.B, *BDCP Tidal Habitat Evolution Assessment*) to be below MLLW in Suisun and MLLW + 1 ft. in the rest of the Delta. See Table 5.J-1 for methods and assumptions used to apply the hypothetical footprint to determine effects.

16 Totals may not sum due to rounding.

17 Loss reduced to zero. Although the temporary powerline footprint overlaps with 2 acres of alkali seasonal wetland complex and 16 acres of vernal pool complex in Conservation Zone 8, AMM30 requires that wetted acres of alkali seasonal wetlands and vernal pools be avoided during temporary powerline installation.

18 Of the 11,284 acres of vernal pool complex natural community, 2,576 acres are considered "degraded". Of the original (some impacts subsequently reduced, see footnotes 17 and 19) 15 acres of permanent loss (CM1), 0 acres of temporary loss (CM1), and 28 acres of permanent loss (CM4), 7 acres, 2 acres, and 370 acres of loss are to degraded vernal pool complex, respectively.

19 Total permanent loss reduced from 201 acres (CM4) to 28 acres. This reduction is based on a 10-acre cap for total loss of wetted acres, assuming 15% density of vernal pools in the area affected. Acreage of vernal pool complex loss may be higher if actual vernal pool density is lower. The maximum acreage loss is based on loss of wetted acres and not total vernal pool complex acreage.

20 Current proposed transmission line alignment extends outside the Plan Area, although final alignment is unknown. Acreage loss associated with transmission line construction outside the Plan Area is included in this column. Plan Area will be adjusted if needed for final plan when transmission line alignment is further designed.

Table 5.J-9. Near Term Wildlife Modeled Habitat Loss and Conversion by Covered Activity

		Maximum Allowable Habitat Loss by Covered Activity [1,2,3]														
		CM4 Tidal Natural Communities Restoration														
		Suisun Marsh							Delta						Plan Area Total [7]	
Covered Wildlife Species	Total Existing Modeled Habitat in the Plan Area (Acres)[2]	High Tidal Brackish Marsh	Mid Tidal Brackish Marsh	Low Tidal Brackish Marsh	Intertidal Mudflat	Subtidal 1	Subtidal 2	Subtidal 3	Ecotone	Intertidal Mudflat	Tidal Freshwater Marsh	Subtidal 1	Subtidal 2	Subtidal 3	Permanent (Acres)[7,8,9]	Conversion (Acres)
Mammals																
Riparian brush rabbit																
Riparian habitat	2,909	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grassland habitat	3,103	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**6,011**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Riparian woodrat																
Habitat	2,166	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**2,166**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Salt marsh harvest mouse																
Tidal brackish emergent wetland primary	3,641	0	0	64	0	0	0	0	0	0	0	0	0	0	0	64
Tidal brackish emergent wetland secondary	2,718	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upland secondary	749	1	7	0	0	0	0	0	0	0	0	0	0	0	0 [15]	8
Managed wetland—wetland primary, low long-term conservation value	21,891	30	0	534	577	770	3	0	0	0	0	0	0	0	1,349	564
Managed wetland—wetland secondary, low long-term conservation value	2,800	11	0	229	50	23	0	0	0	0	0	0	0	0	74	241
Managed wetland—upland, low long-term conservation value	3,787	8	0	64	70	24	0	0	0	0	0	0	0	0	94	71
Total	**35,588**	**49**	**7**	**892**	**697**	**817**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1,517**	**948**
San Joaquin kit fox																
Breeding, foraging, and dispersal habitat	5,327	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**5,327**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Suisun shrew																
Primary habitat	3,128	0	0	58	0	0	0	0	0	0	0	0	0	0	58	0
Secondary habitat	4,387	10	5	0	22	9	0	0	0	0	0	0	0	0	31 [15]	15
Total	**7,515**	**10**	**5**	**58**	**22**	**9**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**89**	**15**
Birds																
California black rail																
Primary habitat	7,467	0	0	69	0	0	0	0	0	0	0	0	1	0	2	69
Secondary habitat	17,915	49	0	0	402	532	2	0	0	0	1	0	0	0	936 [15]	50
Total	**25,382**	**49**	**0**	**69**	**402**	**532**	**2**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**938**	**120**
California clapper rail[13]																
Primary habitat	296	0	0	26	0	0	0	0	0	0	0	0	0	0	0	26
Secondary habitat	6,420	2	5	0	0	0	0	0	0	0	0	0	0	0	0 [15]	7
Total	**6,716**	**2**	**5**	**26**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**33**

Maximum Allowable Habitat Loss by Covered Activity [1,2,3]																
		CM4 Tidal Natural Communities Restoration														
		Suisun Marsh							Delta						Plan Area Total [7]	
Covered Wildlife Species	Total Existing Modeled Habitat in the Plan Area (Acres)[2]	High Tidal Brackish Marsh	Mid Tidal Brackish Marsh	Low Tidal Brackish Marsh	Intertidal Mudflat	Subtidal 1	Subtidal 2	Subtidal 3	Ecotone	Intertidal Mudflat	Tidal Freshwater Marsh	Subtidal 1	Subtidal 2	Subtidal 3	Permanent (Acres)[7,8,9]	Conversion (Acres)
California least tern																
Nesting and Migratory Habitat	86,263	0	0	1	0	0	0	0	1	1	11	12	4	0	30	0
Total	**86,263**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**	**1**	**11**	**12**	**4**	**0**	**30**	**0**
Greater sandhill crane																
Roosting and foraging - Permanent	7,340	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Roosting and foraging - Temporary	16,522	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Foraging	162,164	0	0	0	0	0	0	0	2	0	709	852	363	26	1,951	0
Total	**186,025**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**709**	**852**	**363**	**26**	**1,951**	**0**
Least Bell's vireo																
Migratory and breeding	14,528	1	0	3	1	1	0	0	0	0	282	6	4	2	299	0
Total	**14,528**	**1**	**0**	**3**	**1**	**1**	**0**	**0**	**0**	**0**	**282**	**6**	**4**	**2**	**299**	**0**
Suisun song sparrow																
Primary habitat	3,722	0	0	54	0	0	0	0	0	0	0	0	0	0	0	54
Secondary habitat	23,986	53	5	0	432	605	2	0	0	0	0	0	0	0	1,040 [15]	58
Total	**27,707**	**53**	**5**	**54**	**432**	**605**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1,040**	**112**
Swainson's hawk																
Foraging habitat	470,324	27	29	192	59	43	0	0	773	152	3,742	882	352	27	6,278	0
Nesting habitat	9,796	0	0	4	1	0	0	0	0	0	164	2	1	1	173	0
Total	**480,120**	**27**	**29**	**196**	**60**	**43**	**0**	**0**	**773**	**152**	**3,906**	**884**	**354**	**27**	**6,451**	**0**
Tricolored blackbird																
Breeding habitat-ag foraging	100,198	0	0	0	0	0	0	0	106	0	79	0	0	0	106	79
Breeding habitat-foraging	58,181	19	2	286	153	99	0	0	1	0	1	0	0	0	272	288
Breeding habitat-nesting	1,741	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nonbreeding habitat-foraging ag	194,251	0	0	0	0	0	0	0	332	8	2,065	488	312	19	1,159	2,065
Nonbreeding habitat-roosting	28,066	36	1	0	230	171	1	0	116	0	0	4	2	1	562	0
Nonbreeding habitat-foraging	34,308	0	0	0	0	0	0	0	41	3	355	37	16	6	104	355
Total	**416,745**	**54**	**2**	**286**	**383**	**270**	**2**	**0**	**595**	**11**	**2,499**	**529**	**331**	**26**	**2,203**	**2,787**
Western burrowing owl																
High-value habitat	149,783	17	11	122	98	52	0	0	623	5	2,037	143	157	33	3,297	0
Low-value habitat	251,767	1	17	23	3	1	0	0	141	148	1,505	397	64	2	2,300	0
Total	**401,550**	**17**	**28**	**145**	**100**	**53**	**0**	**0**	**764**	**152**	**3,541**	**540**	**220**	**35**	**5,597**	**0**
Western yellow-billed cuckoo																
Breeding habitat	1,970	0	0	0	0	0	0	0	0	0	1	1	1	0	3	0
Migratory habitat	10,425	0	0	0	0	0	0	0	0	0	216	2	1	1	221	0
Total	**12,395**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**217**	**3**	**2**	**1**	**224**	**0**

Maximum Allowable Habitat Loss by Covered Activity [1,2,3]																
		CM4 Tidal Natural Communities Restoration														
		Suisun Marsh							Delta						Plan Area Total [7]	
Covered Wildlife Species	Total Existing Modeled Habitat in the Plan Area (Acres)[2]	High Tidal Brackish Marsh	Mid Tidal Brackish Marsh	Low Tidal Brackish Marsh	Intertidal Mudflat	Subtidal 1	Subtidal 2	Subtidal 3	Ecotone	Intertidal Mudflat	Tidal Freshwater Marsh	Subtidal 1	Subtidal 2	Subtidal 3	Permanent (Acres)[7,8,9]	Conversion (Acres)
White-tailed kite																
Breeding habitat	14,069	0	0	4	1	0	0	0	0	0	218	3	2	1	230	0
Foraging habitat	500,365	0	32	986	733	931	3	0	0	152	3,578	870	353	27	7,667	0
Total	**514,434**	**0**	**32**	**991**	**733**	**931**	**3**	**0**	**0**	**153**	**3,796**	**873**	**355**	**28**	**7,896**	**0**
Yellow-breasted chat																
Primary nesting and migratory habitat	8,178	0	0	0	0	0	0	0	0	0	83	1	2	1	87	0
Secondary nesting and migratory habitat	5,528	0	0	0	0	0	0	0	0	0	199	5	2	1	206	0
Suisun Marsh/Upper Yolo Bypass nest and migratory habitat	841	1	0	3	1	1	0	0	0	0	0	0	0	0	5	0
Total	**14,547**	**1**	**0**	**3**	**1**	**1**	**0**	**0**	**0**	**0**	**282**	**6**	**4**	**2**	**299**	**0**
Reptiles																
Giant garter snake																
Aquatic - tidal	12,097	0	0	0	0	0	0	0	2	0	0	0	0	0	2	0
Aquatic - nontidal[19]	19,027	0	0	0	0	0	0	0	5	2	89	9	3	0	109	0
Upland-high	21,581	0	0	0	0	0	0	0	43	1	239	32	32	17	364	0
Upland-moderate	25,407	0	0	0	0	0	0	0	70	43	552	26	7	1	700	0
Upland-low	5,683	0	0	0	0	0	0	0	11	0	116	1	1	1	129	0
Total	**83,796**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**131**	**48**	**996**	**69**	**43**	**20**	**1,305**	**0**
Aquatic breeding, foraging, and movement (miles)	2,784	0	0	0	0	0	0	0	3	1	30	5	3	1	44	0
Western pond turtle																
Aquatic habitat[10]	81,588	45	0	0	0	0	0	0	0	0	0	0	0	0	45	0
Upland nesting and overwintering habitat	16,043	2	1	48	41	16	0	0	2	0	24	2	0	0	136	0
Upland nesting and overwintering habitat-NHD	12,615	5	5	12	7	2	0	0	9	1	88	9	5	2	144	0
Total	**110,245**	**52**	**6**	**60**	**48**	**18**	**0**	**0**	**10**	**1**	**111**	**11**	**6**	**2**	**326**	**0**
Aquatic habitat linear (miles) - NHD	1,418	0	0	1	1	1	0	0	1	0	14	3	2	0	24	0
Amphibians																
California red-legged frog																
Aquatic habitat	159	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upland cover and dispersal habitat	7,766	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**7,925**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Aquatic habitat (miles)	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
California tiger salamander																
Aquatic breeding habitat	7,845	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Terrestrial cover and aestivation	28,173	0	0	0	0	0	0	0	182	0	21	0	0	0	203	0
Total	**36,018**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**182**	**0**	**21**	**0**	**0**	**0**	**203**	**0**

Covered Wildlife Species	Total Existing Modeled Habitat in the Plan Area (Acres)[2]	Maximum Allowable Habitat Loss by Covered Activity[1,2,3]														
		CM4 Tidal Natural Communities Restoration														
		Suisun Marsh							Delta						Plan Area Total[7]	
		High Tidal Brackish Marsh	Mid Tidal Brackish Marsh	Low Tidal Brackish Marsh	Intertidal Mudflat	Subtidal 1	Subtidal 2	Subtidal 3	Ecotone	Intertidal Mudflat	Tidal Freshwater Marsh	Subtidal 1	Subtidal 2	Subtidal 3	Permanent (Acres)[7,8,9]	Conversion (Acres)
Invertebrates																
Valley elderberry longhorn beetle																
Riparian vegetation	17,464	0	0	0	0	0	0	0	0	0	286	6	4	2	298	0
Nonriparian channels and grasslands	16,585	1	0	9	4	0	0	0	7	0	59	13	6	1	100	0
Total	**34,048**	**1**	**0**	**9**	**4**	**0**	**0**	**0**	**7**	**1**	**345**	**19**	**10**	**2**	**398**	**0**
California linderiella																
Vernal pool complex	8,759	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Degraded vernal pool complex	2,713	0	0	1	0	0	0	0	24	0	3	0	0	0	28	0
Total	**11,472**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**24**	**0**	**3**	**0**	**0**	**0**	**28**	**0**
Conservancy fairy shrimp																
Vernal pool complex	8,759	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Degraded vernal pool complex	2,713	0	0	1	0	0	0	0	24	0	3	0	0	0	28	0
Total	**11,472**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**24**	**0**	**3**	**0**	**0**	**0**	**28**	**0**
Longhorn fairy shrimp																
Vernal pool complex	8,759	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Degraded vernal pool complex	2,713	0	0	1	0	0	0	0	24	0	3	0	0	0	28	0
Total	**11,472**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**24**	**0**	**3**	**0**	**0**	**0**	**28**	**0**
Midvalley fairy shrimp																
Vernal pool complex	8,759	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Degraded vernal pool complex	2,713	0	0	1	0	0	0	0	24	0	3	0	0	0	28	0
Total	**11,472**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**24**	**0**	**3**	**0**	**0**	**0**	**28**	**0**
Vernal pool fairy shrimp																
Vernal pool complex	8,759	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Degraded vernal pool complex	2,713	0	0	1	0	0	0	0	24	0	3	0	0	0	28	0
Total	**11,472**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**24**	**0**	**3**	**0**	**0**	**0**	**28**	**0**
Vernal pool tadpole shrimp																
Vernal pool complex	8,759	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Degraded vernal pool complex	2,713	0	0	1	0	0	0	0	24	0	3	0	0	0	28	0
Total	**11,472**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**24**	**0**	**3**	**0**	**0**	**0**	**28**	**0**

Table 5.J-9. Near Term Wildlife Modeled Habitat Loss and Conversion by Covered Activity (cont'd)

		Maximum Allowable Habitat Loss by Covered Activity [1,2,3]																
		CM1 Water Facilities and Operation				CM2 Yolo Bypass Fisheries Enhancement		CM5 Seasonally Inundated Floodplain Restoration		CM7 Riparian Natural Community Restoration			CM10 Nontidal Marsh Natural Community Restoration	CM11 Natural Community Enhancement and Management	CM18 Conservation Hatcheries			
		Tunnel/Pipeline Facilities Construction				Fremont Weir and Yolo Bypass Improvements		Levee Construction		Riparian Restoration as Part of Tidal Natural Communities Restoration	Riparian Restoration as Part of Seasonal Floodplain Restoration	CM8 Grassland Restoration	Constructio n and Inundation	Construction of Recreational-Related Facilities	Construction	Maximum Allowable Habitat Loss		
Covered Wildlife Species	Total Existing Modeled Habitat in the Plan Area (Acres)[2]	Permanent (Acres)[4]	Permanent - Reusable Tunnel Material (Acres)[17]	Temporary (Borrow and Spoil) (Acres)[4,5]	Temporary (Acres)[4]	Permanent (Acres)[6]	Temporary (Acres)[6]	Permanent (Acres)[10]	Temporary (Acres)[10]	Permanent (Acres)	Permanent (Acres)[11]	Permanent (Acres)[12]	Permanent (Acres)[12]	Permanent (Acres)	Permanent (Acres)[12]	Permanent (Acres)[16]	Temporary (Borrow and Spoil) (Acres)	Temporary (Acres)
Mammals																		
Riparian brush rabbit																		
Riparian habitat	2,909	3	0	0	1	0	0	0	0	0	0	0	0	0	0	3	0	1
Grassland habitat	3,103	124	0	0	54	0	0	0	0	0	0	0	0	0	0	124	0	54
Total	**6,011**	**127**	**0**	**0**	**54**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**127**	**0**	**54**
Riparian woodrat																		
Habitat	2,166	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**2,166**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Salt marsh harvest mouse																		
Tidal brackish emergent wetland primary	3,641	0	0	0	0	0	0	0	0	0	0	0	0	0	0	64	0	0
Tidal brackish emergent wetland secondary	2,718	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upland secondary	749	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0
Managed wetland—wetland primary, low long-term conservation value	21,891	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,913	0	0
Managed wetland—wetland secondary, low long-term conservation value	2,800	0	0	0	0	0	0	0	0	0	0	0	0	0	0	315	0	0
Managed wetland—upland, low long-term conservation value	3,787	0	0	0	0	0	0	0	0	0	0	0	0	0	0	165	0	0
Total	**35,588**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2,465**	**0**	**0**
San Joaquin kit fox																		
Breeding, foraging, and dispersal habitat	5,327	155	52	0	103	0	0	0	0	0	0	0	0	3	0	210	0	103
Total	**5,327**	**155**	**52**	**0**	**103**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**0**	**210**	**0**	**103**
Suisun shrew																		
Primary habitat	3,128	0	0	0	0	0	0	0	0	0	0	0	0	0	0	58	0	0
Secondary habitat	4,387	0	0	0	0	0	0	0	0	0	0	0	0	0	0	47 [15]	0	0
Total	**7,515**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**105**	**0**	**0**

Maximum Allowable Habitat Loss by Covered Activity [1,2,3]																		
		CM1 Water Facilities and Operation				CM2 Yolo Bypass Fisheries Enhancement		CM5 Seasonally Inundated Floodplain Restoration		CM7 Riparian Natural Community Restoration			CM10 Nontidal Marsh Natural Community Restoration	CM11 Natural Community Enhancement and Management	CM18 Conservation Hatcheries			
		Tunnel/Pipeline Facilities Construction				Fremont Weir and Yolo Bypass Improvements		Levee Construction		Riparian Restoration as Part of Tidal Natural Communities Restoration	Riparian Restoration as Part of Seasonal Floodplain Restoration	CM8 Grassland Restoration	Constructio n and Inundation	Construction of Recreational-Related Facilities	Construction	Maximum Allowable Habitat Loss		
Covered Wildlife Species	Total Existing Modeled Habitat in the Plan Area (Acres)[2]	Permanent (Acres)[4]	Permanent - Reusable Tunnel Material (Acres)[17]	Temporary (Borrow and Spoil) (Acres)[4,5]	Temporary (Acres)[4]	Permanent (Acres)[6]	Temporary (Acres)[6]	Permanent (Acres)[10]	Temporary (Acres)[10]	Permanent (Acres)	Permanent (Acres)[11]	Permanent (Acres)[12]	Permanent (Acres)[12]	Permanent (Acres)	Permanent (Acres)[12]	Permanent (Acres)[16]	Temporary (Borrow and Spoil) (Acres)	Temporary (Acres)
Birds																		
California black rail																		
Primary habitat	7,467	0	0	0	18	5	0	0	0	0	0	0	0	0	0	76	0	18
Secondary habitat	17,915	0	0	0	0	0	0	0	0	0	0	0	0	0	0	986 [15]	0	0
Total	**25,382**	**0**	**0**	**0**	**18**	**5**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1,062**	**0**	**18**
California clapper rail[13]																		
Primary habitat	296	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26	0	0
Secondary habitat	6,420	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7 [15]	0	0
Total	**6,716**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**33**	**0**	**0**
California least tern																		
Nesting and Migratory Habitat	86,263	178	0	0	2,101	8	11	0	0	0	0	0	0	0	0	216	0	2,112
Total	**86,263**	**178**	**0**	**0**	**2,101**	**8**	**11**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**216**	**0**	**2,112**
Greater sandhill crane																		
Roosting and foraging - Permanent	7,340	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	8
Roosting and foraging - Temporary	16,522	0 [14]	0	0	16	0	0	0	0	0	0	0	0	0	0	0	0	16
Foraging	162,164	352	2,347	183	778	0	0	0	0	0	0	257	567	1	0	5,474	183	778
Total	**186,025**	**352**	**2,347**	**183**	**802**	**0**	**0**	**0**	**0**	**0**	**0**	**257**	**567**	**1**	**0**	**5,474**	**183**	**802**
Least Bell's vireo																		
Migratory and breeding	14,528	11	18	1	22	83	88	0	0	0	0	0	0	0	0	411	1	110
Total	**14,528**	**11**	**18**	**1**	**22**	**83**	**88**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**411**	**1**	**110**
Suisun song sparrow																		
Primary habitat	3,722	0	0	0	0	0	0	0	0	0	0	0	0	0	0	54	0	0
Secondary habitat	23,986	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,097 [15]	0	0
Total	**27,707**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1,151**	**0**	**0**
Swainson's hawk																		
Foraging habitat	470,324	1,100	3,235	183	1,113	996	504	0	0	13	0	1,054	527	13	35	13,251	183	1,617
Nesting habitat	9,796	8	10	0	18	79	54	0	0	0	0	0	0	0	0	270	0	72
Total	**480,120**	**1,108**	**3,245**	**183**	**1,131**	**1,075**	**558**	**0**	**0**	**13**	**0**	**1,054**	**527**	**13**	**35**	**13,521**	**183**	**1,689**
Tricolored blackbird																		
Breeding habitat-ag foraging	100,198	634	795	81	148	477	84	0	0	2	0	867	126	0	0	3,086	81	232
Breeding habitat-foraging	58,181	161	52	0	114	105	155	0	0	4	0	0	0	13	35	930	0	268

Maximum Allowable Habitat Loss by Covered Activity [1,2,3]

Covered Wildlife Species	Total Existing Modeled Habitat in the Plan Area (Acres)[2]	CM1 Water Facilities and Operation				CM2 Yolo Bypass Fisheries Enhancement		CM5 Seasonally Inundated Floodplain Restoration		CM7 Riparian Natural Community Restoration		CM8 Grassland Restoration	CM10 Nontidal Marsh Natural Community Restoration	CM11 Natural Community Enhancement and Management	CM18 Conservation Hatcheries	Maximum Allowable Habitat Loss		
		Tunnel/Pipeline Facilities Construction				Fremont Weir and Yolo Bypass Improvements		Levee Construction		Riparian Restoration as Part of Tidal Natural Communities Restoration	Riparian Restoration as Part of Seasonal Floodplain Restoration		Constructio n and Inundation	Construction of Recreational-Related Facilities	Construction			
		Permanent (Acres)[4]	Permanent - Reusable Tunnel Material (Acres)[17]	Temporary (Borrow and Spoil) (Acres)[4,5]	Temporary (Acres)[4]	Permanent (Acres)[6]	Temporary (Acres)[6]	Permanent (Acres)[10]	Temporary (Acres)[10]	Permanent (Acres)	Permanent (Acres)[11]	Permanent (Acres)[12]	Permanent (Acres)[12]	Permanent (Acres)	Permanent (Acres)[12]	Permanent (Acres)[16]	Temporary (Borrow and Spoil) (Acres)	Temporary (Acres)
Breeding habitat-nesting	1,741	4	0	1	2	13	75	0	0	0	0	0	0	0	0	17	1	77
Nonbreeding habitat-foraging ag	194,251	203	2,124	0	575	0	54	0	0	7	0	120	397	0	0	6,074	0	628
Nonbreeding habitat-roosting	28,066	7	12	0	20	8	0	0	0	0	0	0	0	0	0	590	0	20
Nonbreeding habitat-foraging	34,308	48	197	0	47	0	0	0	0	0	0	0	0	0	0	704	0	47
Total	**416,745**	**1,057**	**3,180**	**82**	**905**	**603**	**367**	**0**	**0**	**13**	**0**	**987**	**523**	**13**	**35**	**11,401**	**82**	**1,273**
Western burrowing owl																		
High-value habitat	149,783	340	541	0	351	882	245	0	0	4	0	206	63	13	35	5,381	0	596
Low-value habitat	251,767	689	2,324	101	588	98	144	0	0	9	0	749	371	0	0	6,540	101	732
Total	**401,550**	**1,030**	**2,864**	**102**	**939**	**979**	**389**	**0**	**0**	**13**	**0**	**955**	**434**	**13**	**35**	**11,921**	**102**	**1,328**
Western yellow-billed cuckoo																		
Breeding habitat	1,970	3	6	0	1	26	5	0	0	0	0	0	0	0	0	38	0	5
Migratory habitat	10,425	4	10	0	18	57	83	0	0	0	0	0	0	0	0	292	0	101
Total	**12,395**	**7**	**16**	**0**	**19**	**83**	**88**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**330**	**0**	**106**
White-tailed kite																		
Breeding habitat	14,069	10	16	0	23	82	88	0	0	0	0	0	0	0	0	338	0	110
Foraging habitat	500,365	1,100	3,239	183	1,112	1,008	516	0	0	13	0	0	0	13	35	13,075	183	1,629
Total	**514,434**	**1,111**	**3,255**	**183**	**1,135**	**1,090**	**604**	**0**	**0**	**13**	**0**	**0**	**0**	**13**	**35**	**13,413**	**183**	**1,739**
Yellow-breasted chat																		
Primary nesting and migratory habitat	8,178	7	10	0	6	9	58	0	0	0	0	0	0	0	0	113	0	64
Secondary nesting and migratory habitat	5,528	3	8	1	16	3	0	0	0	0	0	0	0	0	0	220	1	16
Suisun Marsh/Upper Yolo Bypass nest and migratory habitat	841	0	0	0	0	71	29	0	0	0	0	0	0	0	0	76	0	29
Total	**14,547**	**10**	**18**	**1**	**22**	**83**	**88**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**410**	**1**	**110**
Reptiles																		
Giant garter snake																		
Aquatic - tidal	12,097	16	1	0	55	9	2	0	0	0	0	0	0	0	0	28	0	57
Aquatic - nontidal[19]	19,027	10	56	0	13	59	13	0	0	0	0	0	0	0	0	235	0	26
Upland-high	21,581	66	106	0	48	178	158	0	0	0	0	0	0	0	0	715	0	206
Upland-moderate	25,407	167	54	0	135	60	61	0	0	0	0	0	0	0	35	1,017	0	196

Maximum Allowable Habitat Loss by Covered Activity [1,2,3]																		
		CM1 Water Facilities and Operation				CM2 Yolo Bypass Fisheries Enhancement		CM5 Seasonally Inundated Floodplain Restoration		CM7 Riparian Natural Community Restoration			CM10 Nontidal Marsh Natural Community Restoration	CM11 Natural Community Enhancement and Management	CM18 Conservation Hatcheries			
		Tunnel/Pipeline Facilities Construction				Fremont Weir and Yolo Bypass Improvements		Levee Construction		Riparian Restoration as Part of Tidal Natural Communities Restoration	Riparian Restoration as Part of Seasonal Floodplain Restoration	CM8 Grassland Restoration	Constructio n and Inundation	Construction of Recreational-Related Facilities	Construction	Maximum Allowable Habitat Loss		
Covered Wildlife Species	Total Existing Modeled Habitat in the Plan Area (Acres)[2]	Permanent (Acres)[4]	Permanent - Reusable Tunnel Material (Acres)[17]	Temporary (Borrow and Spoil) (Acres)[4,5]	Temporary (Acres)[4]	Permanent (Acres)[6]	Temporary (Acres)[6]	Permanent (Acres)[10]	Temporary (Acres)[10]	Permanent (Acres)	Permanent (Acres)[11]	Permanent (Acres)[12]	Permanent (Acres)[12]	Permanent (Acres)	Permanent (Acres)[12]	Permanent (Acres)[16]	Temporary (Borrow and Spoil) (Acres)	Temporary (Acres)
Upland-low	5,683	14	4	0	5	1	0	0	0	0	0	0	0	0	0	148	0	5
Total	**83,796**	**274**	**222**	**0**	**257**	**306**	**234**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**35**	**2,142**	**0**	**491**
Aquatic breeding, foraging, and movement (miles)	2,784	7	6	0	6	5	9	0	0	0	0	0	0	0	0	61	0	15
Western pond turtle																		
Aquatic habitat[10]	81,588	180	57	0	2,098	37	23	0	0	0	0	0	0	0	0	320	0	2,120
Upland nesting and overwintering habitat	16,043	105	97	0	34	109	70	0	0	4	0	0	0	0	0	451	0	104
Upland nesting and overwintering habitat-NHD[20]	12,615	30	47	0	34	21	49	0	0	0	0	0	0	0	0	242	0	83
Total	**110,245**	**315**	**201**	**0**	**2,166**	**167**	**141**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**0**	**1,012**	**0**	**2,307**
Aquatic habitat linear (miles) – NHD[20]	1,418	3	6	0	3	1	3	0	0	0	0	0	0	0	0	34	0	6
Amphibians																		
California red-legged frog																		
Aquatic habitat	159	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Upland cover and dispersal habitat	7,766	6	0	0	39	0	0	0	0	0	0	0	0	8	0	14	0	39
Total	**7,925**	**7**	**0**	**0**	**39**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**8**	**0**	**15**	**0**	**39**
Aquatic habitat (miles)	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
California tiger salamander																		
Aquatic breeding habitat	7,845	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Terrestrial cover and aestivation	28,173	6	0	0	32	42	0	0	0	0	0	0	0	12	35	298	0	32
Total	**36,018**	**6**	**0**	**0**	**32**	**42**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**12**	**35**	**298**	**0**	**32**
Invertebrates																		
Valley elderberry longhorn beetle																		
Riparian vegetation	17,464	16	18	1	29	83	76	0	0	0	0	0	0	0	0	415	1	105
Nonriparian channels and grasslands	16,585	126	101	0	62	41	94	0	0	0	0	0	0	0	0	369	0	156
Total	**34,048**	**142**	**119**	**1**	**90**	**125**	**170**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**784**	**1**	**261**
California linderiella																		
Vernal pool complex	8,759	8	0	0	0 [18]	0	0	0	0	0	0	0	0	0	0	8	0	0
Degraded vernal pool complex	2,713	7	0	0	0 [18]	0	0	0	0	0	0	0	0	0	0	35	0	0
Total	**11,472**	**15**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**43**	**0**	**0**

Maximum Allowable Habitat Loss by Covered Activity [1,2,3]																		
		CM1 Water Facilities and Operation				CM2 Yolo Bypass Fisheries Enhancement		CM5 Seasonally Inundated Floodplain Restoration		CM7 Riparian Natural Community Restoration			CM10 Nontidal Marsh Natural Community Restoration	CM11 Natural Community Enhancement and Management	CM18 Conservation Hatcheries			
		Tunnel/Pipeline Facilities Construction				Fremont Weir and Yolo Bypass Improvements		Levee Construction		Riparian Restoration as Part of Tidal Natural Communities Restoration	Riparian Restoration as Part of Seasonal Floodplain Restoration	CM8 Grassland Restoration	Constructio n and Inundation	Construction of Recreational-Related Facilities	Construction	Maximum Allowable Habitat Loss		
Covered Wildlife Species	Total Existing Modeled Habitat in the Plan Area (Acres)[2]	Permanent (Acres)[4]	Permanent - Reusable Tunnel Material (Acres)[17]	Temporary (Borrow and Spoil) (Acres)[4,5]	Temporary (Acres)[4]	Permanent (Acres)[6]	Temporary (Acres)[6]	Permanent (Acres)[10]	Temporary (Acres)[10]	Permanent (Acres)	Permanent (Acres)[11]	Permanent (Acres)[12]	Permanent (Acres)[12]	Permanent (Acres)	Permanent (Acres)[12]	Permanent (Acres)[16]	Temporary (Borrow and Spoil) (Acres)	Temporary (Acres)
Conservancy fairy shrimp																		
Vernal pool complex	8,759	8	0	0	0 [18]	0	0	0	0	0	0	0	0	0	0	8	0	0
Degraded vernal pool complex	2,713	7	0	0	0 [18]	0	0	0	0	0	0	0	0	0	0	35	0	0
Total	11,472	15	0	0	0	0	0	0	0	0	0	0	0	0	0	43	0	0
Longhorn fairy shrimp																		
Vernal pool complex	8,759	8	0	0	0 [18]	0	0	0	0	0	0	0	0	0	0	8	0	0
Degraded vernal pool complex	2,713	7	0	0	0 [18]	0	0	0	0	0	0	0	0	0	0	35	0	0
Total	11,472	15	0	0	0	0	0	0	0	0	0	0	0	0	0	43	0	0
Midvalley fairy shrimp																		
Vernal pool complex	8,759	8	0	0	0 [18]	0	0	0	0	0	0	0	0	0	0	8	0	0
Degraded vernal pool complex	2,713	7	0	0	0 [18]	0	0	0	0	0	0	0	0	0	0	35	0	0
Total	11,472	15	0	0	0	0	0	0	0	0	0	0	0	0	0	43	0	0
Vernal pool fairy shrimp																		
Vernal pool complex	8,759	8	0	0	0 [18]	0	0	0	0	0	0	0	0	0	0	8	0	0
Degraded vernal pool complex	2,713	7	0	0	0 [18]	0	0	0	0	0	0	0	0	0	0	35	0	0
Total	11,472	15	0	0	0	0	0	0	0	0	0	0	0	0	0	43	0	0
Vernal pool tadpole shrimp																		
Vernal pool complex	8,759	8	0	0	0 [18]	0	0	0	0	0	0	0	0	0	0	8	0	0
Degraded vernal pool complex	2,713	7	0	0	0 [18]	0	0	0	0	0	0	0	0	0	0	35	0	0
Total	11,472	15	0	0	0	0	0	0	0	0	0	0	0	0	0	43	0	0

1 The following covered activities and associated federal actions (listed here by the header/category as described in Chapter 4, Covered Activities and Associated Federal Actions) are assumed not to have footprint impacts on natural communities or species habitat: Operations and Maintenance of Existing SWP Facilities; Power Generation Water Use - Mirant Delta, LLC activities; Activities to Reduce Contaminants; Activities to Reduce Predators and Other Sources of Direct Mortality; Monitoring and Research Programs; Emergency Actions; CVP Operations and Maintenance; and Joint Federal and Non-federal Actions.

2 Existing habitat and habitat loss are estimated using habitat models created from detailed vegetation mapping, See Appendix 2.A, *Covered Species Accounts*, for a complete description of species-specific mapping methods. Effects on species' habitat will be tracked during implementation through on-the-ground surveys performed by qualified biologists.

3 See Table 5.J.1, *Quantitative Effects Analysis Methods and Assumptions*, in Appendix 5.J, *Effects on Natural Communities, Wildlife, and Plants*, for a description methods and assumptions relevant to estimating natural community loss by covered activity type and Table 5.J.3, *Key Assumptions Related to Tidal Restoration Effects on Covered Species Habitat*, for a list of assumptions used to determine permanent loss or conversion as a result of inundation caused by tidal restoration.

4 Permanent and temporary effects assessed under CM1 are associated with construction of the following conveyance-related facilities: forebay, intake facilities, permanent access roads, shaft locations, and transmission lines. See Chapter 4, Section 4.2.1.1, North Delta Diversions Construction and Operations, for a complete description of all activities assessed under CM1.

5 Borrow/Spoil Area Borrow: location from where construction material, such as sand or clay, will be taken. Spoil: area where construction by-products, such as removed earth, will be placed and stored. Borrow/spoil: an area that will originally be used for borrow and then later be used for spoil.

6 Permanent and temporary effects assessed under CM2 include activities associated with Fremont Weir improvements, Putah Creek realignment activities, Lisbon weir and fish crossing improvements, and Sacramento Weir improvements.

7 Inundation is tidal flooding of existing wetland habitat as a result of tidal restoration actions. Inundation can cause permanent loss of habitat from either the removal of habitat or the conversion of one habitat type to another. See Table 5.J.1, *Quantitative Effects Analysis Methods*

Maximum Allowable Habitat Loss by Covered Activity[1,2,3]																		
		CM1 Water Facilities and Operation				CM2 Yolo Bypass Fisheries Enhancement		CM5 Seasonally Inundated Floodplain Restoration		CM7 Riparian Natural Community Restoration			CM10 Nontidal Marsh Natural Community Restoration	CM11 Natural Community Enhancement and Management	CM18 Conservation Hatcheries			
		Tunnel/Pipeline Facilities Construction				Fremont Weir and Yolo Bypass Improvements		Levee Construction		Riparian Restoration as Part of Tidal Natural Communities Restoration	Riparian Restoration as Part of Seasonal Floodplain Restoration	CM8 Grassland Restoration	Constructio n and Inundation	Construction of Recreational-Related Facilities	Construction	Maximum Allowable Habitat Loss		
Covered Wildlife Species	Total Existing Modeled Habitat in the Plan Area (Acres)[2]	Permanent (Acres)[4]	Permanent - Reusable Tunnel Material (Acres)[17]	Temporary (Borrow and Spoil) (Acres)[4,5]	Temporary (Acres)[4]	Permanent (Acres)[6]	Temporary (Acres)[6]	Permanent (Acres)[10]	Temporary (Acres)[10]	Permanent (Acres)	Permanent (Acres)[11]	Permanent (Acres)[12]	Permanent (Acres)[12]	Permanent (Acres)	Permanent (Acres)[12]	Permanent (Acres)[16]	Temporary (Borrow and Spoil) (Acres)	Temporary (Acres)

and Assumptions, in Appendix 5.J, for a description of relevant assumptions. All construction is assumed to occur within the inundation footprint.

8 Permanent loss calculations are based on hypothetical tidal restoration designs and include those areas modeled by ESAPWA (Appendix 3.B, *BDCP Tidal Habitat Evolution Assessment*) to be below extreme high water elevation. See Table 5.J.1 in Appendix 5.J, for methods and assumptions used to apply the hypothetical footprint to determine effects.

9 Tidal restoration is expected to include riparian restoration where elevations are favorable. Permanent loss from riparian restoration was determined by non-GIS methods. See Table 5.J.1, in Appendix 5.J, for a complete list of methods and assumptions.

10 Calculation of effects based on hypothetical floodplain restoration designs. See Table 5.J.1 in Appendix 5.J, for details.

11 Based on restoration design assumptions described in Appendix 5.E, *Habitat Restoration*, and effects analysis assumptions detailed in Table 5.J.1 in Appendix 5.J.

12 Permanent loss was determined based on non-GIS methods described in Table 5.J.1 in Appendix 5.J.

13 Based on the hypothetical tidal restoration footprint, an estimated 4 acres of habitat will be lost or converted. However, to provide flexibility in implementation of tidal restoration projects, the take limit is set higher than the amount of loss estimated under the hypothetical footprint.

14 AMM30 (Appendix 3.C) requires a reroute of the transmission line so it does not affect a roost site. This will reduce impacts on roosting and foraging habitat by 29 acres.

15 Although the tidal restoration model results in some decreases in acreage of natural community loss between near term and late long-term due to tidal damping and sea level rise, for permitting purposes the maximum acreage of loss is shown for late long-term.

16 Because decimal places are not shown in this table, in some cases, a row total may be larger by one or two acres than the result obtained by manually summing numbers across columns.

17 Reusable tunnel material is flexible and the footprint used in the effects analysis is based on a worst case scenario: the actual area to be affected by reusable tunnel material storage will likely be less than the estimated acreage.

18 Loss reduced to zero. Although the temporary transmission powerline footprint overlaps with 2 acres of alkali seasonal wetland complex and 16 acres of vernal pool complex in Conservation Zone 8, AMM30 requires that wetted acres of alkali seasonal wetlands and vernal pools complex be avoided during transmission powerline installation.

19 Rice loss from CM8 and CM10 are not included in this analysis as rice conversion in Conservation Zone 2 will be avoided. This table will be updated for all other species in the next version.

20 For western pond turtle NHD model types, a 35% habitat suitability correction factor was applied to existing modeled habitat and covered activity loss acreage as it was determined that, in the Plan Area, approximately 35% of all channels and ditches mapped in the NHD layer are likely suitable for western pond turtle. See Appendix 2.A, *Covered Species Accounts*, Section 2.A.29, for more details.

NHD = National Hydrologic Database; SWP = State Water Project; CVP = Central Valley Project.

Table 5.J-10. Early Long-Term Wildlife Modeled Habitat Loss and Conversion by Covered Activity

Maximum Allowable Habitat Loss by Covered Activity [1,2,3]																
		CM4 Tidal Natural Communities Restoration														
		Suisun Marsh							Delta						Plan Area Total [7]	
Covered Wildlife Species	Total Existing Modeled Habitat in the Plan Area (Acres)[2]	High Tidal Brackish Marsh	Mid Tidal Brackish Marsh	Low Tidal Brackish Marsh	Intertidal Mudflat	Subtidal 1	Subtidal 2	Subtidal 3	Ecotone	Intertidal Mudflat	Tidal Freshwater Marsh	Subtidal 1	Subtidal 2	Subtidal 3	Permanent (Acres)[7,8,9]	Conversion (Acres)
Mammals																
Riparian brush rabbit																
Riparian habitat	2,909	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grassland habitat	3,103	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**6,011**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Riparian woodrat																
Habitat	2,166	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**2,166**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Salt marsh harvest mouse																
Tidal brackish emergent wetland primary	3,641	0	0	66	0	0	0	0	0	0	0	0	0	0	0	66
Tidal brackish emergent wetland secondary	2,718	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upland secondary	749	1	7	0	0	0	0	0	0	0	0	0	0	0	0 [15]	8
Managed wetland—wetland primary, low long-term conservation value	21,891	15	36	670	825	1,067	6	0	0	0	0	0	0	0	1,898	721
Managed wetland—wetland secondary, low long-term conservation value	2,800	5	16	226	87	52	1	0	0	0	0	0	0	0	140	248
Managed wetland—upland, low long-term conservation value	3,787	5	9	144	174	61	1	0	0	0	0	0	0	0	236	158
Total	**35,588**	**26**	**69**	**1,106**	**1,086**	**1,181**	**8**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2,275**	**1,201**
San Joaquin kit fox																
Breeding, foraging, and dispersal habitat	5,327	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**5,327**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Suisun shrew																
Primary habitat	3,128	0	0	59	0	0	0	0	0	0	0	0	0	0	59	0
Secondary habitat	4,387	7	17	0	58	22	1	0	0	0	0	0	0	0	81	24
Total	**7,515**	**7**	**17**	**59**	**58**	**22**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**140**	**24**
Birds																
California black rail																
Primary habitat	7,467	0	0	71	0	0	0	0	0	0	0	0	1	0	2	71
Secondary habitat	17,915	29	63	0	607	757	4	0	0	0	1	0	0	0	1,367 [15]	93
Total	**25,382**	**29**	**63**	**71**	**607**	**757**	**4**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**1,369**	**164**
California clapper rail[13]																
Primary habitat	296	0	0	26	0	0	0	0	0	0	0	0	0	0	0	26
Secondary habitat	6,420	3	6	0	0	0	0	0	0	0	0	0	0	0	0 [15]	8
Total	**6,716**	**3**	**6**	**26**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**35**
California least tern																
Nesting and Migratory Habitat	86,263	0	0	1	0	0	0	0	1	1	13	13	4	0	33	0
Total	**86,263**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**	**1**	**13**	**13**	**4**	**0**	**33**	**0**

Maximum Allowable Habitat Loss by Covered Activity [1,2,3]																
		CM4 Tidal Natural Communities Restoration														
		Suisun Marsh							Delta						Plan Area Total [7]	
Covered Wildlife Species	Total Existing Modeled Habitat in the Plan Area (Acres)[2]	High Tidal Brackish Marsh	Mid Tidal Brackish Marsh	Low Tidal Brackish Marsh	Intertidal Mudflat	Subtidal 1	Subtidal 2	Subtidal 3	Ecotone	Intertidal Mudflat	Tidal Freshwater Marsh	Subtidal 1	Subtidal 2	Subtidal 3	Permanent (Acres)[7,8,9]	Conversion (Acres)
Greater sandhill crane																
Roosting and foraging - Permanent	7,340	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Roosting and foraging - Temporary	16,522	0	0	0	0	0	0	0	0	0	41	0	0	0	41	0
Foraging	162,164	0	0	0	0	0	0	0	11	0	1,407	827	381	29	2,655	0
Total	**186,025**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**11**	**0**	**1,448**	**827**	**381**	**29**	**2,696**	**0**
Least Bell's vireo																
Migratory and breeding	14,528	1	1	6	1	1	0	0	0	0	381	6	4	2	403	0
Total	**14,528**	**1**	**1**	**6**	**1**	**1**	**0**	**0**	**0**	**0**	**381**	**6**	**4**	**2**	**403**	**0**
Suisun song sparrow																
Primary habitat	3,722	0	0	55	0	0	0	0	0	0	0	0	0	0	0	55
Secondary habitat	23,986	32	70	0	623	851	5	0	0	0	0	0	0	0	1,479 [15]	102
Total	**27,707**	**32**	**70**	**55**	**624**	**851**	**5**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1,479**	**157**
Swainson's hawk																
Foraging habitat	470,324	24	45	324	216	97	0	0	1,073	192	7,437	2,007	604	37	12,057	0
Nesting habitat	9,796	0	0	4	2	0	0	0	0	0	217	2	2	1	228	0
Total	**480,120**	**24**	**46**	**328**	**218**	**97**	**0**	**0**	**1,073**	**193**	**7,654**	**2,009**	**605**	**38**	**12,285**	**0**
Tricolored blackbird																
Breeding habitat-ag foraging	100,198	0	0	0	0	0	0	0	554	143	2,341	421	7	1	1,126	2,341
Breeding habitat-foraging	58,181	11	20	294	281	165	1	0	7	0	98	2	0	0	468	413
Breeding habitat-nesting	1,741	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Nonbreeding habitat-foraging ag	194,251	0	0	0	0	0	0	0	223	27	2,870	986	548	29	1,813	2,870
Nonbreeding habitat-roosting	28,066	23	43	0	315	282	3	0	91	0	0	4	3	1	765	0
Nonbreeding habitat-foraging	34,308	0	0	0	0	0	0	0	42	3	547	37	17	6	105	547
Total	**416,745**	**34**	**63**	**294**	**596**	**448**	**4**	**0**	**917**	**174**	**5,857**	**1,451**	**574**	**37**	**4,277**	**6,172**
Western burrowing owl																
High-value habitat	149,783	15	24	212	219	105	1	0	886	4	4,039	146	157	34	5,840	0
Low-value habitat	251,767	0	15	25	6	2	0	0	192	157	2,994	1,323	298	13	5,025	0
Total	**401,550**	**15**	**38**	**237**	**225**	**107**	**1**	**0**	**1,077**	**160**	**7,033**	**1,469**	**455**	**46**	**10,865**	**0**
Western yellow-billed cuckoo																
Breeding habitat	1,970	0	0	0	0	0	0	0	0	0	52	0	1	0	53	0
Migratory habitat	10,425	0	0	0	0	0	0	0	0	0	248	2	1	1	254	0
Total	**12,395**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**300**	**3**	**2**	**2**	**307**	**0**
White-tailed kite																
Breeding habitat	14,069	0	0	4	2	0	0	0	0	0	284	3	2	2	298	0
Foraging habitat	500,365	0	79	1,054	1,124	1,360	23	0	0	193	7,288	1,999	605	38	13,764	0
Total	**514,434**	**0**	**79**	**1,059**	**1,127**	**1,360**	**23**	**0**	**0**	**193**	**7,572**	**2,001**	**607**	**40**	**14,061**	**0**

Maximum Allowable Habitat Loss by Covered Activity[1,2,3]																
		CM4 Tidal Natural Communities Restoration														
		Suisun Marsh							Delta						Plan Area Total[7]	
Covered Wildlife Species	Total Existing Modeled Habitat in the Plan Area (Acres)[2]	High Tidal Brackish Marsh	Mid Tidal Brackish Marsh	Low Tidal Brackish Marsh	Intertidal Mudflat	Subtidal 1	Subtidal 2	Subtidal 3	Ecotone	Intertidal Mudflat	Tidal Freshwater Marsh	Subtidal 1	Subtidal 2	Subtidal 3	Permanent (Acres)[7,8,9]	Conversion (Acres)
Yellow-breasted chat																
Primary nesting and migratory habitat	8,178	0	0	0	0	0	0	0	0	0	105	1	2	1	109	0
Secondary nesting and migratory habitat	5,528	0	0	0	0	0	0	0	0	0	276	4	2	1	283	0
Suisun Marsh/Upper Yolo Bypass nest and migratory habitat	841	1	1	6	1	1	0	0	0	0	0	0	0	0	11	0
Total	**14,547**	**1**	**1**	**6**	**1**	**1**	**0**	**0**	**0**	**0**	**381**	**6**	**4**	**2**	**403**	**0**
Reptiles																
Giant garter snake																
Aquatic - tidal	12,097	0	0	0	0	0	0	0	2	0	0	0	0	0	2	0
Aquatic - nontidal[19]	19,027	0	0	0	0	0	0	0	8	0	134	12	3	0	158	0
Upland-high	21,581	0	0	0	0	0	0	0	41	0	420	33	32	17	544	0
Upland-moderate	25,407	0	0	0	0	0	0	0	66	1	722	69	12	1	871	0
Upland-low	5,683	0	0	0	0	0	0	0	6	0	122	1	1	1	131	0
Total	**83,796**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**122**	**2**	**1,398**	**115**	**48**	**20**	**1,705**	**0**
Aquatic breeding, foraging, and movement (miles)	2,784	0	0	0	0	0	0	0	4	1	49	11	7	2	74	0
Western pond turtle																
Aquatic habitat[10]	81,588	45	0	0	0	0	0	0	0	0	0	0	0	0	45	0
Upland nesting and overwintering habitat	16,043	2	4	108	98	35	1	0	2	0	44	2	0	0	295	0
Upland nesting and overwintering habitat-NHD[20]	12,615	4	7	11	15	7	0	0	7	1	164	10	6	2	235	0
Total	**110,245**	**52**	**11**	**120**	**113**	**41**	**1**	**0**	**9**	**1**	**208**	**12**	**6**	**2**	**576**	**0**
Aquatic habitat linear (miles) – NHD[20]	1,418	0	0	1	1	1	0	0	2	1	26	8	4	1	46	0
Amphibians																
California red-legged frog																
Aquatic habitat	159	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upland cover and dispersal habitat	7,766	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**7,925**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Aquatic habitat (miles)	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
California tiger salamander																
Aquatic breeding habitat	7,845	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Terrestrial cover and aestivation	28,173	0	0	0	0	0	0	0	140	0	135	0	0	0	275	0
Total	**36,018**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**140**	**0**	**135**	**0**	**0**	**0**	**275**	**0**
Invertebrates																
Valley elderberry longhorn beetle																
Riparian vegetation	17,464	0	0	0	0	0	0	0	0	0	389	7	5	2	403	0
Nonriparian channels and grasslands	16,585	1	1	14	9	2	0	0	10	0	107	15	6	1	164	0
Total	**34,048**	**1**	**1**	**14**	**9**	**2**	**0**	**0**	**10**	**0**	**497**	**22**	**10**	**2**	**568**	**0**
California linderiella																
Vernal pool complex	8,759	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Maximum Allowable Habitat Loss by Covered Activity [1,2,3]																
		CM4 Tidal Natural Communities Restoration														
		Suisun Marsh							Delta						Plan Area Total [7]	
Covered Wildlife Species	Total Existing Modeled Habitat in the Plan Area (Acres)[2]	High Tidal Brackish Marsh	Mid Tidal Brackish Marsh	Low Tidal Brackish Marsh	Intertidal Mudflat	Subtidal 1	Subtidal 2	Subtidal 3	Ecotone	Intertidal Mudflat	Tidal Freshwater Marsh	Subtidal 1	Subtidal 2	Subtidal 3	Permanent (Acres)[7,8,9]	Conversion (Acres)
Degraded vernal pool complex	2,713	0	0	0	0	0	0	0	19	0	18	0	0	0	38	0
Total	**11,472**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**19**	**0**	**18**	**0**	**0**	**0**	**38**	**0**
Conservancy fairy shrimp																
Vernal pool complex	8,759	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Degraded vernal pool complex	2,713	0	0	0	0	0	0	0	19	0	18	0	0	0	38	0
Total	**11,472**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**19**	**0**	**18**	**0**	**0**	**0**	**38**	**0**
Longhorn fairy shrimp																
Vernal pool complex	8,759	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Degraded vernal pool complex	2,713	0	0	0	0	0	0	0	19	0	18	0	0	0	38	0
Total	**11,472**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**19**	**0**	**18**	**0**	**0**	**0**	**38**	**0**
Midvalley fairy shrimp																
Vernal pool complex	8,759	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Degraded vernal pool complex	2,713	0	0	0	0	0	0	0	19	0	18	0	0	0	38	0
Total	**11,472**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**19**	**0**	**18**	**0**	**0**	**0**	**38**	**0**
Vernal pool fairy shrimp																
Vernal pool complex	8,759	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Degraded vernal pool complex	2,713	0	0	0	0	0	0	0	19	0	18	0	0	0	38	0
Total	**11,472**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**19**	**0**	**18**	**0**	**0**	**0**	**38**	**0**
Vernal pool tadpole shrimp																
Vernal pool complex	8,759	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Degraded vernal pool complex	2,713	0	0	0	0	0	0	0	19	0	18	0	0	0	38	0
Total	**11,472**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**19**	**0**	**18**	**0**	**0**	**0**	**38**	**0**

Table 5.J-10. Early Long-Term Wildlife Modeled Habitat Loss and Conversion by Covered Activity (cont'd)

		Maximum Allowable Habitat Loss by Covered Activity[1,2,3]																
		CM1 Water Facilities and Operation				CM2 Yolo Bypass Fisheries Enhancement		CM5 Seasonally Inundated Floodplain Restoration		CM7 Riparian Natural Community Restoration			CM10 Nontidal Marsh Natural Community Restoration	CM11 Natural Community Enhancement and Management	CM18 Conservation Hatcheries			
		Tunnel/Pipeline Facilities Construction				Fremont Weir and Yolo Bypass Improvements		Levee Construction		Riparian Restoration as Part of Tidal Natural Communities Restoration	Riparian Restoration as Part of Seasonal Floodplain Restoration	CM8 Grassland Restoration	Construction and Inundation	Construction of Recreational-Related Facilities	Construction	Maximum Allowable Habitat Loss		
Covered Wildlife Species	Total Existing Modeled Habitat in the Plan Area (Acres)[2]	Permanent (Acres)[4]	Permanent - Reusable Tunnel Material (Acres)[17]	Temporary (Borrow and Spoil) (Acres)[4,5]	Temporary (Acres)[4]	Permanent (Acres)[6]	Temporary (Acres)[6]	Permanent (Acres)[10]	Temporary (Acres)[10]	Permanent (Acres)	Permanent (Acres)[11]	Permanent (Acres)[12]	Permanent (Acres)[12]	Permanent (Acres)	Permanent (Acres)[12]	Permanent (Acres)[16]	Temporary (Borrow and Spoil) (Acres)	Temporary (Acres)
Mammals																		
Riparian brush rabbit																		
Riparian habitat	2,909	3	0	0	1	0	0	6	6	0	0	0	0	0	0	9	0	7
Grassland habitat	3,103	124	0	0	54	0	0	3	6	0	0	0	0	0	0	127	0	60
Total	**6,011**	**127**	**0**	**0**	**54**	**0**	**0**	**8**	**12**	**0**	**0**	**0**	**0**	**0**	**0**	**136**	**0**	**67**
Riparian woodrat																		
Habitat	2,166	0	0	0	0	0	0	6	6	0	0	0	0	0	0	6	0	6
Total	**2,166**	**0**	**0**	**0**	**0**	**0**	**0**	**6**	**6**	**0**	**0**	**0**	**0**	**0**	**0**	**6**	**0**	**6**
Salt marsh harvest mouse																		
Tidal brackish emergent wetland primary	3,641	0	0	0	0	0	0	0	0	0	0	0	0	0	0	66	0	0
Tidal brackish emergent wetland secondary	2,718	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upland secondary	749	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0
Managed wetland—wetland primary, low long-term conservation value	21,891	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,619	0	0
Managed wetland—wetland secondary, low long-term conservation value	2,800	0	0	0	0	0	0	0	0	0	0	0	0	0	0	387	0	0
Managed wetland—upland, low long-term conservation value	3,787	0	0	0	0	0	0	0	0	0	0	0	0	0	0	395	0	0
Total	**35,588**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3,476**	**0**	**0**
San Joaquin kit fox																		
Breeding, foraging, and dispersal habitat	5,327	155	52	0	103	0	0	0	0	0	0	0	0	4	0	211	0	103
Total	**5,327**	**155**	**52**	**0**	**103**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**4**	**0**	**211**	**0**	**103**
Suisun shrew																		
Primary habitat	3,128	0	0	0	0	0	0	0	0	0	0	0	0	0	0	59	0	0
Secondary habitat	4,387	0	0	0	0	0	0	0	0	0	0	0	0	0	0	105	0	0

Maximum Allowable Habitat Loss by Covered Activity [1,2,3]																		
		CM1 Water Facilities and Operation				CM2 Yolo Bypass Fisheries Enhancement		CM5 Seasonally Inundated Floodplain Restoration		CM7 Riparian Natural Community Restoration			CM10 Nontidal Marsh Natural Community Restoration	CM11 Natural Community Enhancement and Management	CM18 Conservation Hatcheries			
		Tunnel/Pipeline Facilities Construction				Fremont Weir and Yolo Bypass Improvements		Levee Construction		Riparian Restoration as Part of Tidal Natural Communities Restoration	Riparian Restoration as Part of Seasonal Floodplain Restoration	CM8 Grassland Restoration	Construction and Inundation	Construction of Recreational-Related Facilities	Construction	Maximum Allowable Habitat Loss		
Covered Wildlife Species	Total Existing Modeled Habitat in the Plan Area (Acres)[2]	Permanent (Acres)[4]	Permanent - Reusable Tunnel Material (Acres)[17]	Temporary (Borrow and Spoil) (Acres)[4,5]	Temporary (Acres)[4]	Permanent (Acres)[6]	Temporary (Acres)[6]	Permanent (Acres)[10]	Temporary (Acres)[10]	Permanent (Acres)	Permanent (Acres)[11]	Permanent (Acres)[12]	Permanent (Acres)[12]	Permanent (Acres)	Permanent (Acres)[12]	Permanent (Acres)[16]	Temporary (Borrow and Spoil) (Acres)	Temporary (Acres)
Total	**7,515**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**164**	**0**	**0**
Birds																		
California black rail																		
Primary habitat	7,467	0	0	0	18	5	0	0	0	0	0	0	0	0	0	77	0	18
Secondary habitat	17,915	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,460 [15]	0	0
Total	**25,382**	**0**	**0**	**0**	**18**	**5**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1,538**	**0**	**18**
California clapper rail[13]																		
Primary habitat	296	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26	0	0
Secondary habitat	6,420	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9 [15]	0	0
Total	**6,716**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**35**	**0**	**0**
California least tern																		
Nesting and Migratory Habitat	86,263	178	0	0	2,101	8	11	0	0	0	0	0	0	0	0	219	0	2,112
Total	**86,263**	**178**	**0**	**0**	**2,101**	**8**	**11**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**219**	**0**	**2,112**
Greater sandhill crane																		
Roosting and foraging - Permanent	7,340	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	8
Roosting and foraging - Temporary	16,522	0 [14]	0	0	16	0	0	0	0	0	0	0	0	0	0	41	0	16
Foraging	162,164	352	2,347	183	778	0	0	0	0	0	0	333	750	3	0	6,439	183	778
Total	**186,025**	**352**	**2,347**	**183**	**802**	**0**	**0**	**0**	**0**	**0**	**0**	**333**	**750**	**3**	**0**	**6,481**	**183**	**802**
Least Bell's vireo																		
Migratory and breeding	14,528	11	18	1	22	83	88	6	4	0	0	0	0	0	0	521	1	114
Total	**14,528**	**11**	**18**	**1**	**22**	**83**	**88**	**6**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**521**	**1**	**114**
Suisun song sparrow																		
Primary habitat	3,722	0	0	0	0	0	0	0	0	0	0	0	0	0	0	55	0	0
Secondary habitat	23,986	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,581 [15]	0	0
Total	**27,707**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1,637**	**0**	**0**
Swainson's hawk																		
Foraging habitat	470,324	1,100	3,235	183	1,113	996	504	197	122	726	0	1,368	746	20	35	20,479	183	1,739
Nesting habitat	9,796	8	10	0	18	79	54	6	6	0	0	0	0	0	0	330	0	78
Total	**480,120**	**1,108**	**3,245**	**183**	**1,131**	**1,075**	**558**	**202**	**128**	**726**	**0**	**1,368**	**746**	**20**	**35**	**20,809**	**183**	**1,817**

Maximum Allowable Habitat Loss by Covered Activity [1,2,3]																		
		CM1 Water Facilities and Operation				CM2 Yolo Bypass Fisheries Enhancement		CM5 Seasonally Inundated Floodplain Restoration		CM7 Riparian Natural Community Restoration			CM10 Nontidal Marsh Natural Community Restoration	CM11 Natural Community Enhancement and Management	CM18 Conservation Hatcheries			
		Tunnel/Pipeline Facilities Construction				Fremont Weir and Yolo Bypass Improvements		Levee Construction		Riparian Restoration as Part of Tidal Natural Communities Restoration	Riparian Restoration as Part of Seasonal Floodplain Restoration	CM8 Grassland Restoration	Construction and Inundation	Construction of Recreational-Related Facilities	Construction	Maximum Allowable Habitat Loss		
Covered Wildlife Species	Total Existing Modeled Habitat in the Plan Area (Acres)[2]	Permanent (Acres)[4]	Permanent - Reusable Tunnel Material (Acres)[17]	Temporary (Borrow and Spoil) (Acres)[4,5]	Temporary (Acres)[4]	Permanent (Acres)[6]	Temporary (Acres)[6]	Permanent (Acres)[10]	Temporary (Acres)[10]	Permanent (Acres)	Permanent (Acres)[11]	Permanent (Acres)[12]	Permanent (Acres)[12]	Permanent (Acres)	Permanent (Acres)[12]	Permanent (Acres)[16]	Temporary (Borrow and Spoil) (Acres)	Temporary (Acres)
Tricolored blackbird																		
Breeding habitat-ag foraging	100,198	634	795	81	148	477	84	98	57	705	0	1,125	237	0	0	7,537	81	289
Breeding habitat-foraging	58,181	161	52	0	114	105	155	11	11	7	0	0	0	20	35	1,272	0	279
Breeding habitat-nesting	1,741	4	0	1	2	13	75	0	0	0	0	0	0	0	0	18	1	77
Nonbreeding habitat-foraging ag	194,251	203	2,124	0	575	0	54	56	32	14	0	155	525	0	0	7,760	0	660
Nonbreeding habitat-roosting	28,066	7	12	0	20	8	0	0	0	0	0	0	0	0	0	793	0	20
Nonbreeding habitat-foraging	34,308	48	197	0	47	0	0	0	0	0	0	0	0	0	0	897	0	47
Total	**416,745**	**1,057**	**3,180**	**82**	**905**	**603**	**367**	**165**	**100**	**726**	**0**	**1,281**	**761**	**20**	**35**	**18,277**	**82**	**1,373**
Western burrowing owl																		
High-value habitat	149,783	340	541	0	351	882	245	13	13	7	0	268	86	20	35	8,030	0	609
Low-value habitat	251,767	689	2,324	101	588	98	144	146	83	719	0	972	509	0	0	10,482	101	815
Total	**401,550**	**1,030**	**2,864**	**102**	**939**	**979**	**389**	**159**	**96**	**726**	**0**	**1,240**	**594**	**20**	**35**	**18,512**	**102**	**1,424**
Western yellow-billed cuckoo																		
Breeding habitat	1,970	3	6	0	1	26	5	0	0	0	0	0	0	0	0	89	0	5
Migratory habitat	10,425	4	10	0	18	57	83	0	0	0	0	0	0	0	0	325	0	102
Total	**12,395**	**7**	**16**	**0**	**19**	**83**	**88**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**413**	**0**	**107**
White-tailed kite																		
Breeding habitat	14,069	10	16	0	23	82	88	6	6	0	0	0	0	0	0	411	0	116
Foraging habitat	500,365	1,100	3,239	183	1,112	1,008	516	197	123	726	0	0	0	20	35	20,089	183	1,752
Total	**514,434**	**1,111**	**3,255**	**183**	**1,135**	**1,090**	**604**	**203**	**130**	**726**	**0**	**0**	**0**	**20**	**35**	**20,501**	**183**	**1,869**
Yellow-breasted chat																		
Primary nesting and migratory habitat	8,178	7	10	0	6	9	58	6	4	0	0	0	0	0	0	141	0	68
Secondary nesting and migratory habitat	5,528	3	8	1	16	3	0	0	0	0	0	0	0	0	0	297	1	16
Suisun Marsh/Upper Yolo Bypass nest and migratory habitat	841	0	0	0	0	71	29	0	0	0	0	0	0	0	0	82	0	29
Total	**14,547**	**10**	**18**	**1**	**22**	**83**	**88**	**6**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**520**	**1**	**114**
Reptiles																		

Maximum Allowable Habitat Loss by Covered Activity[1,2,3]																		
		CM1 Water Facilities and Operation				CM2 Yolo Bypass Fisheries Enhancement		CM5 Seasonally Inundated Floodplain Restoration		CM7 Riparian Natural Community Restoration			CM10 Nontidal Marsh Natural Community Restoration	CM11 Natural Community Enhancement and Management	CM18 Conservation Hatcheries			
		Tunnel/Pipeline Facilities Construction				Fremont Weir and Yolo Bypass Improvements		Levee Construction		Riparian Restoration as Part of Tidal Natural Communities Restoration	Riparian Restoration as Part of Seasonal Floodplain Restoration	CM8 Grassland Restoration	Construction and Inundation	Construction of Recreational-Related Facilities	Construction	Maximum Allowable Habitat Loss		
Covered Wildlife Species	Total Existing Modeled Habitat in the Plan Area (Acres)[2]	Permanent (Acres)[4]	Permanent - Reusable Tunnel Material (Acres)[17]	Temporary (Borrow and Spoil) (Acres)[4,5]	Temporary (Acres)[4]	Permanent (Acres)[6]	Temporary (Acres)[6]	Permanent (Acres)[10]	Temporary (Acres)[10]	Permanent (Acres)	Permanent (Acres)[11]	Permanent (Acres)[12]	Permanent (Acres)[12]	Permanent (Acres)	Permanent (Acres)[12]	Permanent (Acres)[16]	Temporary (Borrow and Spoil) (Acres)	Temporary (Acres)
Giant garter snake																		
Aquatic - tidal	12,097	16	1	0	55	9	2	0	0	0	0	0	0	0	0	27	0	58
Aquatic - nontidal[19]	19,027	10	56	0	13	59	13	20	10	0	0	0	0	0	0	303	0	36
Upland-high	21,581	66	106	0	48	178	158	0	0	0	0	0	0	0	0	894	0	206
Upland-moderate	25,407	167	54	0	135	60	61	6	8	0	0	0	0	0	35	1,193	0	204
Upland-low	5,683	14	4	0	5	1	0	4	3	0	0	0	0	0	0	154	0	8
Total	**83,796**	**274**	**222**	**0**	**257**	**306**	**234**	**30**	**22**	**0**	**0**	**0**	**0**	**0**	**35**	**2,572**	**0**	**513**
Aquatic breeding, foraging, and movement (miles)	2,784	7	6	0	6	5	9	0	0	0	0	0	0	0	0	91	0	15
Western pond turtle																		
Aquatic habitat[10]	81,588	180	57	0	2,098	37	23	19	9	0	0	0	0	0	0	339	0	2,129
Upland nesting and overwintering habitat	16,043	105	97	0	34	109	70	3	8	6	0	0	0	0	0	615	0	112
Upland nesting and overwintering habitat-NHD[20]	12,615	30	47	0	34	21	49	0	0	0	0	0	0	0	0	333	0	83
Total	**110,245**	**315**	**201**	**0**	**2,166**	**167**	**141**	**22**	**17**	**6**	**0**	**0**	**0**	**0**	**0**	**1,287**	**0**	**2,324**
Aquatic habitat linear (miles) – NHD[20]	1,418	3	6	0	3	1	3	0	0	0	0	0	0	0	0	56	0	6
Amphibians																		
California red-legged frog																		
Aquatic habitat	159	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Upland cover and dispersal habitat	7,766	6	0	0	39	0	0	0	0	0	0	0	0	11	0	17	0	39
Total	**7,925**	**7**	**0**	**0**	**39**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**11**	**0**	**18**	**0**	**39**
Aquatic habitat (miles)	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
California tiger salamander																		
Aquatic breeding habitat	7,845	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Terrestrial cover and aestivation	28,173	6	0	0	32	42	0	0	0	0	0	0	0	17	35	375	0	32
Total	**36,018**	**6**	**0**	**0**	**32**	**42**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**17**	**35**	**375**	**0**	**32**

Maximum Allowable Habitat Loss by Covered Activity [1,2,3]																		
		CM1 Water Facilities and Operation				CM2 Yolo Bypass Fisheries Enhancement		CM5 Seasonally Inundated Floodplain Restoration		CM7 Riparian Natural Community Restoration			CM10 Nontidal Marsh Natural Community Restoration	CM11 Natural Community Enhancement and Management	CM18 Conservation Hatcheries			
		Tunnel/Pipeline Facilities Construction				Fremont Weir and Yolo Bypass Improvements		Levee Construction		Riparian Restoration as Part of Tidal Natural Communities Restoration	Riparian Restoration as Part of Seasonal Floodplain Restoration	CM8 Grassland Restoration	Construction and Inundation	Construction of Recreational-Related Facilities	Construction	Maximum Allowable Habitat Loss		
Covered Wildlife Species	Total Existing Modeled Habitat in the Plan Area (Acres)[2]	Permanent (Acres)[4]	Permanent - Reusable Tunnel Material (Acres)[17]	Temporary (Borrow and Spoil) (Acres)[4,5]	Temporary (Acres)[4]	Permanent (Acres)[6]	Temporary (Acres)[6]	Permanent (Acres)[10]	Temporary (Acres)[10]	Permanent (Acres)	Permanent (Acres)[11]	Permanent (Acres)[12]	Permanent (Acres)[12]	Permanent (Acres)	Permanent (Acres)[12]	Permanent (Acres)[16]	Temporary (Borrow and Spoil) (Acres)	Temporary (Acres)
Invertebrates																		
Valley elderberry longhorn beetle																		
Riparian vegetation	17,464	16	18	1	29	83	76	6	6	0	0	0	0	0	0	526	1	111
Nonriparian channels and grasslands	16,585	126	101	0	62	41	94	3	6	0	0	0	0	0	0	436	0	162
Total	**34,048**	**142**	**119**	**1**	**90**	**125**	**170**	**9**	**13**	**0**	**0**	**0**	**0**	**0**	**0**	**962**	**1**	**273**
California linderiella																		
Vernal pool complex	8,759	8	0	0	0[18]	0	0	0	0	0	0	0	0	0	0	8	0	0
Degraded vernal pool complex	2,713	7	0	0	0[18]	0	0	0	0	0	0	0	0	0	0	45	0	0
Total	**11,472**	**15**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**53**	**0**	**0**
Conservancy fairy shrimp																		
Vernal pool complex	8,759	8	0	0	0[18]	0	0	0	0	0	0	0	0	0	0	8	0	0
Degraded vernal pool complex	2,713	7	0	0	0[18]	0	0	0	0	0	0	0	0	0	0	45	0	0
Total	**11,472**	**15**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**53**	**0**	**0**
Longhorn fairy shrimp																		
Vernal pool complex	8,759	8	0	0	0[18]	0	0	0	0	0	0	0	0	0	0	8	0	0
Degraded vernal pool complex	2,713	7	0	0	0[18]	0	0	0	0	0	0	0	0	0	0	45	0	0
Total	**11,472**	**15**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**53**	**0**	**0**
Midvalley fairy shrimp																		
Vernal pool complex	8,759	8	0	0	0[18]	0	0	0	0	0	0	0	0	0	0	8	0	0
Degraded vernal pool complex	2,713	7	0	0	0[18]	0	0	0	0	0	0	0	0	0	0	45	0	0
Total	**11,472**	**15**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**53**	**0**	**0**
Vernal pool fairy shrimp																		
Vernal pool complex	8,759	8	0	0	0[18]	0	0	0	0	0	0	0	0	0	0	8	0	0
Degraded vernal pool complex	2,713	7	0	0	0[18]	0	0	0	0	0	0	0	0	0	0	45	0	0
Total	**11,472**	**15**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**53**	**0**	**0**
Vernal pool tadpole shrimp																		
Vernal pool complex	8,759	8	0	0	0[18]	0	0	0	0	0	0	0	0	0	0	8	0	0
Degraded vernal pool complex	2,713	7	0	0	0[18]	0	0	0	0	0	0	0	0	0	0	45	0	0
Total	**11,472**	**15**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**53**	**0**	**0**

Maximum Allowable Habitat Loss by Covered Activity[1,2,3]																		
		CM1 Water Facilities and Operation				CM2 Yolo Bypass Fisheries Enhancement		CM5 Seasonally Inundated Floodplain Restoration		CM7 Riparian Natural Community Restoration			CM10 Nontidal Marsh Natural Community Restoration	CM11 Natural Community Enhancement and Management	CM18 Conservation Hatcheries			
		Tunnel/Pipeline Facilities Construction				Fremont Weir and Yolo Bypass Improvements		Levee Construction		Riparian Restoration as Part of Tidal Natural Communities Restoration	Riparian Restoration as Part of Seasonal Floodplain Restoration	CM8 Grassland Restoration	Construction and Inundation	Construction of Recreational-Related Facilities	Construction	Maximum Allowable Habitat Loss		
Covered Wildlife Species	Total Existing Modeled Habitat in the Plan Area (Acres)[2]	Permanent (Acres)[4]	Permanent - Reusable Tunnel Material (Acres)[17]	Temporary (Borrow and Spoil) (Acres)[4,5]	Temporary (Acres)[4]	Permanent (Acres)[6]	Temporary (Acres)[6]	Permanent (Acres)[10]	Temporary (Acres)[10]	Permanent (Acres)	Permanent (Acres)[11]	Permanent (Acres)[12]	Permanent (Acres)[12]	Permanent (Acres)	Permanent (Acres)[12]	Permanent (Acres)[16]	Temporary (Borrow and Spoil) (Acres)	Temporary (Acres)

1 The following covered activities and associated federal actions (listed here by the header/category as described in Chapter 4, Covered Activities and Associated Federal Actions) are assumed not to have footprint impacts on natural communities or species habitat: Operations and Maintenance of Existing SWP Facilities; Power Generation Water Use - Mirant Delta, LLC activities; Activities to Reduce Contaminants; Activities to Reduce Predators and Other Sources of Direct Mortality; Monitoring and Research Programs; Emergency Actions; CVP Operations and Maintenance; and Joint Federal and Non-federal Actions.

2 Existing habitat and habitat loss are estimated using habitat models created from detailed vegetation mapping, See Appendix 2.A, *Covered Species Accounts*, for a complete description of species-specific mapping methods. Effects on species' habitat will be tracked during implementation through on-the-ground surveys performed by qualified biologists.

3 See Table 5.J.1, *Quantitative Effects Analysis Methods and Assumptions*, in Appendix 5.J, *Effects on Natural Communities, Wildlife, and Plants*, for a description methods and assumptions relevant to estimating natural community loss by covered activity type and Table 5.J.3, *Key Assumptions Related to Tidal Restoration Effects on Covered Species Habitat*, for a list of assumptions used to determine permanent loss or conversion as a result of inundation caused by tidal restoration.

4 Permanent and temporary effects assessed under CM1 are associated with construction of the following conveyance-related facilities: forebay, intake facilities, permanent access roads, shaft locations, and transmission lines. See Chapter 4, Section 4.2.1.1, North Delta Diversions Construction and Operations, for a complete description of all activities assessed under CM1.

5 Borrow/Spoil Area Borrow: location from where construction material, such as sand or clay, will be taken. Spoil: area where construction by-products, such as removed earth, will be placed and stored. Borrow/spoil: an area that will originally be used for borrow and then later be used for spoil.

6 Permanent and temporary effects assessed under CM2 include activities associated with Fremont Weir improvements, Putah Creek realignment activities, Lisbon weir and fish crossing improvements, and Sacramento Weir improvements.

7 Inundation is tidal flooding of existing wetland habitat as a result of tidal restoration actions. Inundation can cause permanent loss of habitat from either the removal of habitat or the conversion of one habitat type to another. See Table 5.J.1, *Quantitative Effects Analysis Methods and Assumptions*, in Appendix 5.J, for a description of relevant assumptions. All construction is assumed to occur within the inundation footprint.

8 Permanent loss calculations are based on hypothetical tidal restoration designs and include those areas modeled by ESAPWA (Appendix 3.B, *BDCP Tidal Habitat Evolution Assessment*) to be below extreme high water elevation. See Table 5.J.1 in Appendix 5.J, for methods and assumptions used to apply the hypothetical footprint to determine effects.

9 Tidal restoration is expected to include riparian restoration where elevations are favorable. Permanent loss from riparian restoration was determined by non-GIS methods. See Table 5.J.1, in Appendix 5.J, for a complete list of methods and assumptions.

10 Calculation of effects based on hypothetical floodplain restoration designs. See Table 5.J.1 in Appendix 5.J, for details.

11 Based on restoration design assumptions described in Appendix 5.E, *Habitat Restoration*, and effects analysis assumptions detailed in Table 5.J.1 in Appendix 5.J.

12 Permanent loss was determined based on non-GIS methods described in Table 5.J.1 in Appendix 5.J.

13 Based on the hypothetical tidal restoration footprint, an estimated 4 acres of habitat will be lost or converted. However, to provide flexibility in implementation of tidal restoration projects, the take limit is set higher than the amount of loss estimated under the hypothetical footprint.

14 AMM30 (Appendix 3.C) requires a reroute of the transmission line so it does not affect a roost site. This will reduce impacts on roosting and foraging habitat by 29 acres.

15 Although the tidal restoration model results in some decreases in acreage of natural community loss between near term and late long-term due to tidal damping and sea level rise, for permitting purposes the maximum acreage of loss is shown for late long-term.

16 Because decimal places are not shown in this table, in some cases, a row total may be larger by one or two acres than the result obtained by manually summing numbers across columns.

17 Reusable tunnel material is flexible and the footprint used in the effects analysis is based on a worst case scenario: the actual area to be affected by reusable tunnel material storage will likely be less than the estimated acreage.

18 Loss reduced to zero. Although the temporary transmission powerline footprint overlaps with 2 acres of alkali seasonal wetland complex and 16 acres of vernal pool complex in Conservation Zone 8, AMM30 requires that wetted acres of alkali seasonal wetlands and vernal pools complex be avoided during transmission powerline installation.

19 Rice loss from CM8 and CM10 are not included in this analysis as rice conversion in Conservation Zone 2 will be avoided. This table will be updated for all other species in the next version.

20 For western pond turtle NHD model types, a 35% habitat suitability correction factor was applied to existing modeled habitat and covered activity loss acreage as it was determined that, in the Plan Area, approximately 35% of all channels and ditches mapped in the NHD layer are likely suitable for western pond turtle. See Appendix 2.A, *Covered Species Accounts*, Section 2.A.29, for more details.

NHD = National Hydrologic Database; SWP = State Water Project; CVP = Central Valley Project.

Table 5.J-11. Late Long-Term Wildlife Modeled Habitat Loss and Conversion by Covered Activity

Maximum Allowable Habitat Loss by Covered Activity[1,2,3]																
		CM4 Tidal Natural Communities Restoration														
		Suisun Marsh							Delta						Plan Area Total[7]	
Covered Wildlife Species	Total Existing Modeled Habitat in the Plan Area (Acres)[2]	High Tidal Brackish Marsh	Mid Tidal Brackish Marsh	Low Tidal Brackish Marsh	Intertidal Mudflat	Subtidal 1	Subtidal 2	Subtidal 3	Ecotone	Intertidal Mudflat	Tidal Freshwater Marsh	Subtidal 1	Subtidal 2	Subtidal 3	Permanent (Acres)[7,8,9]	Conversion (Acres)
Mammals																
Riparian brush rabbit																
Riparian habitat	2,909	0	0	0	0	0	0	0	5	0	7	3	3	1	19	0
Grassland habitat	3,103	0	0	0	0	0	0	0	3	0	11	1	2	0	18	0
Total	**6,011**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**8**	**0**	**19**	**4**	**4**	**1**	**37**	**0**
Riparian woodrat																
Habitat	2,166	0	0	0	0	0	0	0	4	0	5	1	0	0	10	0
Total	**2,166**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**4**	**0**	**5**	**1**	**0**	**0**	**10**	**0**
Salt marsh harvest mouse																
Tidal brackish emergent wetland primary	3,641	0	0	67	0	0	0	0	0	0	0	0	0	0	0	67
Tidal brackish emergent wetland secondary	2,718	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upland secondary	749	1	7	0	0	0	0	0	0	0	0	0	0	0	1[15]	8
Managed wetland—wetland primary, low long-term conservation value	21,891	5	7	991	807	3,353	160	0	0	0	0	0	0	0	4,320	1,003
Managed wetland—wetland secondary, low long-term conservation value	2,800	2	3	336	135	317	14	0	0	0	0	0	0	0	467	340
Managed wetland—upland, low long-term conservation value	3,787	6	9	158	164	419	5	0	0	0	0	0	0	0	588	174
Total	**35,588**	**13**	**26**	**1,552**	**1,107**	**4,090**	**179**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**5,376**	**1,592**
San Joaquin kit fox																
Breeding, foraging, and dispersal habitat	5,327	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**5,327**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Suisun shrew																
Primary habitat	3,128	0	0	60	0	0	0	0	0	0	0	0	0	0	60	0
Secondary habitat	4,387	7	17	0	97	208	12	0	0	0	0	0	0	0	318[15]	24
Total	**7,515**	**7**	**17**	**60**	**97**	**208**	**12**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**377**	**24**
Birds																
California black rail																
Primary habitat	7,467	0	0	71	0	0	0	0	5	0	0	1	1	1	3	76
Secondary habitat	17,915	29	52	0	587	2,240	118	0	0	0	12	5	0	0	2,951[15]	93
Total	**25,382**	**29**	**52**	**71**	**587**	**2,240**	**118**	**0**	**5**	**0**	**12**	**6**	**2**	**1**	**2,954**	**168**
California clapper rail[13]																
Primary habitat	296	0	0	27	0	0	0	0	0	0	0	0	0	0	0	27
Secondary habitat	6,420	5	3	0	0	0	0	0	0	0	0	0	0	0	0[15]	8

Maximum Allowable Habitat Loss by Covered Activity[1,2,3]																
		CM4 Tidal Natural Communities Restoration														
	Total Existing Modeled Habitat in the Plan Area (Acres)[2]	Suisun Marsh							Delta						Plan Area Total[7]	
Covered Wildlife Species		High Tidal Brackish Marsh	Mid Tidal Brackish Marsh	Low Tidal Brackish Marsh	Intertidal Mudflat	Subtidal 1	Subtidal 2	Subtidal 3	Ecotone	Intertidal Mudflat	Tidal Freshwater Marsh	Subtidal 1	Subtidal 2	Subtidal 3	Permanent (Acres)[7,8,9]	Conversion (Acres)
Total	**6,716**	**5**	**3**	**27**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**35**
California least tern																
Nesting and Migratory Habitat	86,263	0	0	1	0	0	0	0	1	1	14	8	9	0	36	0
Total	**86,263**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**	**1**	**14**	**8**	**9**	**0**	**36**	**0**
Greater sandhill crane																
Roosting and foraging - Permanent	7,340	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Roosting and foraging - Temporary	16,522	0	0	0	0	0	0	0	0	0	41	0	0	0	41	0
Foraging	162,164	0	0	0	0	0	0	0	1	0	1,467	514	614	117	2,713	0
Total	**186,025**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1,508**	**514**	**614**	**117**	**2,754**	**0**
Least Bell's vireo																
Migratory and breeding	14,528	2	1	8	1	2	0	0	0	0	477	23	25	6	545	0
Total	**14,528**	**2**	**1**	**8**	**1**	**2**	**0**	**0**	**0**	**0**	**477**	**23**	**25**	**6**	**545**	**0**
Suisun song sparrow																
Primary habitat	3,722	0	0	55	0	0	0	0	0	0	0	0	0	0	0	55
Secondary habitat	23,986	53	70	0	657	2,712	140	0	0	0	0	0	0	0	3510[15]	123
Total	**27,707**	**53**	**70**	**55**	**657**	**2,712**	**140**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3,510**	**178**
Swainson's hawk																
Foraging habitat	470,324	62	63	411	349	666	11	0	1,319	3	17,988	6,280	7,393	2,814	37,359	0
Nesting habitat	9,796	0	0	2	4	2	0	0	0	0	258	12	15	2	295	0
Total	**480,120**	**62**	**63**	**413**	**353**	**668**	**11**	**0**	**1,319**	**3**	**18,246**	**6,292**	**7,408**	**2,816**	**37,654**	**0**
Tricolored blackbird																
Breeding habitat-ag foraging	100,198	2	0	0	0	0	0	0	338	0	3,635	1,335	1,093	47	2,814	3,635
Breeding habitat-foraging	58,181	10	11	382	299	692	18	0	38	0	254	28	16	2	1,102	647
Breeding habitat-nesting	1,741	0	0	0	0	0	0	0	6	0	34	10	4	0	21	34
Nonbreeding habitat-foraging ag	194,251	0	0	0	0	0	0	0	530	1	8,716	2,991	4,115	851	8,489	8,716
Nonbreeding habitat-roosting	28,066	5	7	0	404	1,119	29	0	41	0	0	13	10	5	1,633	0
Nonbreeding habitat-foraging	34,308	0	0	8	44	465	7	0	38	3	651	33	49	33	672	659
Total	**416,745**	**17**	**19**	**391**	**746**	**2,276**	**54**	**0**	**992**	**3**	**13,291**	**4,410**	**5,287**	**939**	**14,732**	**13,692**
Western burrowing owl																
High-value habitat	149,783	39	40	324	216	795	81	0	620	3	6,253	783	617	158	9,929	0
Low-value habitat	251,767	0	4	44	21	14	0	0	478	0	9,281	3,919	3,751	2,226	19,739	0
Total	**401,550**	**39**	**44**	**368**	**236**	**809**	**81**	**0**	**1,098**	**3**	**15,534**	**4,702**	**4,368**	**2,384**	**29,668**	**0**
Western yellow-billed cuckoo																
Breeding habitat	1,970	0	0	0	0	0	0	0	0	0	86	13	10	1	110	0
Migratory habitat	10,425	0	0	0	0	0	0	0	0	0	290	6	9	4	310	0

Maximum Allowable Habitat Loss by Covered Activity[1,2,3]																
		CM4 Tidal Natural Communities Restoration														
		Suisun Marsh							Delta						Plan Area Total[7]	
Covered Wildlife Species	**Total Existing Modeled Habitat in the Plan Area (Acres)[2]**	**High Tidal Brackish Marsh**	**Mid Tidal Brackish Marsh**	**Low Tidal Brackish Marsh**	**Intertidal Mudflat**	**Subtidal 1**	**Subtidal 2**	**Subtidal 3**	**Ecotone**	**Intertidal Mudflat**	**Tidal Freshwater Marsh**	**Subtidal 1**	**Subtidal 2**	**Subtidal 3**	**Permanent (Acres)[7,8,9]**	**Conversion (Acres)**
Total	**12,395**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**376**	**19**	**20**	**5**	**420**	**0**
White-tailed kite																
Breeding habitat	14,069	0	0	2	4	2	0	0	0	0	339	15	17	3	383	0
Foraging habitat	500,365	0	71	1,372	1,133	4,528	425	0	0	3	17,811	6,227	7,240	2,815	41,625	0
Total	**514,434**	**0**	**71**	**1,374**	**1,137**	**4,530**	**425**	**0**	**0**	**3**	**18,151**	**6,242**	**7,257**	**2,818**	**42,008**	**0**
Yellow-breasted chat																
Primary nesting and migratory habitat	8,178	0	0	0	0	0	0	0	0	0	149	14	16	3	182	0
Secondary nesting and migratory habitat	5,528	0	0	0	0	0	0	0	0	0	328	9	9	3	349	0
Suisun Marsh/Upper Yolo Bypass nest and migratory habitat	841	2	1	8	1	2	0	0	0	0	0	0	0	0	14	0
Total	**14,547**	**2**	**1**	**8**	**1**	**2**	**0**	**0**	**0**	**0**	**478**	**23**	**25**	**6**	**545**	**0**
Reptiles																
Giant garter snake																
Aquatic - tidal	12,097	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0
Aquatic - nontidal[19]	19,027	0	0	0	0	0	0	0	37	0	237	38	60	21	393	0
Upland-high	21,581	0	0	0	0	0	0	0	33	0	477	17	26	39	594	0
Upland-moderate	25,407	0	0	0	0	0	0	0	60	0	1,019	128	140	28	1,375	0
Upland-low	5,683	0	0	0	0	0	0	0	7	0	137	4	3	2	154	0
Total	**83,796**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**139**	**1**	**1,870**	**188**	**230**	**90**	**2,518**	**0**
Aquatic breeding, foraging, and movement (miles)	2,784	0	0	0	0	0	0	0	8	0	73	18	23	16	138	0
Western pond turtle																
Aquatic habitat[10]	81,588	45	0	0	0	0	0	0	0	0	0	0	0	0	45	0
Upland nesting and overwintering habitat	16,043	3	5	86	95	139	2	0	13	0	113	6	5	4	473	0
Upland nesting and overwintering habitat-NHD[20]	12,615	9	9	48	11	64	1	0	12	1	203	16	15	11	399	0
Total	**110,245**	**57**	**14**	**134**	**107**	**203**	**3**	**0**	**24**	**1**	**316**	**22**	**20**	**15**	**917**	**0**
Aquatic habitat linear (miles) – NHD[20]	1,418	0	0	2	2	7	1	0	4	0	43	15	20	12	106	0
Amphibians																
California red-legged frog																
Aquatic habitat	159	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upland cover and dispersal habitat	7,766	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**7,925**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Aquatic habitat (miles)	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
California tiger salamander																
Aquatic breeding habitat	7,845	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Terrestrial cover and aestivation	28,173	0	0	0	0	0	0	0	101	0	404	5	6	0	517	0

Maximum Allowable Habitat Loss by Covered Activity [1,2,3]																
		CM4 Tidal Natural Communities Restoration														
		Suisun Marsh							Delta						Plan Area Total[7]	
Covered Wildlife Species	Total Existing Modeled Habitat in the Plan Area (Acres)[2]	High Tidal Brackish Marsh	Mid Tidal Brackish Marsh	Low Tidal Brackish Marsh	Intertidal Mudflat	Subtidal 1	Subtidal 2	Subtidal 3	Ecotone	Intertidal Mudflat	Tidal Freshwater Marsh	Subtidal 1	Subtidal 2	Subtidal 3	Permanent (Acres)[7,8,9]	Conversion (Acres)
Total	**36,018**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**101**	**0**	**404**	**5**	**6**	**0**	**517**	**0**
Invertebrates																
Valley elderberry longhorn beetle																
Riparian vegetation	17,464	0	0	0	0	0	0	0	0	0	490	25	28	8	552	0
Nonriparian channels and grasslands	16,585	1	2	11	10	18	0	0	18	0	149	16	22	13	260	0
Total	**34,048**	**1**	**2**	**11**	**10**	**18**	**0**	**0**	**18**	**0**	**640**	**42**	**50**	**21**	**813**	**0**
California linderiella																
Vernal pool complex	8,759	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Degraded vernal pool complex	2,713	0	0	1	0	0	0	0	9	0	41	1	0	0	52	0
Total	**11,472**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**9**	**0**	**41**	**1**	**0**	**0**	**52**	**0**
Conservancy fairy shrimp																
Vernal pool complex	8,759	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Degraded vernal pool complex	2,713	0	0	1	0	0	0	0	9	0	41	1	0	0	52	0
Total	**11,472**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**9**	**0**	**41**	**1**	**0**	**0**	**52**	**0**
Longhorn fairy shrimp																
Vernal pool complex	8,759	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Degraded vernal pool complex	2,713	0	0	1	0	0	0	0	9	0	41	1	0	0	52	0
Total	**11,472**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**9**	**0**	**41**	**1**	**0**	**0**	**52**	**0**
Midvalley fairy shrimp																
Vernal pool complex	8,759	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Degraded vernal pool complex	2,713	0	0	1	0	0	0	0	9	0	41	1	0	0	52	0
Total	**11,472**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**9**	**0**	**41**	**1**	**0**	**0**	**52**	**0**
Vernal pool fairy shrimp																
Vernal pool complex	8,759	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Degraded vernal pool complex	2,713	0	0	1	0	0	0	0	9	0	41	1	0	0	52	0
Total	**11,472**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**9**	**0**	**41**	**1**	**0**	**0**	**52**	**0**
Vernal pool tadpole shrimp																
Vernal pool complex	8,759	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Degraded vernal pool complex	2,713	0	0	1	0	0	0	0	9	0	41	1	0	0	52	0
Total	**11,472**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**9**	**0**	**41**	**1**	**0**	**0**	**52**	**0**

Table 5.J-11. Late Long-Term Wildlife Modeled Habitat Loss and Conversion by Covered Activity (cont'd)

		Maximum Allowable Habitat Loss by Covered Activity[1,2,3]																
		CM1 Water Facilities and Operation				CM2 Yolo Bypass Fisheries Enhancement		CM5 Seasonally Inundated Floodplain Restoration		CM7 Riparian Natural Community Restoration			CM10 Nontidal Marsh Natural Community Restoration	CM11 Natural Community Enhancement and Management	CM18 Conservation Hatcheries			
	Total Existing Modeled Habitat in the Plan Area (Acres)[2]	Tunnel/Pipeline Facilities Construction				Fremont Weir and Yolo Bypass Improvements		Levee Construction		Riparian Restoration as Part of Tidal Natural Communities Restoration	Riparian Restoration as Part of Seasonal Floodplain Restoration	CM8 Grassland Restoration	Construction and Inundation	Construction of Recreational-Related Facilities	Construction	Maximum Allowable Habitat Loss		
Covered Wildlife Species		Permanent (Acres)[4]	Permanent - Reusable Tunnel Material (Acres)[17]	Temporary (Borrow and Spoil) (Acres)[4,5]	Temporary (Acres)[4]	Permanent (Acres)[6]	Temporary (Acres)[6]	Permanent (Acres)[10]	Temporary (Acres)[10]	Permanent (Acres)	Permanent (Acres)[11]	Permanent (Acres)[12]	Permanent (Acres)[12]	Permanent (Acres)	Permanent (Acres)[12]	Permanent (Acres)[16]	Temporary (Borrow and Spoil) (Acres)	Temporary (Acres)
Mammals																		
Riparian brush rabbit																		
Riparian habitat	2,909	3	0	0	1	0	0	43	35	0	0	0	0	0	0	65	0	35
Grassland habitat	3,103	124	0	0	54	0	0	26	20	0	0	0	0	0	0	168	0	74
Total	**6,011**	**127**	**0**	**0**	**54**	**0**	**0**	**69**	**54**	**0**	**0**	**0**	**0**	**0**	**0**	**232**	**0**	**109**
Riparian woodrat																		
Habitat	2,166	0	0	0	0	0	0	41	33	0	0	0	0	0	0	51	0	33
Total	**2,166**	**0**	**0**	**0**	**0**	**0**	**0**	**41**	**33**	**0**	**0**	**0**	**0**	**0**	**0**	**51**	**0**	**33**
Salt marsh harvest mouse																		
Tidal brackish emergent wetland primary	3,641	0	0	0	0	0	0	0	0	0	0	0	0	0	0	67	0	0
Tidal brackish emergent wetland secondary	2,718	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upland secondary	749	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0
Managed wetland—wetland primary, low long-term conservation value	21,891	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,323	0	0
Managed wetland—wetland secondary, low long-term conservation value	2,800	0	0	0	0	0	0	0	0	0	0	0	0	0	0	807	0	0
Managed wetland—upland, low long-term conservation value	3,787	0	0	0	0	0	0	0	0	0	0	0	0	0	0	762	0	0
Total	**35,588**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**6,968**	**0**	**0**
San Joaquin kit fox																		
Breeding, foraging, and dispersal habitat	5,327	155	52	0	103	0	0	0	0	0	0	0	0	8	0	214	0	103
Total	**5,327**	**155**	**52**	**0**	**103**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**8**	**0**	**214**	**0**	**103**
Suisun shrew																		
Primary habitat	3,128	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60	0	0

Covered Wildlife Species	Total Existing Modeled Habitat in the Plan Area (Acres)[2]	Maximum Allowable Habitat Loss by Covered Activity[1,2,3]																
		CM1 Water Facilities and Operation				CM2 Yolo Bypass Fisheries Enhancement		CM5 Seasonally Inundated Floodplain Restoration		CM7 Riparian Natural Community Restoration			CM10 Nontidal Marsh Natural Community Restoration	CM11 Natural Community Enhancement and Management	CM18 Conservation Hatcheries			
		Tunnel/Pipeline Facilities Construction				Fremont Weir and Yolo Bypass Improvements		Levee Construction		Riparian Restoration as Part of Tidal Natural Communities Restoration	Riparian Restoration as Part of Seasonal Floodplain Restoration	CM8 Grassland Restoration	Construction and Inundation	Construction of Recreational-Related Facilities	Construction	Maximum Allowable Habitat Loss		
		Permanent (Acres)[4]	Permanent - Reusable Tunnel Material (Acres)[17]	Temporary (Borrow and Spoil) (Acres)[4,5]	Temporary (Acres)[4]	Permanent (Acres)[6]	Temporary (Acres)[6]	Permanent (Acres)[10]	Temporary (Acres)[10]	Permanent (Acres)	Permanent (Acres)[11]	Permanent (Acres)[12]	Permanent (Acres)[12]	Permanent (Acres)	Permanent (Acres)[12]	Permanent (Acres)[16]	Temporary (Borrow and Spoil) (Acres)	Temporary (Acres)
Secondary habitat	4,387	0	0	0	0	0	0	0	0	0	0	0	0	0	0	342 [15]	0	0
Total	**7,515**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**401**	**0**	**0**
Birds																		
California black rail																		
Primary habitat	7,467	0	0	0	18	5	0	0	0	0	0	0	0	0	0	83	0	18
Secondary habitat	17,915	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3,043 [15]	0	0
Total	**25,382**	**0**	**0**	**0**	**18**	**5**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3,127**	**0**	**18**
California clapper rail[13]																		
Primary habitat	296	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27	0	0
Secondary habitat	6,420	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8 [15]	0	0
Total	**6,716**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**35**	**0**	**0**
California least tern																		
Nesting and Migratory Habitat	86,263	178	0	0	2,101	8	11	2	5	0	0	0	0	0	0	224	0	2,116
Total	**86,263**	**178**	**0**	**0**	**2,101**	**8**	**11**	**2**	**5**	**0**	**0**	**0**	**0**	**0**	**0**	**224**	**0**	**2,116**
Greater sandhill crane																		
Roosting and foraging - Permanent	7,340	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	8
Roosting and foraging - Temporary	16,522	0 [14]	0	0	16	0	0	0	0	0	0	0	0	0	0	41	0	16
Foraging	162,164	352	2,347	183	778	0	0	0	0	0	0	300	1,350	4	0	7,065	183	778
Total	**186,025**	**352**	**2,347**	**183**	**802**	**0**	**0**	**0**	**0**	**0**	**0**	**300**	**1,350**	**4**	**0**	**7,107**	**183**	**802**
Least Bell's vireo																		
Migratory and breeding	14,528	11	18	1	22	83	88	28	21	0	0	0	0	0	0	685	1	131
Total	**14,528**	**11**	**18**	**1**	**22**	**83**	**88**	**28**	**21**	**0**	**0**	**0**	**0**	**0**	**0**	**685**	**1**	**131**
Suisun song sparrow																		
Primary habitat	3,722	0	0	0	0	0	0	0	0	0	0	0	0	0	0	55	0	0
Secondary habitat	23,986	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3633 [15]	0	0
Total	**27,707**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3,688**	**0**	**0**
Swainson's hawk																		
Foraging habitat	470,324	1,100	3,235	183	1,113	996	504	1,820	1,036	971	3,991	1,849	1,440	50	35	52,845	183	2,653
Nesting habitat	9,796	8	10	0	18	79	54	38	31	0	0	0	0	0	0	430	0	104

Covered Wildlife Species	Total Existing Modeled Habitat in the Plan Area (Acres)[2]	Maximum Allowable Habitat Loss by Covered Activity[1,2,3]: CM1 Water Facilities and Operation – Tunnel/Pipeline Facilities Construction – Permanent (Acres)[4]	CM1 – Tunnel/Pipeline Facilities Construction – Permanent - Reusable Tunnel Material (Acres)[17]	CM1 – Tunnel/Pipeline Facilities Construction – Temporary (Borrow and Spoil) (Acres)[4,5]	CM1 – Tunnel/Pipeline Facilities Construction – Temporary (Acres)[4]	CM2 Yolo Bypass Fisheries Enhancement – Fremont Weir and Yolo Bypass Improvements – Permanent (Acres)[6]	CM2 – Fremont Weir and Yolo Bypass Improvements – Temporary (Acres)[6]	CM5 Seasonally Inundated Floodplain Restoration – Levee Construction – Permanent (Acres)[10]	CM5 – Levee Construction – Temporary (Acres)[10]	CM7 Riparian Natural Community Restoration – Riparian Restoration as Part of Tidal Natural Communities Restoration – Permanent (Acres)	CM7 – Riparian Restoration as Part of Seasonal Floodplain Restoration – Permanent (Acres)[11]	CM8 Grassland Restoration – Permanent (Acres)[12]	CM10 Nontidal Marsh Natural Community Restoration – Construction and Inundation – Permanent (Acres)[12]	CM11 Natural Community Enhancement and Management – Construction of Recreational-Related Facilities – Permanent (Acres)	CM18 Conservation Hatcheries – Construction – Permanent (Acres)[12]	Maximum Allowable Habitat Loss – Permanent (Acres)[16]	Maximum Allowable Habitat Loss – Temporary (Borrow and Spoil) (Acres)	Maximum Allowable Habitat Loss – Temporary (Acres)
Total	**480,120**	**1,108**	**3,245**	**183**	**1,131**	**1,075**	**558**	**1,857**	**1,067**	**971**	**3,991**	**1,849**	**1,440**	**50**	**35**	**53,275**	**183**	**2,756**
Tricolored blackbird																		
Breeding habitat-ag foraging	100,198	634	795	81	148	477	84	503	275	7	0	1,521	568	0	0	10,954	81	507
Breeding habitat-foraging	58,181	161	52	0	114	105	155	47	30	11	0	0	0	44	35	2,204	0	298
Breeding habitat-nesting	1,741	4	0	1	2	13	75	4	2	0	0	0	0	0	0	77	1	79
Nonbreeding habitat-foraging ag	194,251	203	2,124	0	575	0	54	652	367	953	3,991	210	945	0	0	26,282	0	995
Nonbreeding habitat-roosting	28,066	7	12	0	20	8	0	1	1	0	0	0	0	0	0	1,662	0	22
Nonbreeding habitat-foraging	34,308	48	197	0	47	0	0	3	3	0	0	0	0	7	0	1,586	0	50
Total	**416,745**	**1,057**	**3,180**	**82**	**905**	**603**	**367**	**1,211**	**678**	**971**	**3,991**	**1,731**	**1,513**	**50**	**35**	**42,766**	**82**	**1,950**
Western burrowing owl																		
High-value habitat	149,783	340	541	0	351	882	245	142	83	11	0	362	159	50	35	12,450	0	679
Low-value habitat	251,767	689	2,324	101	588	98	144	1,452	827	960	3,991	1,314	952	0	0	31,519	101	1,558
Total	**401,550**	**1,030**	**2,864**	**102**	**939**	**979**	**389**	**1,594**	**910**	**971**	**3,991**	**1,675**	**1,111**	**50**	**35**	**43,969**	**102**	**2,237**
Western yellow-billed cuckoo																		
Breeding habitat	1,970	3	6	0	1	26	5	6	5	0	0	0	0	0	0	150	0	11
Migratory habitat	10,425	4	10	0	18	57	83	16	11	0	0	0	0	0	0	397	0	112
Total	**12,395**	**7**	**16**	**0**	**19**	**83**	**88**	**21**	**17**	**0**	**0**	**0**	**0**	**0**	**0**	**547**	**0**	**123**
White-tailed kite																		
Breeding habitat	14,069	10	16	0	23	82	88	42	33	0	0	0	0	0	0	533	0	144
Foraging habitat	500,365	1,100	3,239	183	1,112	1,008	516	1,706	968	971	3,991	1,849	1,440	50	35	57,015	183	2,597
Total	**514,434**	**1,111**	**3,255**	**183**	**1,135**	**1,090**	**604**	**1,748**	**1,001**	**971**	**3,991**	**1,849**	**1,440**	**50**	**35**	**57,548**	**183**	**2,740**
Yellow-breasted chat																		
Primary nesting and migratory habitat	8,178	7	10	0	6	9	58	23	15	0	0	0	0	0	0	232	0	79
Secondary nesting and migratory habitat	5,528	3	8	1	16	3	0	5	6	0	0	0	0	0	0	367	1	22
Suisun Marsh/Upper Yolo Bypass nest and migratory habitat	841	0	0	0	0	71	29	0	0	0	0	0	0	0	0	85	0	29
Total	**14,547**	**10**	**18**	**1**	**22**	**83**	**88**	**28**	**21**	**0**	**0**	**0**	**0**	**0**	**0**	**684**	**1**	**131**

Maximum Allowable Habitat Loss by Covered Activity [1,2,3]

Covered Wildlife Species	Total Existing Modeled Habitat in the Plan Area (Acres)[2]	CM1 Water Facilities and Operation: Tunnel/Pipeline Facilities Construction				CM2 Yolo Bypass Fisheries Enhancement: Fremont Weir and Yolo Bypass Improvements		CM5 Seasonally Inundated Floodplain Restoration: Levee Construction		CM7 Riparian Natural Community Restoration: Riparian Restoration as Part of Tidal Natural Communities Restoration	CM7 Riparian Natural Community Restoration: Riparian Restoration as Part of Seasonal Floodplain Restoration	CM8 Grassland Restoration	CM10 Nontidal Marsh Natural Community Restoration: Construction and Inundation	CM11 Natural Community Enhancement and Management: Construction of Recreational-Related Facilities	CM18 Conservation Hatcheries: Construction	Maximum Allowable Habitat Loss		
		Permanent (Acres)[4]	Permanent - Reusable Tunnel Material (Acres)[17]	Temporary (Borrow and Spoil) (Acres)[4,5]	Temporary (Acres)[4]	Permanent (Acres)[6]	Temporary (Acres)[6]	Permanent (Acres)[10]	Temporary (Acres)[10]	Permanent (Acres)	Permanent (Acres)[11]	Permanent (Acres)[12]	Permanent (Acres)[12]	Permanent (Acres)	Permanent (Acres)[12]	Permanent (Acres)[16]	Temporary (Borrow and Spoil) (Acres)	Temporary (Acres)
Reptiles																		
Giant garter snake																		
Aquatic - tidal	12,097	16	1	0	55	9	2	2	3	0	0	0	0	0	0	28	0	60
Aquatic - nontidal[19]	19,027	10	56	0	13	59	13	34	21	0	0	0	0	0	0	553	0	47
Upland-high	21,581	66	106	0	48	178	158	0	0	0	0	0	0	0	0	944	0	206
Upland-moderate	25,407	167	54	0	135	60	61	27	24	0	0	0	0	0	35	1,718	0	220
Upland-low	5,683	14	4	0	5	1	0	20	18	0	0	0	0	0	0	193	0	23
Total	**83,796**	**274**	**222**	**0**	**257**	**306**	**234**	**82**	**65**	**0**	**0**	**0**	**0**	**0**	**35**	**3,437**	**0**	**556**
Aquatic breeding, foraging, and movement (miles)	2,784	7	6	0	6	5	9	2	1	0	0	0	0	0	0	156	0	16
Western pond turtle																		
Aquatic habitat[10]	81,588	180	57	0	2,098	37	23	32	21	0	0	0	0	0	0	351	0	2,141
Upland nesting and overwintering habitat	16,043	105	97	0	34	109	70	12	15	10	0	0	0	0	0	805	0	119
Upland nesting and overwintering habitat-NHD[20]	12,615	30	47	0	34	21	49	4	2	0	0	0	0	0	0	501	0	85
Total	**110,245**	**315**	**201**	**0**	**2,166**	**167**	**141**	**48**	**39**	**10**	**0**	**0**	**0**	**0**	**0**	**1,657**	**0**	**2,346**
Aquatic habitat linear (miles) – NHD[20]	1,418	3	6	0	3	1	3	2	1	0	0	0	0	0	0	118	0	7
Amphibians																		
California red-legged frog																		
Aquatic habitat	159	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Upland cover and dispersal habitat	7,766	6	0	0	39	0	0	0	0	0	0	0	0	24	0	30	0	39
Total	**7,925**	**7**	**0**	**0**	**39**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**24**	**0**	**31**	**0**	**39**
Aquatic habitat (miles)	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
California tiger salamander																		
Aquatic breeding habitat	7,845	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Terrestrial cover and aestivation	28,173	6	0	0	32	42	0	0	0	0	0	0	0	40	35	639	0	32
Total	**36,018**	**6**	**0**	**0**	**32**	**42**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**40**	**35**	**639**	**0**	**32**
Invertebrates																		

Maximum Allowable Habitat Loss by Covered Activity[1,2,3]

Covered Wildlife Species	Total Existing Modeled Habitat in the Plan Area (Acres)[2]	CM1 Water Facilities and Operation				CM2 Yolo Bypass Fisheries Enhancement		CM5 Seasonally Inundated Floodplain Restoration		CM7 Riparian Natural Community Restoration			CM10 Nontidal Marsh Natural Community Restoration	CM11 Natural Community Enhancement and Management	CM18 Conservation Hatcheries			
		Tunnel/Pipeline Facilities Construction				Fremont Weir and Yolo Bypass Improvements		Levee Construction		Riparian Restoration as Part of Tidal Natural Communities Restoration	Riparian Restoration as Part of Seasonal Floodplain Restoration	CM8 Grassland Restoration	Construction and Inundation	Construction of Recreational-Related Facilities	Construction	Maximum Allowable Habitat Loss		
		Permanent (Acres)[4]	Permanent - Reusable Tunnel Material (Acres)[17]	Temporary (Borrow and Spoil) (Acres)[4,5]	Temporary (Acres)[4]	Permanent (Acres)[6]	Temporary (Acres)[6]	Permanent (Acres)[10]	Temporary (Acres)[10]	Permanent (Acres)	Permanent (Acres)[11]	Permanent (Acres)[12]	Permanent (Acres)[12]	Permanent (Acres)	Permanent (Acres)[12]	Permanent (Acres)[16]	Temporary (Borrow and Spoil) (Acres)	Temporary (Acres)
Valley elderberry longhorn beetle																		
Riparian vegetation	17,464	16	18	1	29	83	76	43	35	0	0	0	0	0	0	712	1	140
Nonriparian channels and grasslands	16,585	126	101	0	62	41	94	9	14	0	0	0	0	0	0	538	0	170
Total	**34,048**	**142**	**119**	**1**	**90**	**125**	**170**	**52**	**49**	**0**	**0**	**0**	**0**	**0**	**0**	**1,250**	**1**	**310**
California linderiella																		
Vernal pool complex	8,759	8	0	0	0[18]	0	0	0	0	0	0	0	0	0	0	8	0	0
Degraded vernal pool complex	2,713	7	0	0	0[18]	0	0	0	0	0	0	0	0	0	0	59	0	0
Total	**11,472**	**15**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**67**	**0**	**0**
Conservancy fairy shrimp																		
Vernal pool complex	8,759	8	0	0	0[18]	0	0	0	0	0	0	0	0	0	0	8	0	0
Degraded vernal pool complex	2,713	7	0	0	0[18]	0	0	0	0	0	0	0	0	0	0	59	0	0
Total	**11,472**	**15**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**67**	**0**	**0**
Longhorn fairy shrimp																		
Vernal pool complex	8,759	8	0	0	0[18]	0	0	0	0	0	0	0	0	0	0	8	0	0
Degraded vernal pool complex	2,713	7	0	0	0[18]	0	0	0	0	0	0	0	0	0	0	59	0	0
Total	**11,472**	**15**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**67**	**0**	**0**
Midvalley fairy shrimp																		
Vernal pool complex	8,759	8	0	0	0[18]	0	0	0	0	0	0	0	0	0	0	8	0	0
Degraded vernal pool complex	2,713	7	0	0	0[18]	0	0	0	0	0	0	0	0	0	0	59	0	0
Total	**11,472**	**15**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**67**	**0**	**0**
Vernal pool fairy shrimp																		
Vernal pool complex	8,759	8	0	0	0[18]	0	0	0	0	0	0	0	0	0	0	8	0	0
Degraded vernal pool complex	2,713	7	0	0	0[18]	0	0	0	0	0	0	0	0	0	0	59	0	0
Total	**11,472**	**15**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**67**	**0**	**0**
Vernal pool tadpole shrimp																		
Vernal pool complex	8,759	8	0	0	0[18]	0	0	0	0	0	0	0	0	0	0	8	0	0
Degraded vernal pool complex	2,713	7	0	0	0[18]	0	0	0	0	0	0	0	0	0	0	59	0	0
Total	**11,472**	**15**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**67**	**0**	**0**

Maximum Allowable Habitat Loss by Covered Activity [1,2,3]																		
		CM1 Water Facilities and Operation				CM2 Yolo Bypass Fisheries Enhancement		CM5 Seasonally Inundated Floodplain Restoration		CM7 Riparian Natural Community Restoration			CM10 Nontidal Marsh Natural Community Restoration	CM11 Natural Community Enhancement and Management	CM18 Conservation Hatcheries			
		Tunnel/Pipeline Facilities Construction				Fremont Weir and Yolo Bypass Improvements		Levee Construction		Riparian Restoration as Part of Tidal Natural Communities Restoration	Riparian Restoration as Part of Seasonal Floodplain Restoration	CM8 Grassland Restoration	Construction and Inundation	Construction of Recreational-Related Facilities	Construction	Maximum Allowable Habitat Loss		
Covered Wildlife Species	Total Existing Modeled Habitat in the Plan Area (Acres)[2]	Permanent (Acres)[4]	Permanent - Reusable Tunnel Material (Acres)[17]	Temporary (Borrow and Spoil) (Acres)[4,5]	Temporary (Acres)[4]	Permanent (Acres)[6]	Temporary (Acres)[6]	Permanent (Acres)[10]	Temporary (Acres)[10]	Permanent (Acres)	Permanent (Acres)[11]	Permanent (Acres)[12]	Permanent (Acres)[12]	Permanent (Acres)	Permanent (Acres)[12]	Permanent (Acres)[16]	Temporary (Borrow and Spoil) (Acres)	Temporary (Acres)

1 The following covered activities and associated federal actions (listed here by the header/category as described in Chapter 4, Covered Activities and Associated Federal Actions) are assumed not to have footprint impacts on natural communities or species habitat: Operations and Maintenance of Existing SWP Facilities; Power Generation Water Use - Mirant Delta, LLC activities; Activities to Reduce Contaminants; Activities to Reduce Predators and Other Sources of Direct Mortality; Monitoring and Research Programs; Emergency Actions; CVP Operations and Maintenance; and Joint Federal and Non-federal Actions.

2 Existing habitat and habitat loss are estimated using habitat models created from detailed vegetation mapping, See Appendix 2.A, *Covered Species Accounts*, for a complete description of species-specific mapping methods. Effects on species' habitat will be tracked during implementation through on-the-ground surveys performed by qualified biologists.

3 See Table 5.J.1, *Quantitative Effects Analysis Methods and Assumptions*, in Appendix 5.J, *Effects on Natural Communities, Wildlife, and Plants*, for a description methods and assumptions relevant to estimating natural community loss by covered activity type and Table 5.J.3, *Key Assumptions Related to Tidal Restoration Effects on Covered Species Habitat*, for a list of assumptions used to determine permanent loss or conversion as a result of inundation caused by tidal restoration.

4 Permanent and temporary effects assessed under CM1 are associated with construction of the following conveyance-related facilities: forebay, intake facilities, permanent access roads, shaft locations, and transmission lines. See Chapter 4, Section 4.2.1.1, North Delta Diversions Construction and Operations, for a complete description of all activities assessed under CM1.

5 Borrow/Spoil Area Borrow: location from where construction material, such as sand or clay, will be taken. Spoil: area where construction by-products, such as removed earth, will be placed and stored. Borrow/spoil: an area that will originally be used for borrow and then later be used for spoil.

6 Permanent and temporary effects assessed under CM2 include activities associated with Fremont Weir improvements, Putah Creek realignment activities, Lisbon weir and fish crossing improvements, and Sacramento Weir improvements.

7 Inundation is tidal flooding of existing wetland habitat as a result of tidal restoration actions. Inundation can cause permanent loss of habitat from either the removal of habitat or the conversion of one habitat type to another. See Table 5.J.1, *Quantitative Effects Analysis Methods and Assumptions*, in Appendix 5.J, for a description of relevant assumptions. All construction is assumed to occur within the inundation footprint.

8 Permanent loss calculations are based on hypothetical tidal restoration designs and include those areas modeled by ESAPWA (Appendix 3.B, *BDCP Tidal Habitat Evolution Assessment*) to be below extreme high water elevation. See Table 5.J.1 in Appendix 5.J, for methods and assumptions used to apply the hypothetical footprint to determine effects.

9 Tidal restoration is expected to include riparian restoration where elevations are favorable. Permanent loss from riparian restoration was determined by non-GIS methods. See Table 5.J.1, in Appendix 5.J, for a complete list of methods and assumptions.

10 Calculation of effects based on hypothetical floodplain restoration designs. See Table 5.J.1 in Appendix 5.J, for details.

11 Based on restoration design assumptions described in Appendix 5.E, *Habitat Restoration*, and effects analysis assumptions detailed in Table 5.J.1 in Appendix 5.J.

12 Permanent loss was determined based on non-GIS methods described in Table 5.J.1 in Appendix 5.J.

13 Based on the hypothetical tidal restoration footprint, an estimated 4 acres of habitat will be lost or converted. However, to provide flexibility in implementation of tidal restoration projects, the take limit is set higher than the amount of loss estimated under the hypothetical footprint.

14 AMM30 (Appendix 3.C) will require a reroute of the transmission line so it does not affect a roost site. This will reduce impacts on roosting and foraging habitat by 29 acres.

15 Although the tidal restoration model results in some decreases in acreage of natural community loss between near term and late long-term due to tidal damping and sea level rise, for permitting purposes the maximum acreage of loss is shown for late long-term.

16 Because decimal places are not shown in this table, in some cases, a row total may be larger by one or two acres than the result obtained by manually summing numbers across columns.

17 Reusable tunnel material is flexible and the footprint used in the effects analysis is based on a worst case scenario: the actual area to be affected by reusable tunnel material storage will likely be less than the estimated acreage.

18 Loss reduced to zero. Although the temporary transmission powerline footprint overlaps with 2 acres of alkali seasonal wetland complex and 16 acres of vernal pool complex in Conservation Zone 8, AMM30 requires that wetted acres of alkali seasonal wetlands and vernal pools complex be avoided during transmission powerline installation.

19 Rice loss from CM8 and CM10 are not included in this analysis as rice conversion in Conservation Zone 2 will be avoided. This table will be updated for all other species in the next version.

20 For western pond turtle NHD model types, a 35% habitat suitability correction factor was applied to existing modeled habitat and covered activity loss acreage as it was determined that, in the Plan Area, approximately 35% of all channels and ditches mapped in the NHD layer are likely suitable for western pond turtle. See Appendix 2.A, *Covered Species Accounts*, Section 2.A.29, for more details.

NHD = National Hydrologic Database; SWP = State Water Project; CVP = Central Valley Project.

Table 5.J-12. Near Term Plant Modeled Habitat Loss and Conversion by Covered Activity

Resource	Total Existing Modeled Habitat in the Plan Area (Acres)[2]	Maximum Allowable Habitat Loss by Covered Activity[1,2,3]														
		CM4 Tidal Natural Communities Restoration														
		Suisun Marsh							Delta						Plan Area Total[7]	
		High Tidal Brackish Marsh	Mid Tidal Brackish Marsh	Low Tidal Brackish Marsh	Intertidal Mudflat	Subtidal 1	Subtidal 2	Subtidal 3	Ecotone	Intertidal Mudflat	Tidal Freshwater Marsh	Subtidal 1	Subtidal 2	Subtidal 3	Permanent (Acres)[7,8,9]	Conversion (Acres)
Plants																
Brittlescale total[13]	451	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heartscale total	6,451	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0
San Joaquin spearscale total	14,477	0	0	1	0	0	0	0	164	0	31	1	0	0	196	0
Carquinez goldenbush total[13]	1,346	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Delta button celery total	3,361	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Delta mudwort total	6,081	0	0	0	0	0	0	0	0	0	0	3	1	2	5	0
Mason's lilaeopsis total	6,081	0	0	0	0	0	0	0	0	0	0	3	1	2	5	0
Delta tule pea total[14]	5,853	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Suisun Marsh aster total[14]	5,853	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Side-flowering skullcap total[15]	2,497	0	0	0	0	0	0	0	1	0	0	1	1	1	3	0
Slough thistle total	1,834	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Soft bird's-beak total	1,228	0	0	72	0	0	0	0	0	0	0	0	0	0	72	0
Suisun thistle total	1,281	0	0	72	0	0	0	0	0	0	0	0	0	0	72	0
Vernal Pool Plants																
Alkali milk-vetch																
Vernal pool complex	8,709	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
Degraded vernal pool complex	2,576	0	0	0	0	0	0	0	24	0	3	0	0	0	27	0
Alkali seasonal wetland	188	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**11,472**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**24**	**0**	**3**	**0**	**0**	**0**	**28** [20]	**0**
Legenere																
Vernal pool complex	8,709	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
Degraded vernal pool complex	2,576	0	0	0	0	0	0	0	24	0	3	0	0	0	27	0
Alkali seasonal wetland	188	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**11,472**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**24**	**0**	**3**	**0**	**0**	**0**	**28** [20]	**0**
Heckard's peppergrass																
Vernal pool complex	8,709	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
Degraded vernal pool complex	2,576	0	0	0	0	0	0	0	24	0	3	0	0	0	27	0
Alkali seasonal wetland	188	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**11,472**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**24**	**0**	**3**	**0**	**0**	**0**	**28** [20]	**0**
Boggs Lake hedge-hyssop																
Vernal pool complex	8,709	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
Degraded vernal pool complex	2,576	0	0	0	0	0	0	0	24	0	3	0	0	0	27	0
Alkali seasonal wetland	188	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**11,472**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**24**	**0**	**3**	**0**	**0**	**0**	**28** [20]	**0**
Dwarf downingia																
Vernal pool complex	8,709	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
Degraded vernal pool complex	2,576	0	0	0	0	0	0	0	24	0	3	0	0	0	27	0
Alkali seasonal wetland	188	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**11,472**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**24**	**0**	**3**	**0**	**0**	**0**	**28** [20]	**0**

Table 5.J-12. Near Term Plant Modeled Habitat Loss and Conversion by Covered Activity (cont'd)

Resource	Total Existing Modeled Habitat in the Plan Area (Acres)[2]	Maximum Allowable Habitat Loss by Covered Activity[1,2,3]																
		CM1 Water Facilities and Operation				CM2 Yolo Bypass Fisheries Enhancement		CM5 Seasonally Inundated Floodplain Restoration		CM7 Riparian Natural Community Restoration			CM10 Nontidal Marsh Natural Community Restoration	CM11 Natural Community Enhancement and Management	CM18 Conservation Hatcheries			
		Tunnel/Pipeline Facilities Construction				Fremont Weir and Yolo Bypass Improvements		Levee Construction		Riparian Restoration as Part of Tidal Natural Communities Restoration	Riparian Restoration as Part of Seasonal Floodplain Restoration	CM8 Grassland Restoration	Construction and Inundation	Construction of Recreational-Related Facilities	Construction	Maximum Allowable Habitat Loss		
		Permanent (Acres)[4]	Permanent - Reusable Tunnel Material (Acres)[17]	Temporary (Borrow and Spoil) (Acres)[4,5]	Temporary (Acres)[4]	Permanent (Acres)[6]	Temporary (Acres)[6]	Permanent (Acres)[10]	Temporary (Acres)[10]	Permanent (Acres)	Permanent (Acres)[11]	Permanent (Acres)[12]	Permanent (Acres)[12]	Permanent (Acres)	Permanent (Acres)[12]	Permanent (Acres)[16]	Temporary (Borrow and Spoil) (Acres)	Temporary (Acres)
Plants																		
Brittlescale total[13]	451	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heartscale total	6,451	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
San Joaquin spearscale total	14,477	23	30	0	29	56	0	0	0	0	0	0	0	0	0	304	0	30
Carquinez goldenbush total[13]	1,346	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Delta button celery total	3,361	34	39	0	23	0	0	0	0	0	0	0	0	0	0	72	0	23
Delta mudwort total	6,081	12	3	0	15	3	2	0	0	0	0	0	0	0	0	23	0	17
Mason's lilaeopsis total	6,081	12	3	0	15	3	2	0	0	0	0	0	0	0	0	23	0	17
Delta tule pea total[14]	5,853	2	0	0	1	0	0	0	0	0	0	0	0	0	0	3	0	1
Suisun Marsh aster total[14]	5,853	2	0	0	1	0	0	0	0	0	0	0	0	0	0	3	0	1
Side-flowering skullcap total[15]	2,497	3	0	0	5	0	0	0	0	0	0	0	0	0	0	7	0	5
Slough thistle total	1,834	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Soft bird's-beak total	1,228	0	0	0	0	0	0	0	0	0	0	0	0	0	0	72	0	0
Suisun thistle total	1,281	0	0	0	0	0	0	0	0	0	0	0	0	0	0	72	0	0
Vernal Pool Plants																		
Alkali milk-vetch																**0**	**0**	**0**
Vernal pool complex	8,709	8	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0
Degraded vernal pool complex	2,576	7	0	0	0	0	0	0	0	0	0	0	0	0	0	34	0	0
Alkali seasonal wetland	188	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**11,472**	**15**	**0**	**0**	**0** [19]	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**43**	**0**	**0**
Legenere																**0**	**0**	**0**
Vernal pool complex	8,709	8	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0
Degraded vernal pool complex	2,576	7	0	0	0	0	0	0	0	0	0	0	0	0	0	34	0	0

Maximum Allowable Habitat Loss by Covered Activity [1,2,3]																		
		CM1 Water Facilities and Operation				CM2 Yolo Bypass Fisheries Enhancement		CM5 Seasonally Inundated Floodplain Restoration		CM7 Riparian Natural Community Restoration			CM10 Nontidal Marsh Natural Community Restoration	CM11 Natural Community Enhancement and Management	CM18 Conservation Hatcheries			
		Tunnel/Pipeline Facilities Construction				Fremont Weir and Yolo Bypass Improvements		Levee Construction		Riparian Restoration as Part of Tidal Natural Communities Restoration	Riparian Restoration as Part of Seasonal Floodplain Restoration	CM8 Grassland Restoration	Construction and Inundation	Construction of Recreational-Related Facilities	Construction	Maximum Allowable Habitat Loss		
Resource	Total Existing Modeled Habitat in the Plan Area (Acres)[2]	Permanent (Acres)[4]	Permanent - Reusable Tunnel Material (Acres)[17]	Temporary (Borrow and Spoil) (Acres)[4,5]	Temporary (Acres)[4]	Permanent (Acres)[6]	Temporary (Acres)[6]	Permanent (Acres)[10]	Temporary (Acres)[10]	Permanent (Acres)	Permanent (Acres)[11]	Permanent (Acres)[12]	Permanent (Acres)[12]	Permanent (Acres)	Permanent (Acres)[12]	Permanent (Acres)[16]	Temporary (Borrow and Spoil) (Acres)	Temporary (Acres)
Alkali seasonal wetland	188	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**11,472**	**15**	**0**	**0**	**0** [19]	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**43**	**0**	**0**
Heckard's peppergrass																**0**	**0**	**0**
Vernal pool complex	8,709	8	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0
Degraded vernal pool complex	2,576	7	0	0	0	0	0	0	0	0	0	0	0	0	0	34	0	0
Alkali seasonal wetland	188	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**11,472**	**15**	**0**	**0**	**0** [19]	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**43**	**0**	**0**
Boggs Lake hedge-hyssop																**0**	**0**	**0**
Vernal pool complex	8,709	8	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0
Degraded vernal pool complex	2,576	7	0	0	0	0	0	0	0	0	0	0	0	0	0	34	0	0
Alkali seasonal wetland	188	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**11,472**	**15**	**0**	**0**	**0** [19]	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**43**	**0**	**0**
Dwarf downingia																**0**	**0**	**0**
Vernal pool complex	8,709	8	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0
Degraded vernal pool complex	2,576	7	0	0	0	0	0	0	0	0	0	0	0	0	0	34	0	0
Alkali seasonal wetland	188	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**11,472**	**15**	**0**	**0**	**0** [19]	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**43**	**0**	**0**

[1] The following covered activities and associated federal actions (listed here by the header/category as described in Chapter 4, Covered Activities and Associated Federal Actions) are assumed not to have footprint impacts on natural communities or species habitat: Operations and Maintenance of Existing SWP Facilities; Power Generation Water Use - Mirant Delta, LLC activities; Activities to Reduce Contaminants; Activities to Reduce Predators and Other Sources of Direct Mortality; Monitoring and Research Programs; Emergency Actions; CVP Operations and Maintenance; and Joint Federal and Non-federal Actions.

[2] Existing habitat and habitat loss are estimated using habitat models created from detailed vegetation mapping, See Appendix 2.A, *Covered Species Accounts*, for a complete description of species-specific mapping methods. Effects on species' habitat will be tracked during implementation through on-the-ground surveys performed by qualified biologists.

[3] See Table 5.J.1, *Quantitative Effects Analysis Methods and Assumptions*, in Appendix 5.J, *Effects on Natural Communities, Wildlife, and Plants*, for a description methods and assumptions relevant to estimating natural community loss by covered activity type and Table 5.J.3, *Key Assumptions Related to Tidal Restoration Effects on Covered Species Habitat*, for a list of assumptions used to determine permanent loss or conversion as a result of inundation caused by tidal restoration.

[4] Permanent and temporary effects assessed under CM1 are associated with construction of the following conveyance-related facilities: forebay, intake facilities, permanent access roads, shaft locations, and transmission lines. See Chapter 4, Covered Activities and Associated Federal Actions, Section 4.2.1.1 North Delta Diversions Construction and Operations for a complete description of all activities assessed under CM1.

[5] Borrow/Spoil Area: Borrow: location from where construction material, such as sand or clay, will be taken. Spoil: area where construction by-products, such as removed earth, will be placed and stored. Borrow/spoil: an area that will originally be used for borrow and then later be used for spoil.

Maximum Allowable Habitat Loss by Covered Activity[1,2,3]																		
		CM1 Water Facilities and Operation				CM2 Yolo Bypass Fisheries Enhancement		CM5 Seasonally Inundated Floodplain Restoration		CM7 Riparian Natural Community Restoration			CM10 Nontidal Marsh Natural Community Restoration	CM11 Natural Community Enhancement and Management	CM18 Conservation Hatcheries			
		Tunnel/Pipeline Facilities Construction				Fremont Weir and Yolo Bypass Improvements		Levee Construction		Riparian Restoration as Part of Tidal Natural Communities Restoration	Riparian Restoration as Part of Seasonal Floodplain Restoration	CM8 Grassland Restoration	Construction and Inundation	Construction of Recreational-Related Facilities	Construction	Maximum Allowable Habitat Loss		
Resource	Total Existing Modeled Habitat in the Plan Area (Acres)[2]	Permanent (Acres)[4]	Permanent - Reusable Tunnel Material (Acres)[17]	Temporary (Borrow and Spoil) (Acres)[4,5]	Temporary (Acres)[4]	Permanent (Acres)[6]	Temporary (Acres)[6]	Permanent (Acres)[10]	Temporary (Acres)[10]	Permanent (Acres)	Permanent (Acres)[11]	Permanent (Acres)[12]	Permanent (Acres)[12]	Permanent (Acres)	Permanent (Acres)[12]	Permanent (Acres)[16]	Temporary (Borrow and Spoil) (Acres)	Temporary (Acres)

6 Permanent and temporary effects assessed under CM2 include activities associated with Fremont Weir improvements, Putah Creek realignment activities, Lisbon weir and fish crossing improvements, and Sacramento Weir improvements.

7 Inundation is tidal flooding of existing wetland habitat as a result of tidal restoration actions. Inundation can cause permanent loss of habitat from either the removal of habitat or the conversion of one habitat type to another. See Table 5.J.1, *Quantitative Effects Analysis Methods and Assumptions*, in Appendix 5.J, for a description of relevant assumptions. All construction is assumed to occur within the inundation footprint.

8 Permanent loss calculations are based on hypothetical tidal restoration designs and include those areas modeled by ESAPWA (Appendix 3.B, *BDCP Tidal Habitat Evolution Assessment*) to be below extreme high water elevation. See Table 5.J.1 in Appendix 5.J, for methods and assumptions used to apply the hypothetical footprint to determine effects.

9 Tidal restoration is expected to include riparian restoration where elevations are favorable. Permanent loss from riparian restoration was determined by non-GIS methods. See Table 5.J.1, in Appendix 5.J, for a complete list of methods and assumptions.

10 Calculation of effects based on hypothetical floodplain restoration designs. See Table 5.J.1 in Appendix 5.J, for details.

11 Based on restoration design assumptions described in Appendix 5.E, *Habitat Restoration*, and effects analysis assumptions detailed in Table 5.J.1 in Appendix 5.J.

12 Permanent loss was determined based on non-GIS methods described in Table 5.J.1 in Appendix 5.J.

13 Based on the hypothetical tidal restoration footprint, an estimated 4 acres of habitat will be lost or converted. However, to provide flexibility in implementation of tidal restoration projects, the take limit is set higher than the amount of loss estimated under the hypothetical footprint.

14 Based on the hypothetical tidal restoration footprint, an estimated 2 acres of habitat will be lost or converted. However, to provide flexibility in implementation of tidal restoration projects, the take limit is set higher than the amount of loss estimated under the hypothetical footprint.

15 Based on the hypothetical tidal restoration footprint, an estimated 4 acres of habitat will be lost or converted. However, to provide flexibility in implementation of tidal restoration projects, the take limit is set higher than the amount of loss estimated under the hypothetical footprint.

16 Reusable tunnel material is flexible and the footprint used in the effects analysis is based on a worst case scenario: the actual area to be affected by reusable tunnel material storage will likely be less than the estimated acreage.

17 Because decimal places are not shown in this table, in some cases, a row total may be larger by one or two acres than the result obtained by manually summing numbers across columns.

18 Although the tidal restoration model results in some decreases in acreage of natural community loss between near term and late long-term due to tidal damping and sea level rise, for permitting purposes the maximum acreage of loss is shown for late long-term.

19 Loss reduced to zero. Although the temporary transmission powerline footprint overlaps with 2 acres of alkali seasonal wetland complex and 16 acres of vernal pool complex in Conservation Zone 8, AMM30 requires that wetted acres of alkali seasonal wetlands and vernal pools complex be avoided during transmission powerline installation.

20 Total permanent loss reduced from 201 acres (CM4) to 28 acres. This reduction is based on a 10-acre cap for total loss of wetted acres, assuming 15% density of vernal pools in the area affected. Acreage of vernal pool complex loss may be higher if actual vernal pool density is lower. The maximum acreage loss is based on loss of wetted acres and not total vernal pool complex acreage.

NHD = National Hydrologic Database; SWP = State Water Project; CVP = Central Valley Project.

Table 5.J-13. Early Long-Term Plant Modeled Habitat Loss and Conversion by Covered Activity

		Maximum Allowable Habitat Loss by Covered Activity [1,2,3]														
		CM4 Tidal Natural Communities Restoration														
		Suisun Marsh							Delta						Plan Area Total [7]	
Resource	Total Existing Modeled Habitat in the Plan Area (Acres)[2]	High Tidal Brackish Marsh	Mid Tidal Brackish Marsh	Low Tidal Brackish Marsh	Intertidal Mudflat	Subtidal 1	Subtidal 2	Subtidal 3	Ecotone	Intertidal Mudflat	Tidal Freshwater Marsh	Subtidal 1	Subtidal 2	Subtidal 3	Permanent (Acres)[7,8,9]	Conversion (Acres)
Plants																
Brittlescale total[13]	451	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heartscale total	6,451	0	0	1	0	0	0	0	4	0	83	1	0	0	90	0
San Joaquin spearscale total	14,477	0	0	0	0	0	0	0	123	0	255	1	0	0	380	0
Carquinez goldenbush total[13]	1,346	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Delta button celery total	3,361	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Delta mudwort total	6,081	0	0	0	0	0	0	0	0	0	0	3	1	2	6	0
Mason's lilaeopsis total	6,081	0	0	0	0	0	0	0	0	0	0	3	1	2	6	0
Delta tule pea total[14]	5,853	0	0	0	4	4	0	0	0	0	0	19	15	7	50 [21]	0
Suisun Marsh aster total[14]	5,853	0	0	0	4	4	0	0	0	0	0	19	15	7	50 [21]	0
Side-flowering skullcap total[15]	2,497	0	0	0	0	0	0	0	1	0	0	1	1	1	4	0
Slough thistle total	1,834	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Soft bird's-beak total	1,228	0	0	73	0	0	0	0	0	0	0	0	0	0	73	0
Suisun thistle total	1,281	0	0	73	0	0	0	0	0	0	0	0	0	0	73	0
Vernal Pool Plants																
Alkali milk-vetch																
Vernal pool complex	8,709	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Degraded vernal pool complex	2,576	0	0	0	0	0	0	0	19	0	18	0	0	0	37	0
Alkali seasonal wetland	188	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**11,472**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**19**	**0**	**18**	**0**	**0**	**0**	**38 [20]**	**0**
Legenere																
Vernal pool complex	8,709	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Degraded vernal pool complex	2,576	0	0	0	0	0	0	0	19	0	18	0	0	0	37	0
Alkali seasonal wetland	188	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**11,472**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**19**	**0**	**18**	**0**	**0**	**0**	**38 [20]**	**0**
Heckard's peppergrass																
Vernal pool complex	8,709	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Degraded vernal pool complex	2,576	0	0	0	0	0	0	0	19	0	18	0	0	0	37	0
Alkali seasonal wetland	188	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**11,472**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**19**	**0**	**18**	**0**	**0**	**0**	**38 [20]**	**0**
Boggs Lake hedge-hyssop																
Vernal pool complex	8,709	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Degraded vernal pool complex	2,576	0	0	0	0	0	0	0	19	0	18	0	0	0	37	0
Alkali seasonal wetland	188	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**11,472**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**19**	**0**	**18**	**0**	**0**	**0**	**38 [20]**	**0**
Dwarf downingia																
Vernal pool complex	8,709	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Degraded vernal pool complex	2,576	0	0	0	0	0	0	0	19	0	18	0	0	0	37	0
Alkali seasonal wetland	188	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**11,472**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**19**	**0**	**18**	**0**	**0**	**0**	**38 [20]**	**0**

Table 5.J-13. Early Long-Term Plant Modeled Habitat Loss and Conversion by Covered Activity (cont'd)

	Maximum Allowable Habitat Loss by Covered Activity[1,2,3]																	
		CM1 Water Facilities and Operation				CM2 Yolo Bypass Fisheries Enhancement		CM5 Seasonally Inundated Floodplain Restoration		CM7 Riparian Natural Community Restoration			CM10 Nontidal Marsh Natural Community Restoration	CM11 Natural Community Enhancement and Management	CM18 Conservation Hatcheries			
		Tunnel/Pipeline Facilities Construction				Fremont Weir and Yolo Bypass Improvements		Levee Construction		Riparian Restoration as Part of Tidal Natural Communities Restoration	Riparian Restoration as Part of Seasonal Floodplain Restoration	CM8 Grassland Restoration	Construction and Inundation	Construction of Recreational-Related Facilities	Construction	Maximum Allowable Habitat Loss		
Resource	Total Existing Modeled Habitat in the Plan Area (Acres)[2]	Permanent (Acres)[4]	Permanent - Reusable Tunnel Material (Acres)[17]	Temporary (Borrow and Spoil) (Acres)[4,5]	Temporary (Acres)[4]	Permanent (Acres)[6]	Temporary (Acres)[6]	Permanent (Acres)[10]	Temporary (Acres)[10]	Permanent (Acres)	Permanent (Acres)[11]	Permanent (Acres)[12]	Permanent (Acres)[12]	Permanent (Acres)	Permanent (Acres)[12]	Permanent (Acres)[16]	Temporary (Borrow and Spoil) (Acres)	Temporary (Acres)
Plants																		
Brittlescale total[13]	451	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heartscale total	6,451	0	0	0	0	0	0	0	0	0	0	0	0	0	0	90	0	0
San Joaquin spearscale total	14,477	23	30	0	29	56	0	0	1	0	0	0	0	0	0	488	0	30
Carquinez goldenbush total[13]	1,346	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Delta button celery total	3,361	34	39	0	23	0	0	0	3	0	0	0	0	0	0	72	0	25
Delta mudwort total	6,081	12	3	0	15	3	2	0	0	0	0	0	0	0	0	24	0	17
Mason's lilaeopsis total	6,081	12	3	0	15	3	2	0	0	0	0	0	0	0	0	24	0	17
Delta tule pea total[14]	5,853	2	0	0	1	0	0	0	0	0	0	0	0	0	0	52	0	1
Suisun Marsh aster total[14]	5,853	2	0	0	1	0	0	0	0	0	0	0	0	0	0	52	0	1
Side-flowering skullcap total[15]	2,497	3	0	0	5	0	0	0	0	0	0	0	0	0	0	7	0	5
Slough thistle total	1,834	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	3
Soft bird's-beak total	1,228	0	0	0	0	0	0	0	0	0	0	0	0	0	0	73	0	0
Suisun thistle total	1,281	0	0	0	0	0	0	0	0	0	0	0	0	0	0	73	0	0
Vernal Pool Plants																		
Alkali milk-vetch																**0**	**0**	**0**
Vernal pool complex	8,709	8	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0
Degraded vernal pool complex	2,576	7	0	0	0	0	0	0	0	0	0	0	0	0	0	44	0	0
Alkali seasonal wetland	188	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Maximum Allowable Habitat Loss by Covered Activity [1,2,3]																		
		CM1 Water Facilities and Operation				CM2 Yolo Bypass Fisheries Enhancement		CM5 Seasonally Inundated Floodplain Restoration		CM7 Riparian Natural Community Restoration			CM10 Nontidal Marsh Natural Community Restoration	CM11 Natural Community Enhancement and Management	CM18 Conservation Hatcheries			
		Tunnel/Pipeline Facilities Construction				Fremont Weir and Yolo Bypass Improvements		Levee Construction		Riparian Restoration as Part of Tidal Natural Communities Restoration	Riparian Restoration as Part of Seasonal Floodplain Restoration	CM8 Grassland Restoration	Construction and Inundation	Construction of Recreational-Related Facilities	Construction	Maximum Allowable Habitat Loss		
Resource	Total Existing Modeled Habitat in the Plan Area (Acres)[2]	Permanent (Acres)[4]	Permanent - Reusable Tunnel Material (Acres)[17]	Temporary (Borrow and Spoil) (Acres)[4,5]	Temporary (Acres)[4]	Permanent (Acres)[6]	Temporary (Acres)[6]	Permanent (Acres)[10]	Temporary (Acres)[10]	Permanent (Acres)	Permanent (Acres)[11]	Permanent (Acres)[12]	Permanent (Acres)[12]	Permanent (Acres)	Permanent (Acres)[12]	Permanent (Acres)[16]	Temporary (Borrow and Spoil) (Acres)	Temporary (Acres)
Total	**11,472**	**15**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**53**	**0**	**0**
Legenere																**0**	**0**	**0**
Vernal pool complex	8,709	8	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0
Degraded vernal pool complex	2,576	7	0	0	0	0	0	0	0	0	0	0	0	0	0	44	0	0
Alkali seasonal wetland	188	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**11,472**	**15**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**53**	**0**	**0**
Heckard's peppergrass																**0**	**0**	**0**
Vernal pool complex	8,709	8	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0
Degraded vernal pool complex	2,576	7	0	0	0	0	0	0	0	0	0	0	0	0	0	44	0	0
Alkali seasonal wetland	188	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**11,472**	**15**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**53**	**0**	**0**
Boggs Lake hedge-hyssop																**0**	**0**	**0**
Vernal pool complex	8,709	8	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0
Degraded vernal pool complex	2,576	7	0	0	0	0	0	0	0	0	0	0	0	0	0	44	0	0
Alkali seasonal wetland	188	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**11,472**	**15**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**53**	**0**	**0**
Dwarf downingia																**0**	**0**	**0**
Vernal pool complex	8,709	8	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0
Degraded vernal pool complex	2,576	7	0	0	0	0	0	0	0	0	0	0	0	0	0	44	0	0
Alkali seasonal wetland	188	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**11,472**	**15**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**53**	**0**	**0**

Maximum Allowable Habitat Loss by Covered Activity[1,2,3]																		
		CM1 Water Facilities and Operation				CM2 Yolo Bypass Fisheries Enhancement		CM5 Seasonally Inundated Floodplain Restoration		CM7 Riparian Natural Community Restoration			CM10 Nontidal Marsh Natural Community Restoration	CM11 Natural Community Enhancement and Management	CM18 Conservation Hatcheries			
		Tunnel/Pipeline Facilities Construction				Fremont Weir and Yolo Bypass Improvements		Levee Construction		Riparian Restoration as Part of Tidal Natural Communities Restoration	Riparian Restoration as Part of Seasonal Floodplain Restoration	CM8 Grassland Restoration	Construction and Inundation	Construction of Recreational-Related Facilities	Construction	Maximum Allowable Habitat Loss		
Resource	Total Existing Modeled Habitat in the Plan Area (Acres)[2]	Permanent (Acres)[4]	Permanent - Reusable Tunnel Material (Acres)[17]	Temporary (Borrow and Spoil) (Acres)[4,5]	Temporary (Acres)[4]	Permanent (Acres)[6]	Temporary (Acres)[6]	Permanent (Acres)[10]	Temporary (Acres)[10]	Permanent (Acres)	Permanent (Acres)[11]	Permanent (Acres)[12]	Permanent (Acres)[12]	Permanent (Acres)	Permanent (Acres)[12]	Permanent (Acres)[16]	Temporary (Borrow and Spoil) (Acres)	Temporary (Acres)

[1] The following covered activities and associated federal actions (listed here by the header/category as described in Chapter 4, Covered Activities and Associated Federal Actions) are assumed not to have footprint impacts on natural communities or species habitat: Operations and Maintenance of Existing SWP Facilities; Power Generation Water Use - Mirant Delta, LLC activities; Activities to Reduce Contaminants; Activities to Reduce Predators and Other Sources of Direct Mortality; Monitoring and Research Programs; Emergency Actions; CVP Operations and Maintenance; and Joint Federal and Non-federal Actions.

[2] Existing habitat and habitat loss are estimated using habitat models created from detailed vegetation mapping, See Appendix 2.A, *Covered Species Accounts*, for a complete description of species-specific mapping methods. Effects on species' habitat will be tracked during implementation through on-the-ground surveys performed by qualified biologists.

[3] See Table 5.J.1, *Quantitative Effects Analysis Methods and Assumptions*, in Appendix 5.J, *Effects on Natural Communities, Wildlife, and Plants*, for a description methods and assumptions relevant to estimating natural community loss by covered activity type and Table 5.J.3, *Key Assumptions Related to Tidal Restoration Effects on Covered Species Habitat*, for a list of assumptions used to determine permanent loss or conversion as a result of inundation caused by tidal restoration.

[4] Permanent and temporary effects assessed under CM1 are associated with construction of the following conveyance-related facilities: forebay, intake facilities, permanent access roads, shaft locations, and transmission lines. See Chapter 4, Covered Activities and Associated Federal Actions, Section 4.2.1.1 North Delta Diversions Construction and Operations for a complete description of all activities assessed under CM1.

[5] Borrow/Spoil Area: Borrow: location from where construction material, such as sand or clay, will be taken. Spoil: area where construction by-products, such as removed earth, will be placed and stored. Borrow/spoil: an area that will originally be used for borrow and then later be used for spoil.

[6] Permanent and temporary effects assessed under CM2 include activities associated with Fremont Weir improvements, Putah Creek realignment activities, Lisbon weir and fish crossing improvements, and Sacramento Weir improvements.

[7] Inundation is tidal flooding of existing wetland habitat as a result of tidal restoration actions. Inundation can cause permanent loss of habitat from either the removal of habitat or the conversion of one habitat type to another. See Table 5.J.1, *Quantitative Effects Analysis Methods and Assumptions*, in Appendix 5.J, for a description of relevant assumptions. All construction is assumed to occur within the inundation footprint.

[8] Permanent loss calculations are based on hypothetical tidal restoration designs and include those areas modeled by ESAPWA (Appendix 3.B, *BDCP Tidal Habitat Evolution Assessment*) to be below extreme high water elevation. See Table 5.J.1 in Appendix 5.J, for methods and assumptions used to apply the hypothetical footprint to determine effects.

[9] Tidal restoration is expected to include riparian restoration where elevations are favorable. Permanent loss from riparian restoration was determined by non-GIS methods. See Table 5.J.1, in Appendix 5.J, for a complete list of methods and assumptions.

[10] Calculation of effects based on hypothetical floodplain restoration designs. See Table 5.J.1 in Appendix 5.J, for details.

[11] Based on restoration design assumptions described in Appendix 5.E, *Habitat Restoration*, and effects analysis assumptions detailed in Table 5.J.1 in Appendix 5.J.

[12] Permanent loss was determined based on non-GIS methods described in Table 5.J.1 in Appendix 5.J.

[13] Based on the hypothetical tidal restoration footprint, an estimated 4 acres of habitat will be lost or converted. However, to provide flexibility in implementation of tidal restoration projects, the take limit is set higher than the amount of loss estimated under the hypothetical footprint.

[14] Based on the hypothetical tidal restoration footprint, an estimated 2 acres of habitat will be lost or converted. However, to provide flexibility in implementation of tidal restoration projects, the take limit is set higher than the amount of loss estimated under the hypothetical footprint.

[15] Based on the hypothetical tidal restoration footprint, an estimated 4 acres of habitat will be lost or converted. However, to provide flexibility in implementation of tidal restoration projects, the take limit is set higher than the amount of loss estimated under the hypothetical footprint.

[16] Reusable tunnel material is flexible and the footprint used in the effects analysis is based on a worst case scenario: the actual area to be affected by reusable tunnel material storage will likely be less than the estimated acreage.

[17] Because decimal places are not shown in this table, in some cases, a row total may be larger by one or two acres than the result obtained by manually summing numbers across columns.

[18] Although the tidal restoration model results in some decreases in acreage of natural community loss between near term and late long-term due to tidal damping and sea level rise, for permitting purposes the maximum acreage of loss is shown for late long-term.

[19] Loss reduced to zero. Although the temporary transmission powerline footprint overlaps with 2 acres of alkali seasonal wetland complex and 16 acres of vernal pool complex in Conservation Zone 8, AMM3 requires that wetted acres of alkali seasonal wetlands and vernal pools complex be avoided during transmission powerline installation.

[20] Total permanent loss reduced from 201 acres (CM4) to 28 acres. This reduction is based on a 10-acre cap for total loss of wetted acres, assuming 15% density of vernal pools in the area affected. Acreage of vernal pool complex loss may be higher if actual vernal pool density is lower. The maximum acreage loss is based on loss of wetted acres and not total vernal pool complex acreage.

NHD = National Hydrologic Database; SWP = State Water Project; CVP = Central Valley Project.

Table 5.J-14. Late Long-Term Plant Modeled Habitat Loss and Conversion by Covered Activity

	Maximum Allowable Habitat Loss by Covered Activity[1,2,3]															
		CM4 Tidal Natural Communities Restoration														
		Suisun Marsh							Delta						Plan Area Total[7]	
Resource	Total Existing Modeled Habitat in the Plan Area (Acres)[2]	High Tidal Brackish Marsh	Mid Tidal Brackish Marsh	Low Tidal Brackish Marsh	Intertidal Mudflat	Subtidal 1	Subtidal 2	Subtidal 3	Ecotone	Intertidal Mudflat	Tidal Freshwater Marsh	Subtidal 1	Subtidal 2	Subtidal 3	Permanent (Acres)[7,8,9]	Conversion (Acres)
Plants																
Brittlescale total[13]	451	0	0	0	0	0	0	0	0	0	20	0	0	0	20 [21]	0
Heartscale total	6,451	1	0	1	0	0	0	0	38	0	253	7	6	0	306	0
San Joaquin spearscale total	14,477	0	0	1	0	0	0	0	83	0	525	4	8	0	622	0
Carquinez goldenbush total[13]	1,346	0	0	0	0	0	0	0	0	0	50	0	0	0	50 [21]	0
Delta button celery total	3,361	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Delta mudwort total	6,081	0	0	0	0	0	0	0	0	0	0	2	2	2	6	0
Mason's lilaeopsis total	6,081	0	0	0	0	0	0	0	0	0	0	2	2	2	6	0
Delta tule pea total[14]	5,853	0	0	0	4	4	0	0	0	0	0	19	15	7	50 [21]	0
Suisun Marsh aster total[14]	5,853	0	0	0	4	4	0	0	0	0	0	19	15	7	50 [21]	0
Side-flowering skullcap total[15]	2,497	0	0	0	0	0	0	0	1	0	0	1	1	1	4	0
Slough thistle total	1,834	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Soft bird's-beak total	1,228	0	0	73	0	0	0	0	0	0	0	0	0	0	73	0
Suisun thistle total	1,281	0	0	73	0	0	0	0	0	0	0	0	0	0	73	0
Vernal Pool Plants																
Alkali milk-vetch																
Vernal pool complex	8,709	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
Degraded vernal pool complex	2,576	0	0	0	0	0	0	0	9	0	41	1	0	0	51	0
Alkali seasonal wetland	188	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**11,472**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**9**	**0**	**41**	**1**	**0**	**0**	**52 [20]**	**0**
Legenere																
Vernal pool complex	8,709	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
Degraded vernal pool complex	2,576	0	0	0	0	0	0	0	9	0	41	1	0	0	51	0
Alkali seasonal wetland	188	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**11,472**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**9**	**0**	**41**	**1**	**0**	**0**	**52 [20]**	**0**
Heckard's peppergrass																
Vernal pool complex	8,709	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
Degraded vernal pool complex	2,576	0	0	0	0	0	0	0	9	0	41	1	0	0	51	0
Alkali seasonal wetland	188	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**11,472**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**9**	**0**	**41**	**1**	**0**	**0**	**52 [20]**	**0**
Boggs Lake hedge-hyssop																
Vernal pool complex	8,709	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
Degraded vernal pool complex	2,576	0	0	0	0	0	0	0	9	0	41	1	0	0	51	0
Alkali seasonal wetland	188	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**11,472**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**9**	**0**	**41**	**1**	**0**	**0**	**52 [20]**	**0**
Dwarf downingia																
Vernal pool complex	8,709	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
Degraded vernal pool complex	2,576	0	0	0	0	0	0	0	9	0	41	1	0	0	51	0
Alkali seasonal wetland	188	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**11,472**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**9**	**0**	**41**	**1**	**0**	**0**	**52 [20]**	**0**

1 **Table 5.J-14. Late Long-Term Plant Modeled Habitat Loss and Conversion by Covered Activity (cont'd)**

		Maximum Allowable Habitat Loss by Covered Activity[1,2,3]																
		CM1 Water Facilities and Operation				CM2 Yolo Bypass Fisheries Enhancement		CM5 Seasonally Inundated Floodplain Restoration		CM7 Riparian Natural Community Restoration			CM10 Nontidal Marsh Natural Community Restoration	CM11 Natural Community Enhancement and Management	CM18 Conservation Hatcheries			
		Tunnel/Pipeline Facilities Construction				Fremont Weir and Yolo Bypass Improvements		Levee Construction		Riparian Restoration as Part of Tidal Natural Communities Restoration	Riparian Restoration as Part of Seasonal Floodplain Restoration	CM8 Grassland Restoration	Construction and Inundation	Construction of Recreational-Related Facilities	Construction	Maximum Allowable Habitat Loss		
Resource	Total Existing Modeled Habitat in the Plan Area (Acres)[2]	Permanent (Acres)[4]	Permanent - Reusable Tunnel Material (Acres)[17]	Temporary (Borrow and Spoil) (Acres)[4,5]	Temporary (Acres)[4]	Permanent (Acres)[6]	Temporary (Acres)[6]	Permanent (Acres)[10]	Temporary (Acres)[10]	Permanent (Acres)	Permanent (Acres)[11]	Permanent (Acres)[12]	Permanent (Acres)[12]	Permanent (Acres)	Permanent (Acres)[12]	Permanent (Acres)[16]	Temporary (Borrow and Spoil) (Acres)	Temporary (Acres)
Plants																		
Brittlescale total[13]	451	0	0	0	0	0	0	0	0	0	0	0	0		0	20	0	0
Heartscale total	6,451	0	0	0	0	0	0	0	0	0	0	0	0	0	0	306	0	0
San Joaquin spearscale total	14,477	23	30	0	29	56	0	1	1	0	0	0	0	0	0	731	0	30
Carquinez goldenbush total[13]	1,346	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	0	0
Delta button celery total	3,361	34	39	0	23	0	0	7	8	0	0	0	0	0	0	79	0	31
Delta mudwort total	6,081	12	3	0	15	3	2	1	2	0	0	0	0	0	0	25	0	19
Mason's lilaeopsis total	6,081	12	3	0	15	3	2	1	2	0	0	0	0	0	0	25	0	19
Delta tule pea total[14]	5,853	2	0	0	1	0	0	0	0	0	0	0	0	0	0	52	0	2
Suisun Marsh aster total[14]	5,853	2	0	0	1	0	0	0	0	0	0	0	0	0	0	52	0	2
Side-flowering skullcap total[15]	2,497	3	0	0	5	0	0	1	1	0	0	0	0	0	0	8	0	6
Slough thistle total	1,834	0	0	0	0	0	0	50[21]	6	0	0	0	0	0	0	50	0	6
Soft bird's-beak total	1,228	0	0	0	0	0	0	0	0	0	0	0	0	0	0	73	0	0
Suisun thistle total	1,281	0	0	0	0	0	0	0	0	0	0	0	0	0	0	73	0	0
Vernal Pool Plants																		
Alkali milk-vetch																**0**	**0**	**0**
Vernal pool complex	8,709	8	0	0	0	0	0	0	0	0	0	0	0		0	9	0	0
Degraded vernal pool complex	2,576	7	0	0	0	0	0	0	0	0	0	0	0	0	0	58	0	0
Alkali seasonal wetland	188	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**11,472**	**15**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**67**	**0**	**0**
Legenere														**0**		**0**	**0**	**0**
Vernal pool complex	8,709	8	0	0	0	0	0	0	0	0	0	0	0		0	9	0	0
Degraded vernal pool complex	2,576	7	0	0	0	0	0	0	0	0	0	0	0	0	0	58	0	0
Alkali seasonal wetland	188	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**11,472**	**15**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**67**	**0**	**0**

Resource	Total Existing Modeled Habitat in the Plan Area (Acres)[2]	Maximum Allowable Habitat Loss by Covered Activity[1,2,3]																
		CM1 Water Facilities and Operation				CM2 Yolo Bypass Fisheries Enhancement		CM5 Seasonally Inundated Floodplain Restoration		CM7 Riparian Natural Community Restoration		CM8 Grassland Restoration	CM10 Nontidal Marsh Natural Community Restoration	CM11 Natural Community Enhancement and Management	CM18 Conservation Hatcheries	Maximum Allowable Habitat Loss		
		Tunnel/Pipeline Facilities Construction				Fremont Weir and Yolo Bypass Improvements		Levee Construction		Riparian Restoration as Part of Tidal Natural Communities Restoration	Riparian Restoration as Part of Seasonal Floodplain Restoration		Construction and Inundation	Construction of Recreational-Related Facilities	Construction			
		Permanent (Acres)[4]	Permanent - Reusable Tunnel Material (Acres)[17]	Temporary (Borrow and Spoil) (Acres)[4,5]	Temporary (Acres)[4]	Permanent (Acres)[6]	Temporary (Acres)[6]	Permanent (Acres)[10]	Temporary (Acres)[10]	Permanent (Acres)	Permanent (Acres)[11]	Permanent (Acres)[12]	Permanent (Acres)[12]	Permanent (Acres)	Permanent (Acres)[12]	Permanent (Acres)[16]	Temporary (Borrow and Spoil) (Acres)	Temporary (Acres)
Heckard's peppergrass														**0**		**0**	**0**	**0**
Vernal pool complex	8,709	8	0	0	0	0	0	0	0	0	0	0	0		0	9	0	0
Degraded vernal pool complex	2,576	7	0	0	0	0	0	0	0	0	0	0	0	0	0	58	0	0
Alkali seasonal wetland	188	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**11,472**	**15**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**67**	**0**	**0**
Boggs Lake hedge-hyssop														**0**		**0**	**0**	**0**
Vernal pool complex	8,709	8	0	0	0	0	0	0	0	0	0	0	0		0	9	0	0
Degraded vernal pool complex	2,576	7	0	0	0	0	0	0	0	0	0	0	0	0	0	58	0	0
Alkali seasonal wetland	188	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**11,472**	**15**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**67**	**0**	**0**
Dwarf downingia														0		0	0	0
Vernal pool complex	8,709	8	0	0	0	0	0	0	0	0	0	0	0		0	9	0	0
Degraded vernal pool complex	2,576	7	0	0	0	0	0	0	0	0	0	0	0	0	0	58	0	0
Alkali seasonal wetland	188	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	11,472	15	0	0	0	0	0	0	0	0	0	0	0	0	0	67	0	0

		Maximum Allowable Habitat Loss by Covered Activity [1,2,3]																
		CM1 Water Facilities and Operation				CM2 Yolo Bypass Fisheries Enhancement		CM5 Seasonally Inundated Floodplain Restoration		CM7 Riparian Natural Community Restoration		CM8 Grassland Restoration	CM10 Nontidal Marsh Natural Community Restoration	CM11 Natural Community Enhancement and Management	CM18 Conservation Hatcheries			
		Tunnel/Pipeline Facilities Construction				Fremont Weir and Yolo Bypass Improvements		Levee Construction		Riparian Restoration as Part of Tidal Natural Communities Restoration	Riparian Restoration as Part of Seasonal Floodplain Restoration		Construction and Inundation	Construction of Recreational-Related Facilities	Construction	Maximum Allowable Habitat Loss		
Resource	Total Existing Modeled Habitat in the Plan Area (Acres)[2]	Permanent (Acres)[4]	Permanent - Reusable Tunnel Material (Acres)[17]	Temporary (Borrow and Spoil) (Acres)[4,5]	Temporary (Acres)[4]	Permanent (Acres)[6]	Temporary (Acres)[6]	Permanent (Acres)[10]	Temporary (Acres)[10]	Permanent (Acres)	Permanent (Acres)[11]	Permanent (Acres)[12]	Permanent (Acres)[12]	Permanent (Acres)	Permanent (Acres)[12]	Permanent (Acres)[16]	Temporary (Borrow and Spoil) (Acres)	Temporary (Acres)

1 The following covered activities and associated federal actions (listed here by the header/category as described in Chapter 4, Covered Activities and Associated Federal Actions) are assumed not to have footprint impacts on natural communities or species habitat: Operations and Maintenance of Existing SWP Facilities; Power Generation Water Use - Mirant Delta, LLC activities; Activities to Reduce Contaminants; Activities to Reduce Predators and Other Sources of Direct Mortality; Monitoring and Research Programs; Emergency Actions; CVP Operations and Maintenance; and Joint Federal and Non-federal Actions.

2 Existing habitat and habitat loss are estimated using habitat models created from detailed vegetation mapping, See Appendix 2.A, *Covered Species Accounts*, for a complete description of species-specific mapping methods. Effects on species' habitat will be tracked during implementation through on-the-ground surveys performed by qualified biologists.

3 See Table 5.J.1, *Quantitative Effects Analysis Methods and Assumptions*, in Appendix 5.J, *Effects on Natural Communities, Wildlife, and Plants*, for a description methods and assumptions relevant to estimating natural community loss by covered activity type and Table 5.J.3, *Key Assumptions Related to Tidal Restoration Effects on Covered Species Habitat*, for a list of assumptions used to determine permanent loss or conversion as a result of inundation caused by tidal restoration.

4 Permanent and temporary effects assessed under CM1 are associated with construction of the following conveyance-related facilities: forebay, intake facilities, permanent access roads, shaft locations, and transmission lines. See Chapter 4, Covered Activities and Associated Federal Actions, Section 4.2.1.1 North Delta Diversions Construction and Operations for a complete description of all activities assessed under CM1.

5 Borrow/Spoil Area: Borrow: location from where construction material, such as sand or clay, will be taken. Spoil: area where construction by-products, such as removed earth, will be placed and stored. Borrow/spoil: an area that will originally be used for borrow and then later be used for spoil.

6 Permanent and temporary effects assessed under CM2 include activities associated with Fremont Weir improvements, Putah Creek realignment activities, Lisbon weir and fish crossing improvements, and Sacramento Weir improvements.

7 Inundation is tidal flooding of existing wetland habitat as a result of tidal restoration actions. Inundation can cause permanent loss of habitat from either the removal of habitat or the conversion of one habitat type to another. See Table 5.J.1, *Quantitative Effects Analysis Methods and Assumptions*, in Appendix 5.J, for a description of relevant assumptions. All construction is assumed to occur within the inundation footprint.

8 Permanent loss calculations are based on hypothetical tidal restoration designs and include those areas modeled by ESAPWA (Appendix 3.B, *BDCP Tidal Habitat Evolution Assessment*) to be below extreme high water elevation. See Table 5.J.1 in Appendix 5.J, for methods and assumptions used to apply the hypothetical footprint to determine effects.

9 Tidal restoration is expected to include riparian restoration where elevations are favorable. Permanent loss from riparian restoration was determined by non-GIS methods. See Table 5.J.1, in Appendix 5.J, for a complete list of methods and assumptions.

10 Calculation of effects based on hypothetical floodplain restoration designs. See Table 5.J.1 in Appendix 5.J, for details.

11 Based on restoration design assumptions described in Appendix 5.E, *Habitat Restoration*, and effects analysis assumptions detailed in Table 5.J.1 in Appendix 5.J.

12 Permanent loss was determined based on non-GIS methods described in Table 5.J.1 in Appendix 5.J.

13 Based on the hypothetical tidal restoration footprint, an estimated 4 acres of habitat will be lost or converted. However, to provide flexibility in implementation of tidal restoration projects, the take limit is set higher than the amount of loss estimated under the hypothetical footprint.

14 Based on the hypothetical tidal restoration footprint, an estimated 2 acres of habitat will be lost or converted. However, to provide flexibility in implementation of tidal restoration projects, the take limit is set higher than the amount of loss estimated under the hypothetical footprint.

15 Based on the hypothetical tidal restoration footprint, an estimated 4 acres of habitat will be lost or converted. However, to provide flexibility in implementation of tidal restoration projects, the take limit is set higher than the amount of loss estimated under the hypothetical footprint.

16 Reusable tunnel material is flexible and the footprint used in the effects analysis is based on a worst case scenario: the actual area to be affected by reusable tunnel material storage will likely be less than the estimated acreage.

17 Because decimal places are not shown in this table, in some cases, a row total may be larger by one or two acres than the result obtained by manually summing numbers across columns.

18 Although the tidal restoration model results in some decreases in acreage of natural community loss between near term and late long-term due to tidal damping and sea level rise, for permitting purposes the maximum acreage of loss is shown for late long-term.

19 Loss reduced to zero. Although the temporary transmission powerline footprint overlaps with 2 acres of alkali seasonal wetland complex and 16 acres of vernal pool complex in Conservation Zone 8, AMM30 requires that wetted acres of alkali seasonal wetlands and vernal pools complex be avoided during transmission powerline installation.

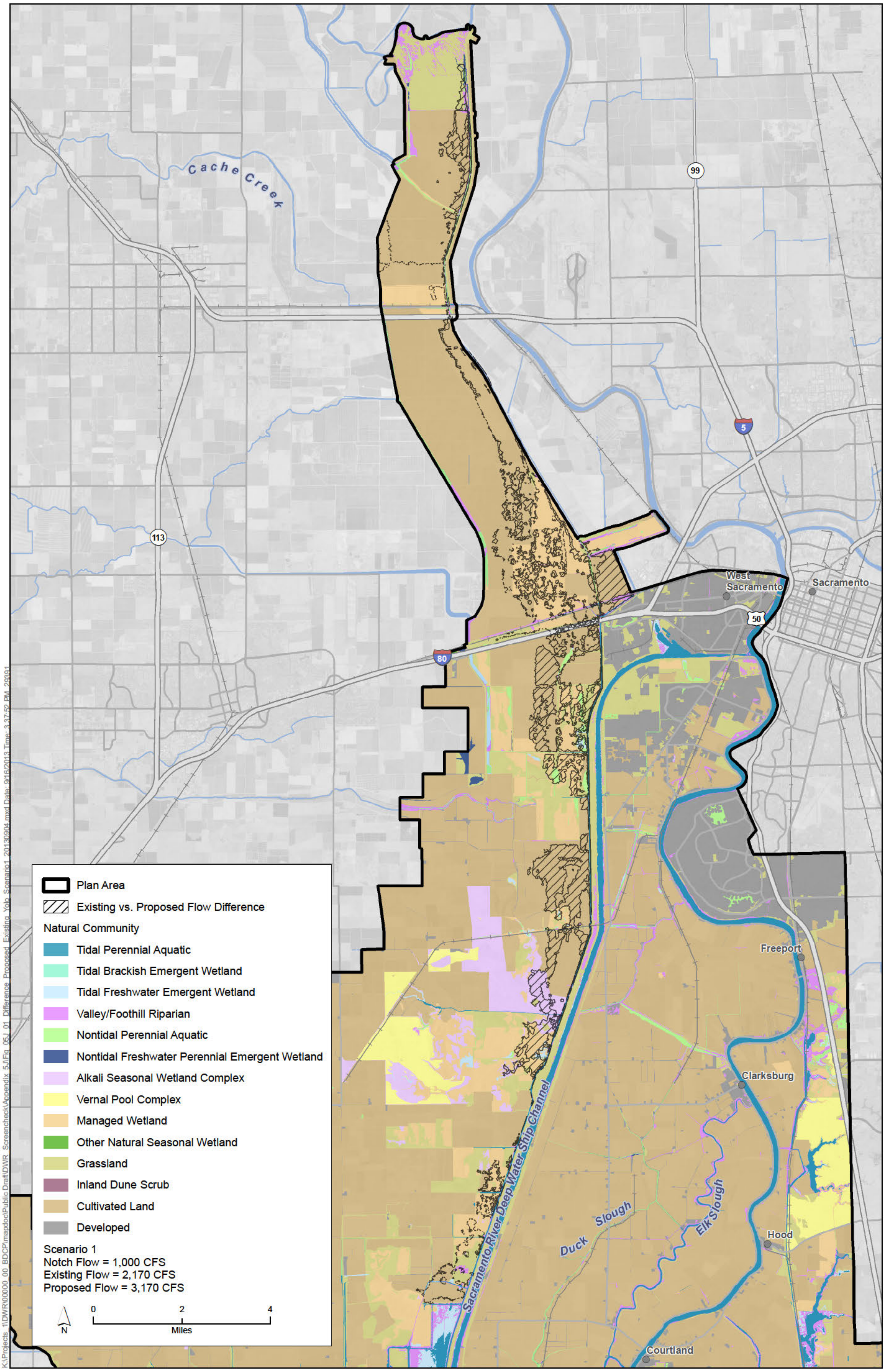
20 Total permanent loss reduced from 372 acres (CM4) to 52 acres. This reduction is based on a 10-acre cap for total loss of wetted acres, assuming 15% density of vernal pools in the area affected. Acreage of vernal pool complex loss may be higher if actual vernal pool density is lower. The maximum acreage loss is based on loss of wetted acres and not total vernal pool complex acreage.

21 To allow for flexibility in implementation and to address uncertainty related to the hypothetical restoration footprints, maximum loss from CM4 has been increased from 4 to 20 acres for brittlescale, 4 to 50 acres for Carquinez goldenbush, and from 1 to 50 acres for delta tule pea and Suisun marsh aster. Maximum loss from CM5 has been increased from 5 to 50 acres for slough thistle.

NHD = National Hydrologic Database; SWP = State Water Project; CVP = Central Valley Project.

5.J.1 Reference

Patterson, Laura. Staff Environmental Scientist, California Department of Water Resources. 2012b. September 11, 2012—Email to Rebecca Sloan detailing methods and results of an analysis to determine percent western pond turtle habitat in the National Hydrologic Dataset (NHD) in the Plan Area.



K:\Projects 1\DWR\00000 00 BDCP\mapdoc\Public Draft\DWR Screencheck\Appendix 5J\Fig 05J 01 Difference Proposed Existing Yolo Scenario1 20130904.mxd Date: 9/16/2013 Time: 3:37:52 PM 29391

Figure 5.J-1
Difference between Proposed and Existing Yolo Bypass Flows: Scenario 1

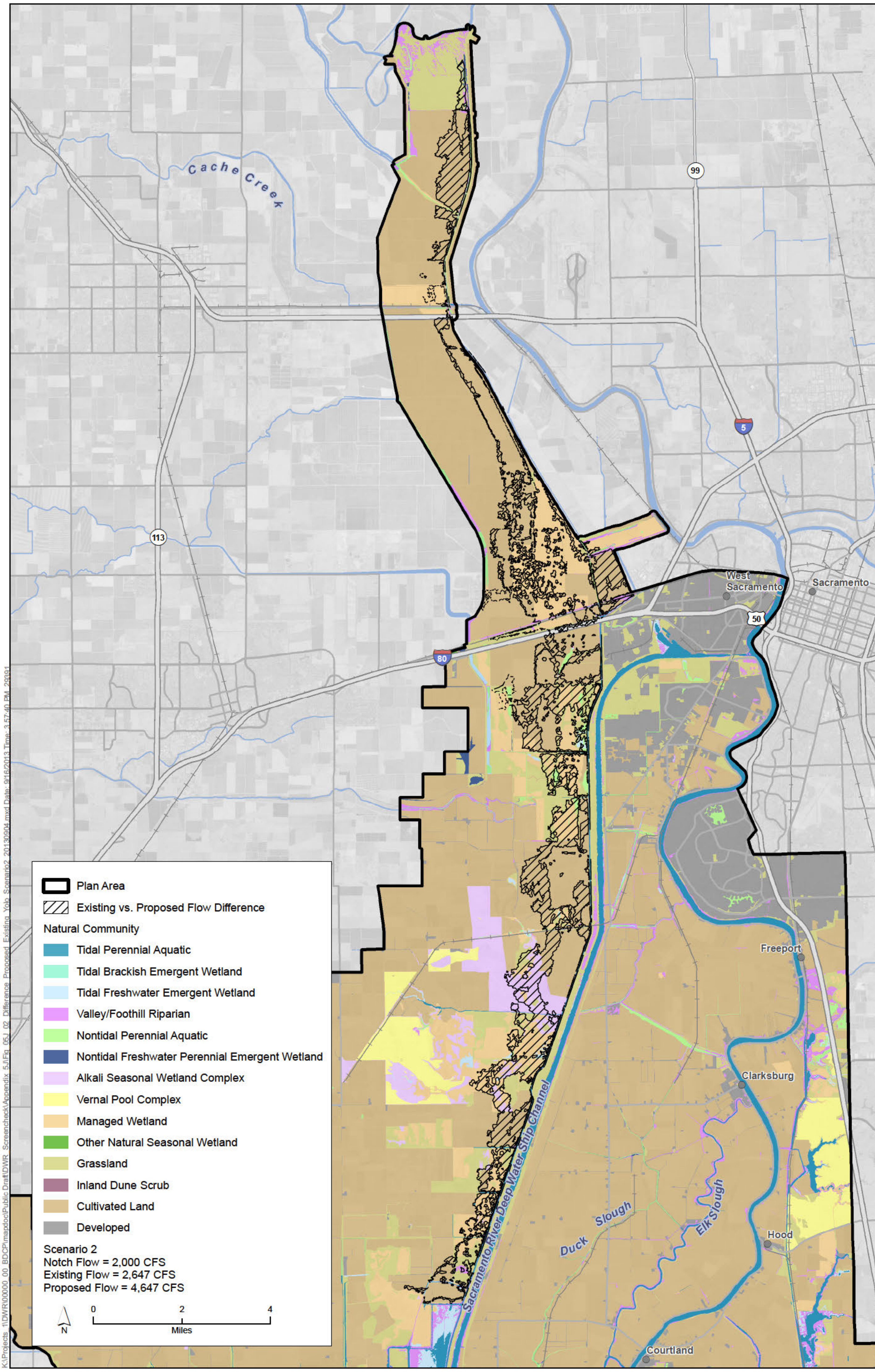
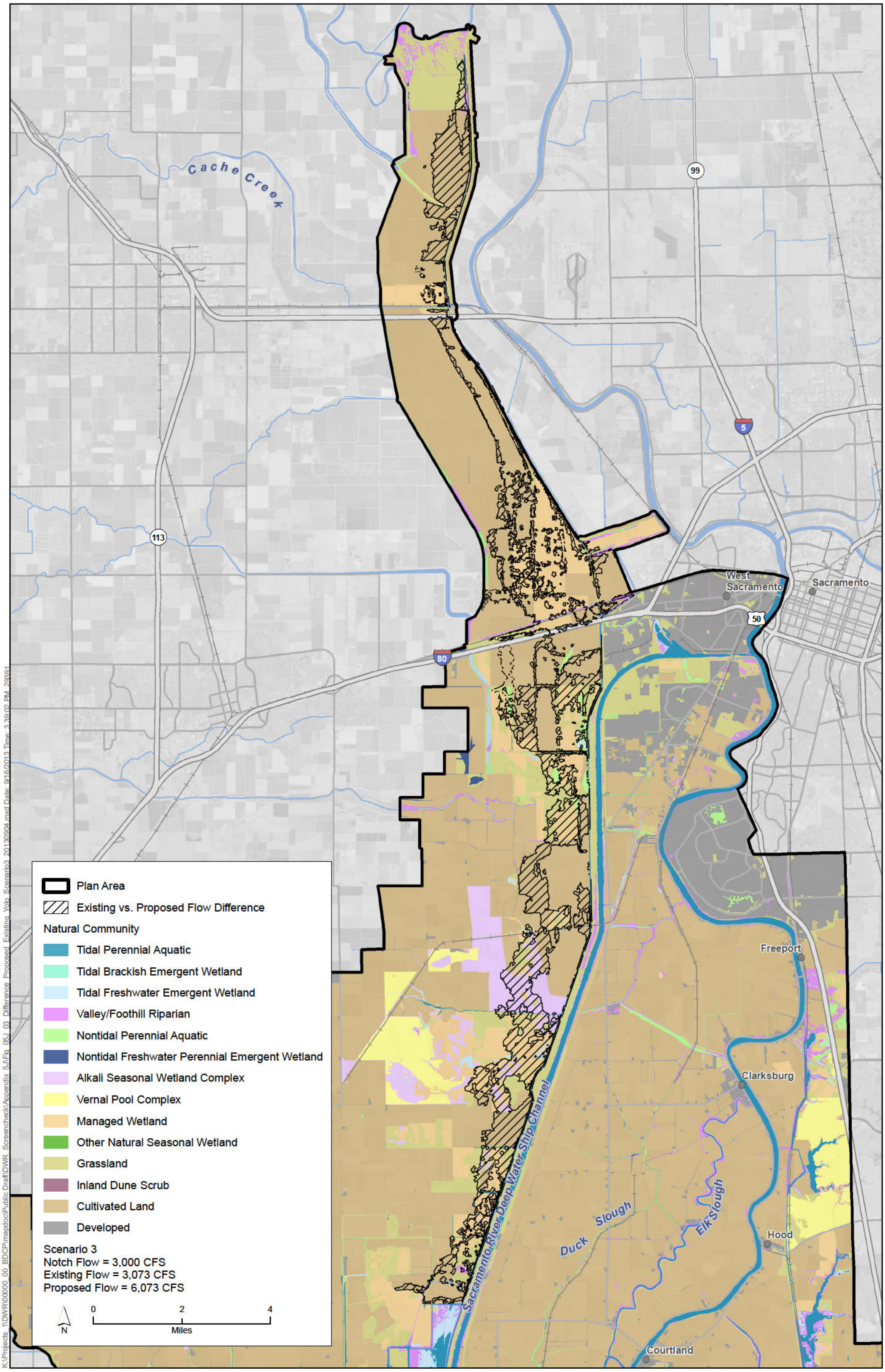


Figure 5.J-2
Difference between Proposed and Existing Yolo Bypass Flows: Scenario 2



K:\Projects_1\DWR\00000_00_BDCP\mapdoc\Public Draft\DWR_Screencheck\Appendix_5J\Fig_05J_03_Difference_Proposed_Existing_Yolo_Scenario3_20130904.mxd Date: 9/16/2013 Time: 3:39:02 PM 29391

Figure 5.J-3
Difference between Proposed and Existing Yolo Bypass Flows: Scenario 3

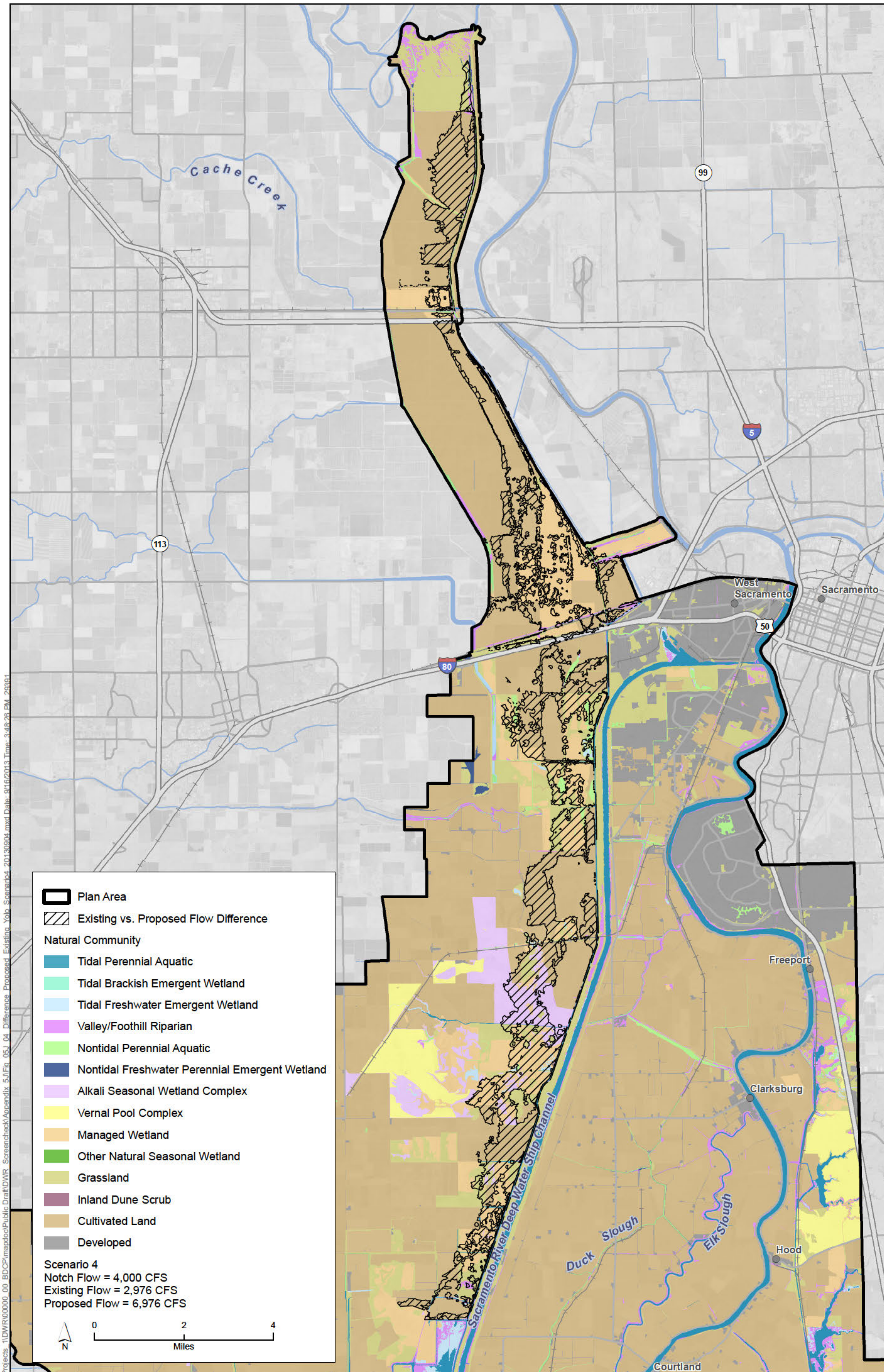


Figure 5.J-4
Difference between Proposed and Existing Yolo Bypass Flows: Scenario 4

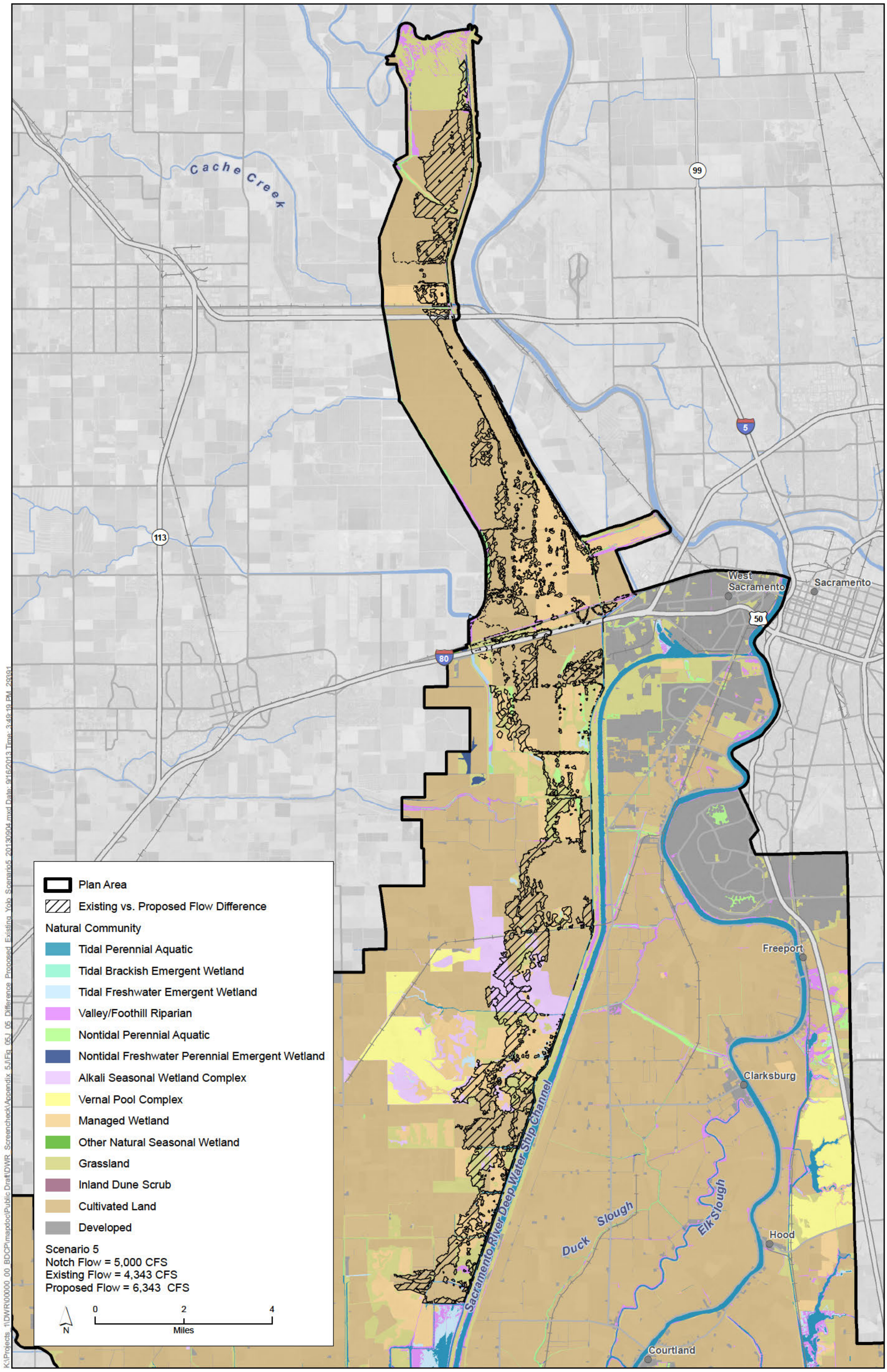
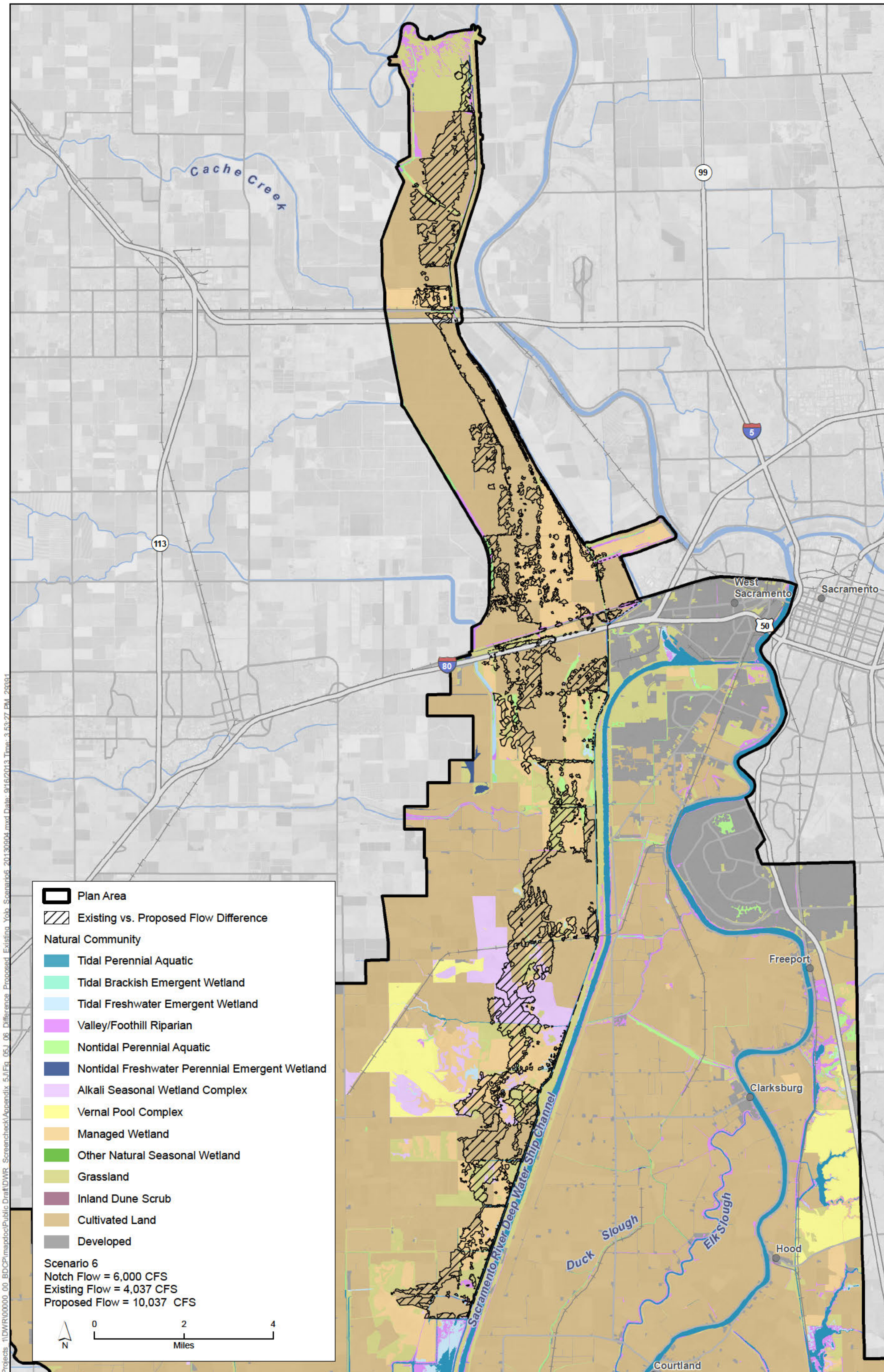
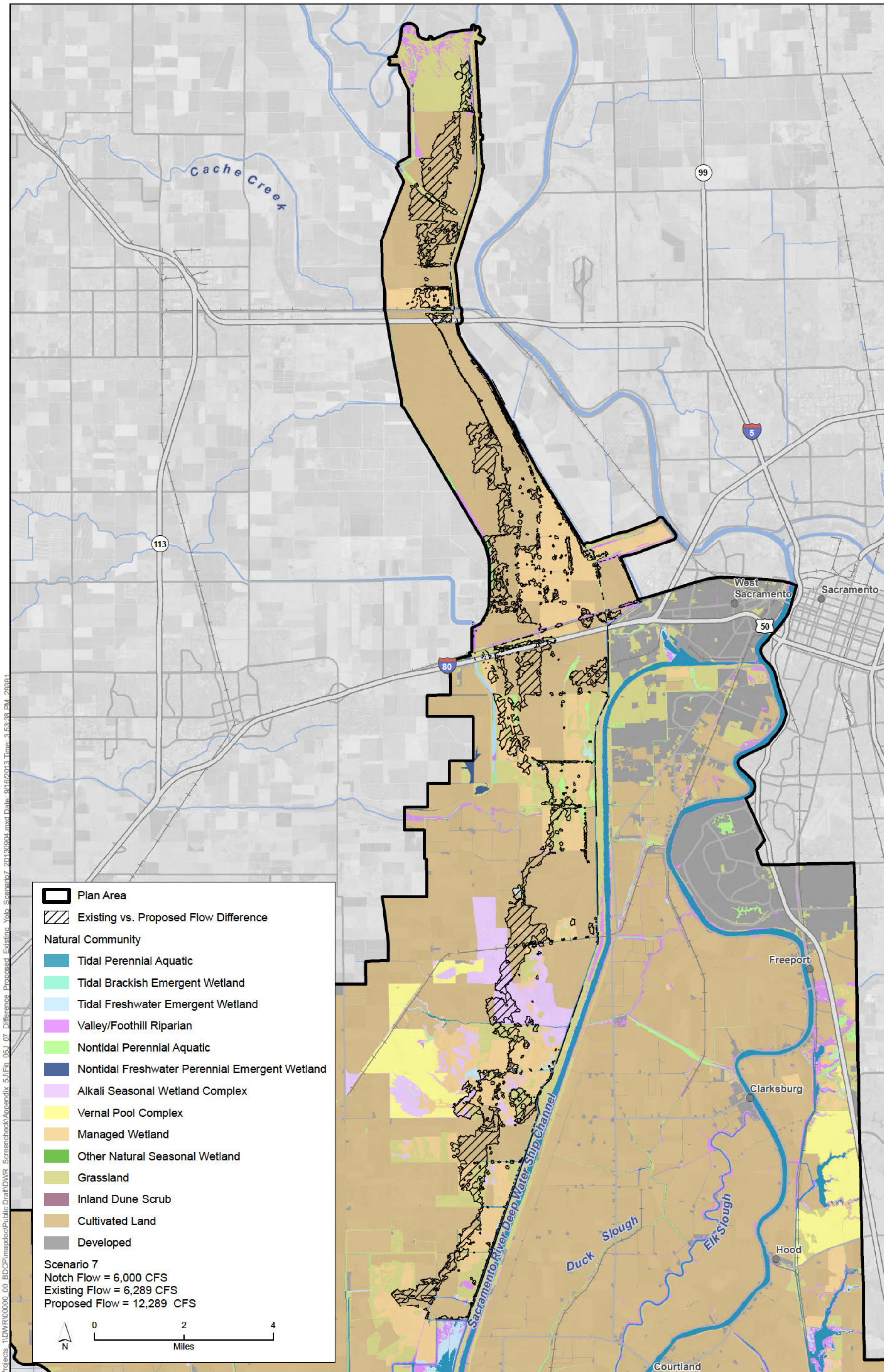


Figure 5.J-5
Difference between Proposed and Existing Yolo Bypass Flows: Scenario 5



K:\Projects_1\DWR\00000_00_BDCP\mapdoc\Public Draft\DWR_Screencheck\Appendix 5.J\Fig_05J_06_Difference_Proposed_Existing_Yolo_Scenario6_20130904.mxd Date: 9/16/2013 Time: 3:53:27 PM 29391

Figure 5.J-6
Difference between Proposed and Existing Yolo Bypass Flows: Scenario 6



K:\Projects_1\DWR\00000_00_BDCP\mapdoc\Public Draft\DWR_Screencheck\Appendix_5J\Fig_05J_07_Difference_Proposed_Existing_Yolo_Scenario7_20130904.mxd Date: 9/16/2013 Time: 3:53:38 PM 29391

Figure 5.J-7
Difference between Proposed and Existing Yolo Bypass Flows: Scenario 7

Attachment 5J.A
Construction-Related Nitrogen Deposition on BDCP Natural Communities

Date:	October 1, 2013
To:	Laura King Moon, Project Manager, BDCP California Department of Water Resources
From:	Paola Bernazzani, M.S., Senior Conservation Biologist, ICF International
Subject:	**Construction-Related Nitrogen Deposition on BDCP Natural Communities**

The primary purpose of this memorandum is to provide context and describe the potential effects of nitrogen deposition from Bay Delta Conservation Plan (BDCP) covered activities with respect to natural communities and associated plants and invertebrates in the Plan Area.

Introduction

BDCP construction activities will require the use of cars, trucks, and machinery that release small amounts of atmospheric nitrogen through the combustion and emissions process associated with motorized vehicles. Emissions will be largely limited to the construction phase of development, which is anticipated to last approximately 9 years. Following combustion, reactive nitrogen is blown downwind and deposited on the landscape, where it acts as a fertilizer (Bay Area Open Space Council 2011) (see Exhibit 1 for details on the nitrogen deposition process). This depositional nitrogen can affect biogeochemical processes and species composition in terrestrial ecosystems, which are largely nitrogen limited (Pardo et al. 2011; Bay Area Open Space Council 2011). Nitrogen can be directly absorbed by plant leaves or taken up by roots through the process of dry deposition, the most common form of deposition in the Central Valley. Increased nitrogen favors nonnative annual grasses and other weeds that crowd out native plants, change fire regimes, and displace rare species adapted to low-nitrogen conditions.

Aquatic natural communities are not addressed in this memo because nitrogen deposition to Delta waters from airborne sources is insignificant compared to other sources of nitrogen; in particular, the ammonium from wastewater discharges and agricultural runoff. High concentrations of ammonium are a concern in the Delta because the ammonium inhibits uptake of nitrate by phytoplankton, contributing to declines in the production of phytoplankton at the base of the Delta's pelagic food web (Wilkerson et al. 2006; Dugdale et al. 2007; Glibert et al. 2011) (Chapter 3, Section 3.5, *Important Regional Actions*, and Appendix 5.F, *Biological Stressors on Covered Fish*).

In California, there are several terrestrial natural communities known to be susceptible to the biological effects of nitrogen deposition, including coastal sage scrub, desert scrub, and serpentine grassland (Weiss 2006). Although the Plan Area does not contain any "susceptible" natural communities, the following natural communities in the Plan Area may be sensitive to nitrogen deposition (Figure 1) (Weiss 2006).

- Grasslands
- Vernal pools (includes vernal pools and alkali seasonal wetlands)
- Salt marsh (tidal brackish emergent wetland)
- Freshwater marsh (tidal freshwater emergent wetland)

The effects of nitrogen deposition on nonserpentine annual grasslands are similar to those on serpentine grasslands, with increased nonnative, invasive plants displacing native grasses and herbs. In addition, vernal pools and alkali seasonal wetlands appear to be particularly vulnerable to overgrowth and invasion by nonnative, annual plants (Marty 2005). Weeds such as yellow starthistle react positively to increased nitrogen availability because they have high growth potential and can rapidly respond to increased nutrient levels. In general, salt and freshwater marsh communities are nitrogen limited, and adding nitrogen could shift plant composition by affecting plant productivity.

The covered activities that may deposit nitrogen, the potential effects on vulnerable communities in the Plan Area, and the context for understanding the effects of nitrogen deposition from covered activities are discussed below.

Covered Activities

Construction activities use trucks and other mechanized equipment that release atmospheric nitrogen via fossil-fuel combustion. These activities will include the construction of the conveyance facilities and restoration sites and associated operations and maintenance. The water conveyance facilities will be constructed with three intakes located at the northern end of the Sacramento–San Joaquin River Delta (Delta) with a transmission line to deliver power to the project. Construction is scheduled to be completed in phases between 2016 and 2024. Construction-related nitrogen emissions will originate primarily from construction equipment and employee vehicle exhaust and concrete batching from onsite plants. The highest levels of nitrogen emissions are expected at utility and construction sites along the tunnel conveyance alignment. These emissions will be temporary and will cease when construction activities are completed.

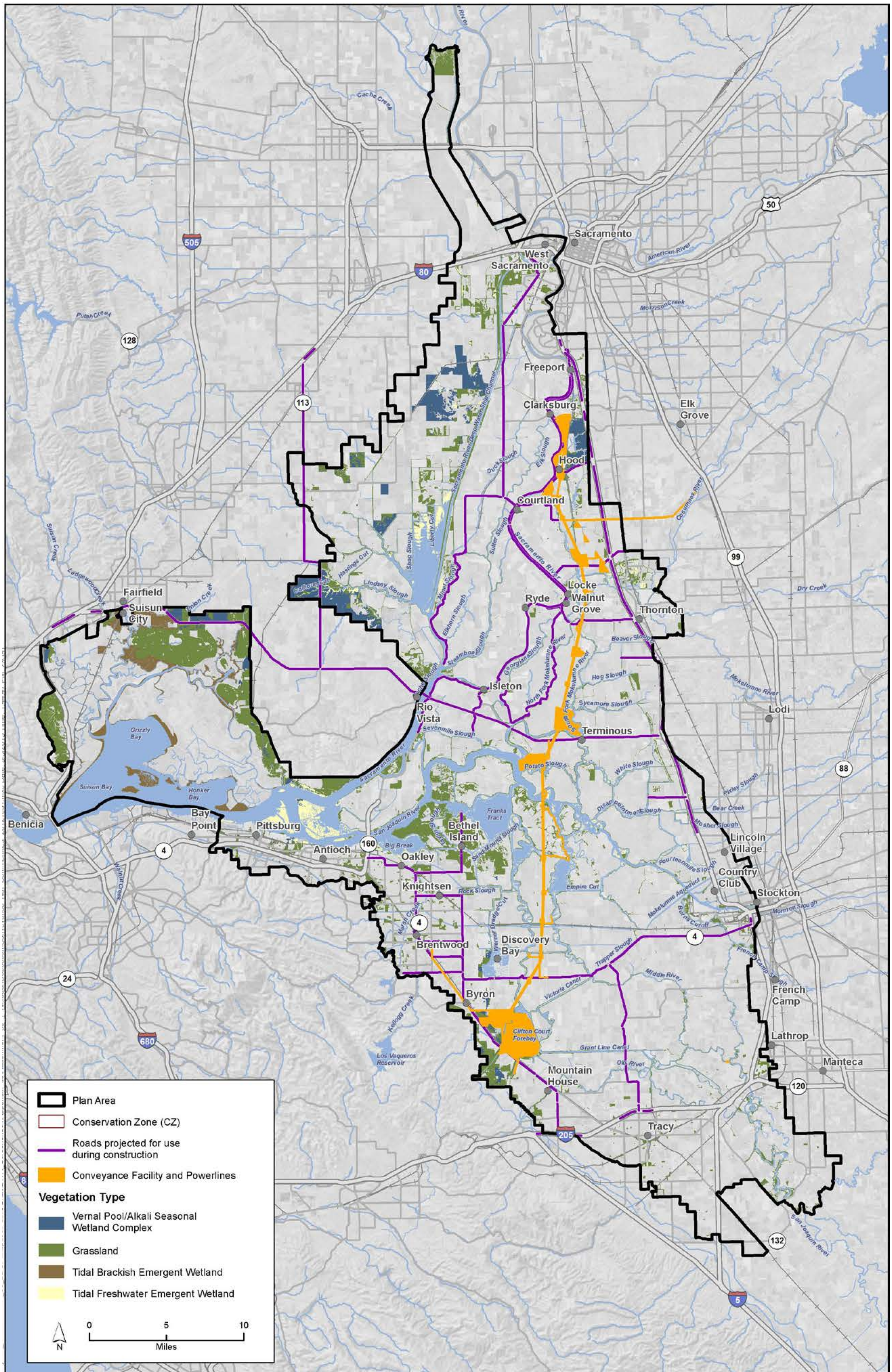


Figure 1. Potential BDCP Sources of Nitrogen and Natural Communities that May Be Sensitive to Effects of Nitrogen Deposition

Restoration activities under *CM2 Yolo Bypass Fisheries Enhancement, 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 Complex Restoration,* and *CM10 Nontidal Marsh Restoration* require the use of construction equipment and would also generate small amounts of atmospheric nitrogen. Emissions would result from temporary earth-moving activities that require the use of heavy equipment and from ongoing restoration or monitoring activities that result in additional traffic on roads and highways in and around Suisun Marsh and the Yolo Bypass. The amount of emissions from these activities will be negligible, and emissions resulting from restoration activities were not modeled as part of the air quality analysis.

In addition, operations and maintenance activities could result in nitrogen emissions originating from vehicle and maintenance equipment exhaust and electrical generation. In general, future emissions are anticipated to decrease because of continuing improvements in vehicle and equipment engine technology. Operations and maintenance activities and construction at restoration sites would contribute a negligible amount of nitrogen relative to construction of conveyance facilities and other ongoing sources of nitrogen in the Central Valley (see *Baseline Conditions* section). For discussion purposes, this memo focuses on emissions from conveyance facilities construction.

Baseline Conditions

In 2002, modeling of nitrogen deposition in California estimated deposition rates of up to 15 kilograms nitrogen (kg-N)/hectare (ha)/year (yr) (81.7 pounds nitrogen (lbs-N)/acre/yr) from urban and agricultural sources. The Central Valley is recognized as a hotspot of nitrogen deposition, with deposition values in the Plan Area ranging from 2.1 to 10 kg-N/ha/yr (11.4 to 54.5 lbs/acre/yr). The southern portion of the Sacramento Valley received 6 to 8 kg-N/ha/yr (32.7 to 43.6 lbs/acre/yr). Areas around Modesto (near but outside the Plan Area) received up to 14 kg-N/ha/yr (76.3 lbs/acre/yr), and in the Bay Area the maximum deposition was 9 kg-N/ha/yr (76.3 lbs/acre/yr) (Weiss 2006).

Nitrogen deposition above 5 kg-N/ha/yr (27.2 lbs/acre/yr) is known to result in exotic grass invasion on serpentine soils, and similar effects are expected for other annual grassland ecosystems and vernal pools in California (Weiss 2006; Fenn et al. 2010). Based on these analyses, current sources of nitrogen have already exceeded these thresholds in and around the Plan Area.

Deposition studies have not been done with respect to future emissions for the BDCP or for the Plan Area *per se*. However, the *California Almanac of Emissions and Air Quality* (2009) provides current and future values for the average annual emissions of the three air quality districts (Table 1) that overlap with the proposed conveyance facilities under Alternative (Figure 2).

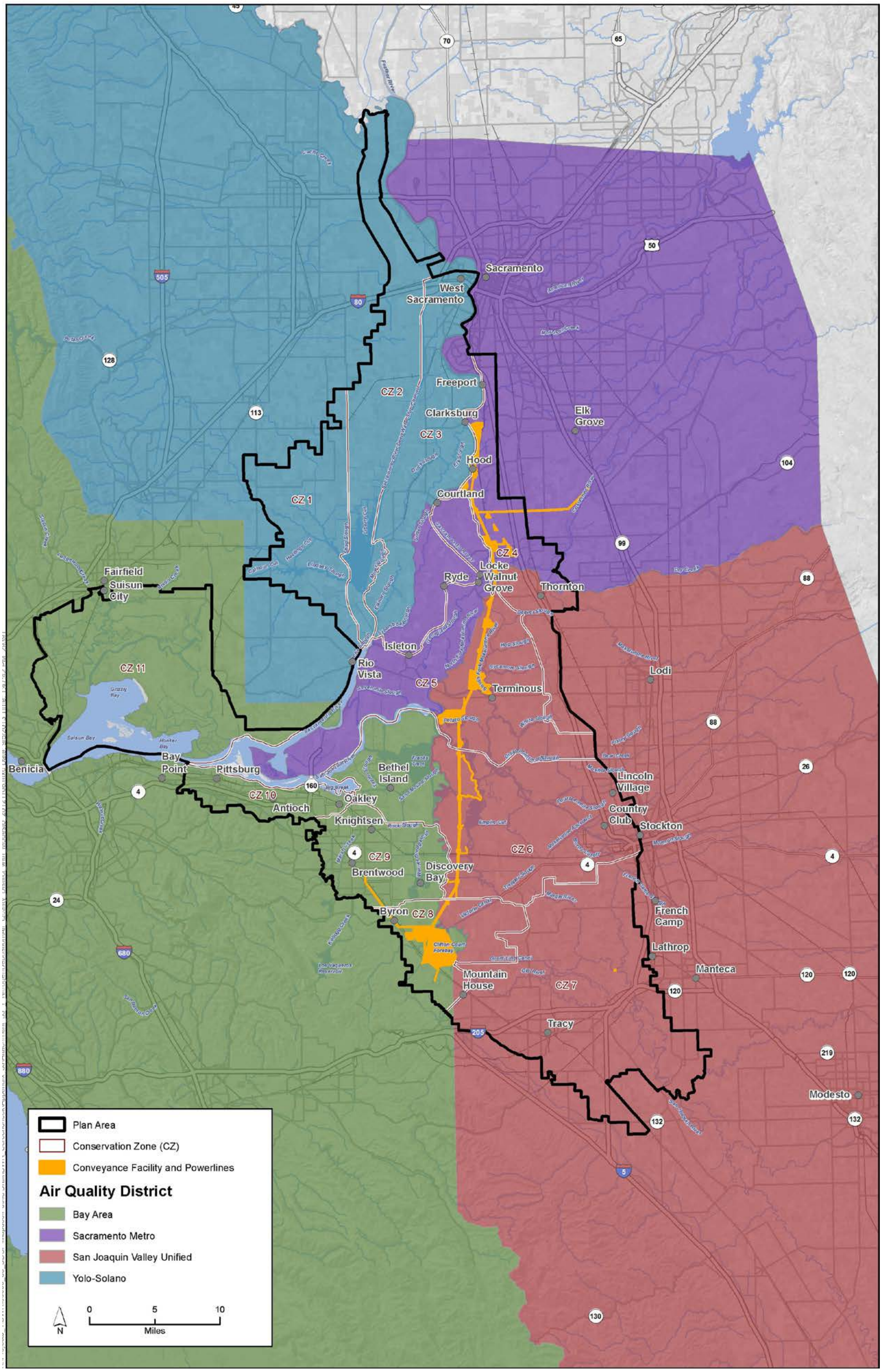


Figure 2. Air Quality Districts in Plan Area

Table 1. Previous and Estimated Future Nitrogen Oxide Emissions

Year	Nitrogen Oxide Annual Average Emissions (tons/day) By Air Quality District		
	Bay Area	Sacramento	San Joaquin
2005	488	292	595
2010	414	249	524
2015	335	198	398
2020	284	161	316
Source: California Environmental Protection Agency 2009.			

As mentioned above, there are four land cover types identified by Weiss (2006) as potentially vulnerable in the Plan Area: vernal pools, grasslands, saltwater marsh (tidal brackish emergent wetland) and freshwater marsh (tidal freshwater emergent wetland). The Plan Area supports an estimated 8,547 acres of vernal pools, 78,624 acres of grasslands, 8,501 acres of tidal brackish wetlands, and 8,953 acres of freshwater emergent wetlands. The location of these natural communities is mapped in relation to the proposed conveyance facilities, powerlines, and primary access routes for construction vehicles (Figure 1). The potential effects of deposition on these natural communities from construction of conveyance facilities is discussed below.

Potential Effects

Natural Communities and Species in the Plan Area

Generally, invasive nonnative plants may compete with native plants for water, nutrients, light, and germination sites, and invasive plants are considered a threat to most of the covered plant species. Perennial pepperweed (*Lepidium latifolium*) is a specific threat to soft bird's-beak (*Chloropyron molle* subsp. *molle*) and Suisun thistle (*Cirsium hydrophilum* var. *hydrophilum*). Perennial ryegrass (*Festuca perennis*, formerly *Lolium perenne*) invades seasonally moist grasslands, seasonal wetlands, and vernal pools, and is a threat to legenere (*Legenere limosa*), alkali milk-vetch (*Astragalus tener* var*. tener*), and other covered plants of these habitats. The invasive aquatic plant water hyacinth (*Eichhornia crassipes*), which forms large mats of floating vegetation, is a specific threat to Mason's lilaeopsis (Zebell and Fiedler 1996). The potential effects of nitrogen deposition are described by natural community type below.

Vernal Pools

Small, annual plants in vernal pools and alkali seasonal wetlands are susceptible to overgrowth by invasive grasses, which can shorten hydroperiods and place associated species at risk (Marty 2005). Annual grass invasions in vernal pools have been documented in the Sacramento Valley (Gerhardt and Collinge 2003) and may be a major threat to ungrazed vernal pools (Marty 2005). Given the responses of annual grasses to additional nitrogen, the intensity of annual grass invasions in vernal pools and alkali seasonal wetlands may increase as the result of increased nitrogen deposition in the Plan Area. Covered plants and invertebrates in vernal pool habitats include the conservancy fairy shrimp (*Branchinecta conservatio*), vernal pool tadpole shrimp (*Lepidurus packardi*), longhorn fairy shrimp (*Branchinecta longiantenna*), vernal pool fairy shrimp (*Branchinecta lynchi*), California linderiella (*Linderiella occidentalis*), midvalley fairy shrimp (*Branchinecta mesovallensis*), alkali milk-vetch (*Astragalus tener* var*. tener),* Boggs Lake hedge-hyssop (*Gratiola heterosepala),* delta button celery (*Eryngium racemosum),* dwarf downingia (*Downingia pusilla),* Heckard's peppergrass (*Lepidium latipes* var. *heckardii*), brittlescale (*Atriplex depressa*), heartscale (*Atriplex cordulata*), San Joaquin spearscale (*Atriplex joaquiniana*), and legenere (*Legenere limosa*).

Annual Grasslands

Although California grasslands are dominated by invasive annual grasses, they do support wildflower and native bunchgrass grassland concentrations. Increased levels of nitrogen deposition can stimulate annual grass growth, thus further adversely affecting these native concentrations, particularly in areas where the soils are nutrient poor, such as on rocky outcrops or steep slopes (Weiss 2006).

Tidal Brackish Emergent Wetlands

Productivity in salt marshes (tidal brackish emergent wetland) is limited by nitrogen (Morris 1991). While salt marshes are major sites for denitrification, additional inputs of nitrogen may exceed the capacity of salt marshes to remove nitrogen from the system and could subsequently alter species assemblages associated with this natural community type. Many salt marshes are already subject to elevated nitrogen due to sewage effluent and agricultural runoff, and, while the direct effects of atmospheric nitrogen deposition on California salt marshes have not been assessed, additional inputs of nitrogen are likely to exacerbate issues associated with invasive plants. Covered plants in tidal brackish habitats include the Suisun thistle (*Cirsium hydrophilum* var. *hydrophilum*), soft bird's beak (*Cordylanthus mollis* ssp. *mollis*), Suisun Marsh aster (*Symphyotrichum lentum*), Delta tule pea (*Lathyrus jepsonii* var. *jepsonii),* Mason's lilaeopsis (*Lilaeopsis masonii*), and delta mudwort (*Limosella subulata*).

Tidal Freshwater Emergent Wetlands

Productivity in freshwater marshes (tidal freshwater emergent wetlands) may be limited by nitrogen (Morris 1991). Because of anoxic conditions and an abundance of organic matter, freshwater marshes, like salt marshes described above, remove nitrogen from the system and may be altered by an abundance of nitrogen. Covered plants in freshwater emergent wetland habitats include the Suisun Marsh aster (*Symphyotrichum lentum*), Delta tule pea (*Lathyrus jepsonii* var. *jepsonii),* Mason's lilaeopsis (*Lilaeopsis masonii*), and delta mudwort (*Limosella subulata).*

Analysis and Discussion

Maximum daily emissions associated with covered activities are presented in Chapter 22 of the Draft BDCP environmental impact report/environmental impact statement (EIR/EIS) (California

Department of Water Resources et al. 2012) for the three air quality districts that overlap with the conveyance facilities in Alterative 4. Results (originally in pounds/day) were converted to tons/day and are summarized in Table 2.

Table 2. Projected Maximum Daily Nitrogen Oxide Emissions from Construction of Conveyance Facilities

Year	Maximum Daily Nitrogen Oxide Emissions (tons/day) By Air Quality District		
	Bay Area	Sacramento	San Joaquin
Source: Draft BDCP EIR/EIS Chapter 22, Table 22-86, for Alternative 4 (converted from pounds/day to tons/day) (California Department of Water Resources et al. 2012)			

The projected total nitrogen emissions (Table 1) are compared to projected nitrogen emissions from covered activities (Table 2) to quantify the relative contribution of covered activities to estimated regional emissions of nitrogen.

Table 3 lists the BDCP contribution by percentage for the three air quality districts that overlap with the proposed conveyance facilities. Results are given for the years 2015/2016 and 2020[1]. In all cases, the BDCP contribution of nitrogen deposition to the estimated annual average total is less than 0.2%, with concentrations in most basins less than 0.08%.

Table 3. Projected Annual Average Nitrogen Emissions from the BDCP as a Percentage of Total Projected Emissions, by Air Quality District

Year	Percentage BDCP Emissions		
	Bay Area	Sacramento	San Joaquin
2015/2016	0.002	0.074	0.024
2020	0.164	0.122	0.041
Sources: California Department of Water Resources et al. 2012 (Chapter 22, Table 22-86, for Alternative 4). California Environmental Protection Agency, Air Resources Board 2009.			

In addition, there is a considerable distance between covered activities that will temporarily emit nitrogen and most covered natural communities potentially sensitive to nitrogen (Figure 1 and Table 4). Furthermore, the direction of the prevailing winds is west to east (Western Regional Climate Center 2012). With most grasslands, vernal pools, and marshes in the Plan Area lying west of the conveyance facilities, most emissions will be transported away from areas of potential concern. The exception is the Stone Lakes Wildlife Refuge complex, located east of the conveyance facilities and discussed further below.

[1] The only year that specifically overlaps both the BDCP emissions analysis and the *California Almanac of Emissions and Air Quality* value is 2020. The years 2015 (California Environmental Protection Agency, Air Resources Board. 2009) and 2016 (BDCP Draft EIR/EIS [California Department of Water Resources et al. 2012) were also compared, since the BDCP projections begin year 2016 (not 2015).

Table 4. Communities that May be Sensitive to Nitrogen Deposition within 5 Kilometers of Proposed Conveyance Facilities

Natural Community Type	Acres	Percent of Total
Vernal pools (includes alkali seasonal wetlands)	1,770	14
Annual grassland	16,716	21
Tidal brackish emergent wetlands	0	0
Tidal freshwater emergent wetlands	1,684	19

With respect to potential effects on natural communities, the following observations are made.

- In the Plan Area, the grassland natural community is often found adjacent to wetland and riparian natural communities. As indicated in Figure 1 and Table 4, most of this community in the Plan Area is over 5 kilometers from emissions locations and west of the proposed facilities. The Byron Hills Area is directly adjacent to proposed construction at the southern end of the facilities. Significant grassland areas that include vernal pools and alkali seasonal wetlands are located here. Temporary nitrogen deposition resulting from construction could affect grasslands in the Byron Hills. However, prevailing winds in this area will likely blow most deposition away from grasslands in that area. Also, the Byron Hills area is a target for acquisition and management, including weed management through grazing, which will likely offset any effects of increased deposition.
- The vernal pool complex, including alkali seasonal wetlands, and associated grasslands are rare in the Plan Area and generally found only in a few locations along the margins of the Plan Area, including the Stone Lakes National Wildlife Refuge, adjacent to and east of proposed construction of conveyance facilities. The North Stone Lake unit of the Stone Lake Wildlife Refuge contains one of the only remaining undeveloped grassland units in the eastern Delta region (U.S. Fish and Wildlife Service 2007), as well as large complexes of vernal pools. Based on proximity to the facilities and its location downwind of construction, this area could be affected by the temporary increases in nitrogen deposition associated with conveyance construction. However, weed control and targeted grazing in the refuge are anticipated to control invasive plants, which might proliferate in an ungrazed system. Grazing throughout the refuge is conducted from November through June to reduce competition between vernal pool plants and nonnative species such as annual ryegrass and yellow starthistle, in accordance with the *Stone Lake Comprehensive Conservation Plan* (U.S. Fish and Wildlife Service 2007).
- Remnant patches of tidal brackish and freshwater emergent wetland natural community are found in the western portion of the Delta. Small patches of tidal brackish marshes are found on islands west of Sherman Island and in Suisun Marsh. Freshwater emergent wetlands are found near the confluence of the Sacramento and San Joaquin Rivers, along Lindsey Slough and the Yolo Bypass, along the mainstem and several channels of the San Joaquin, Old, and Middle Rivers, Lost Slough, and the area where the Cosumnes and Mokelumne Rivers join the Delta. Most of these areas are from 5 to 20 kilometers west of the proposed conveyance facilities and powerlines and are unlikely to experience significant negative effects from temporary, construction-related nitrogen deposition.

Conclusions

Nitrogen emissions from covered activities will not negatively affect natural communities and covered species in the Plan Area for the following reasons.

- The covered activities will make a negligible contribution to projected emissions in the region (less than 0.2%).
- The construction activities will be temporary (less than 9 years).
- There is a substantial distance between the nitrogen sources and potentially sensitive communities.
- Nitrogen emissions will be transported away from most sensitive communities in the Plan Area because of prevailing wind conditions.
- In the grassland and vernal pool natural community portion of the Stone Lakes Wildlife Refuge, where negative effects are most likely to occur, a weed control and grazing plan are already in place.

Moreover, planned management of the BDCP reserve system (*CM11 Natural Communities Enhancement and Management*), which includes invasive vegetation control measures, is expected to minimize the potential adverse effects of nitrogen deposition on protected grasslands, vernal pools, and marshes in the Plan Area.

References Cited

Bay Area Open Space Council. 2011. *The Conservation Lands Network: San Francisco Bay Area Upland Habitat Goals Project Report.* Berkeley, CA

California Department of Water Resources, Bureau of Reclamation, U.S. Fish and Wildlife Service, and National Marine Fisheries Service. 2012. *Environmental Impact Report/Environmental Impact Statement for the Bay Delta Conservation Plan.* Prepared by ICF International. Sacramento, CA. February.

California Environmental Protection Agency, Air Resources Board. 2009. *California Almanac of Emissions and Air Quality.* Air Resources Board. Last revised: January 14, 2010. Available: <http://www.arb.ca.gov/aqd/almanac/almanac09/almanac09.htm>.

Dugdale, R. C., F. P. Wilkerson, V. E. Hogue, and A. Marchi. 2007. The Role of Ammonium and Nitrate In Spring Bloom Development in San Francisco Bay. *Estuarine, Coastal, and Shelf Science* 73:17–29.

Fenn, M. E., E. B. Allen, S. B. Weiss, S. Jovan, L. H. Geiser, G. S. Tonnesen, R. F. Johnson, L. E. Rao, B. S. Gimeno, F. Yuan, T. Meixner, and A. Bytnerowicz. 2010. Nitrogen Critical Loads and Management Alternatives for N-Impacted Ecosystems in California. *Journal of Environmental Management* 91:2402–2423.

Fenn, M. E., J. S. Baron, E. B. Allen, H. M. Rueth, K. R. Nydick, L. Geiser, W. D. Bowman, J. O. Sickman, T. Meixner, D. W. Johnson, and P. Neitlich. 2003. Ecological Effects of Nitrogen Deposition in the Western United States. *Bioscience* 53:404–420.

Fenn M. E., M. A. Poth,, J. D. Aber, J. S. Baron, B. T. Bormann, D. W. Johnson, A. D. Lemly, S. G. McNulty, D. F. Ryan, and R. Stottlemyer. 1998. Nitrogen Excess in North American Ecosystem: Predisposing Factors, Ecosystem Responses, and Management Strategies. *Ecological Applications* 8:706–733.

Galloway, J. N., J. D. Aber, J. W. Erisman, S. P. Seitzinger, R. W. Howarth, E. B. Cowling, and B. J. Cosby. 2003. The Nitrogen Cascade. *BioScience* 53:341–356.

Gerhardt, F. and S. K. Collinge. 2003. Exotic Plant Invasions of Vernal Pools in the Central Valley of California, USA. *Journal of Biogeography* 30(7): 1043–1052.

Glibert, P. M., D. Fullerton, J. M. Burkholder, J. C. Cornwell, and T. M. Kana. 2011. Ecological Stoichiometry, Biogeochemical Cycling, Invasive Species and Aquatic Food Webs: San Francisco Estuary and Comparative Systems. *Reviews in Fisheries Science* 19:358–417.

Marty, J. 2005. Effects of Cattle Grazing on Diversity in Ephemeral Wetlands. *Conservation Biology* 19:1626–1632.

Matson, P. K., A. Lohse, et al. 2002. The Globalization of Nitrogen Deposition: Consequences for Terrestrial Ecosystems. *AMBIO: A Journal of the Human Environment* 31(2): 113–119.

Morris, J. T. 1991. Effects of Nitrogen Loading on Wetland Ecosystems with Particular Reference to Atmospheric Deposition. *Annual Review of Ecology and Systematics* 22: 257–279.

Pardo, L. H., M. J. Robin-Abbott, and C. T. Driscoll (eds.). 2011. *Assessment of Nitrogen Deposition Effects and Empirical Critical Loads of Nitrogen for Ecoregions of the United States*. U.S. Department of Agriculture, Forest Service, Northern Research Station, General Technical Report NRS-80.

U.S. Fish and Wildlife Service. 2007. *Stone Lakes National Wildlife Refuge Comprehensive Conservation Plan.* January. USFWS California Nevada Operations Refuge Planning Office, Sacramento, CA, and Stone Lakes National Wildlife Refuge, Elk Grove, CA. Available: <http://www.fws.gov/stonelakes/SL%20CCP%20Final%20main%20body.pdf>. Accessed: November 2012.

Weiss, S. B. 2006. *Impacts of Nitrogen Deposition on California Ecosystems and Biodiversity*. California Energy Commission, PIER Energy-Related Environmental Research. CEC-500-2005-165.

Western Regional Climate Center. 2012: *Prevailing Wind Direction.* Available: <http://www.wrcc.dri.edu/htmlfiles/westwinddir.html>. Accessed: November 2012.

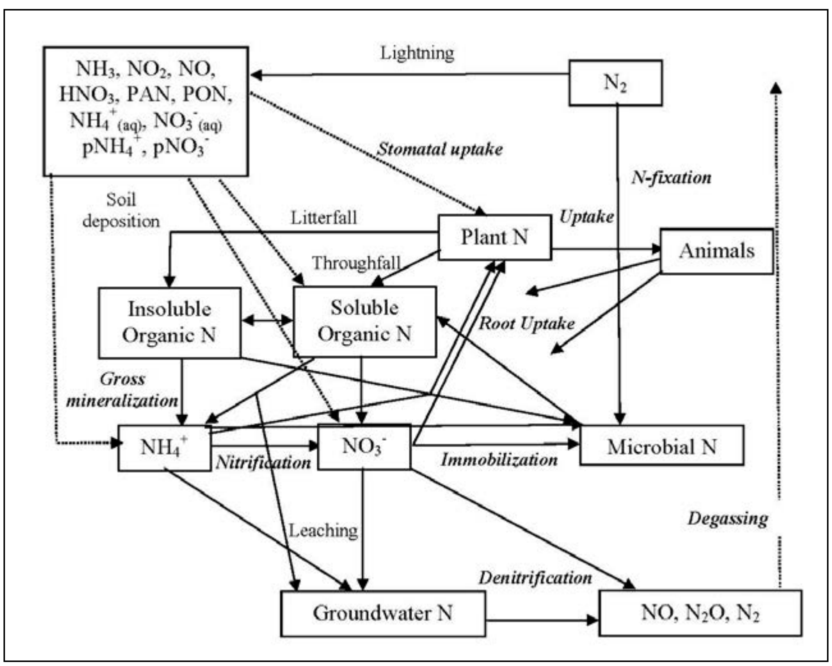
Wilkerson, F. P., R. C. Dugdale, V. E. Hogue, and A. Marchi. 2006. Phytoplankton Blooms and Nitrogen Productivity in San Francisco Estuary. *Estuaries and Coasts* 29: 401–416.

Zebell, R. and P. Fiedler. 1996. *Restoration and Recovery of Mason's lilaeopsis: Phase II.* Final Report to the California Department of Fish and Game, Plant Conservation Program.

Exhibit 1
N-Deposition Pathway

Most of the nitrogen in the atmosphere is in the form of the inert nitrogen gas, dinitrogen (N_2). The primary emissions of nitrogen from anthropogenic sources are nitrogen oxide (NO) and nitrogen dioxide (NO_2), collectively referred to as nitrogen oxides (NO_X). Chemical processes in the atmosphere convert NO and NO_2 to other forms of nitrogen. Of particular interest is the formation of nitric acid (HNO_3), which reacts with ammonia in the atmosphere to form ammonium nitrate, which is biologically available nitrogen deposited to the ground (Matson et al. 2002). In a process known as nitrification, soil microbes oxidize the ammonium (NH_4^+) in ammonium nitrate to produce nitrite (NO_2^-), which is metabolized further to produce nitrate (NO_3^-), the form of nitrogen assimilated by plants. Denitrifying bacteria convert nitrate back to nitrogen gas, providing a pathway for nitrogen cycling back to the atmosphere.

Studies have shown a range of ecosystem responses to elevated inputs of nitrogen from atmospheric deposition, with particular responses depending on multiple, interacting factors such as climate, land use, the ecosystem's current nitrogen status, and the extent and level of nitrogen additions (Fenn et al. 1998; Matson et al. 2002; Fenn et al. 2003; Pardo et al. 2011). For example, nitrogen-poor ecosystems like grasslands tend to accumulate additional nitrogen, while wetlands have a high capacity for removing nitrogen through denitrification (Galloway et al. 2003).



Note: Biological processes are labeled in bold italics, and the lighter arrows show deposition pathways.

Source: Figure 1 from Weiss 2006.

Figure A. Simplified Nitrogen Cycle

Exhibit 1 References Cited

Fenn, M. E., J. S. Baron, E. B. Allen, H. M. Rueth, K. R. Nydick, L. Geiser, W. D. Bowman, J. O. Sickman, T. Meixner, D. W. Johnson, and P. Neitlich. 2003. Ecological Effects of Nitrogen Deposition in the Western United States. *Bioscience* 53:404–420.

Fenn M. E., M. A. Poth,, J. D. Aber, J. S. Baron, B. T. Bormann, D. W. Johnson, A. D. Lemly, S. G. McNulty, D. F. Ryan, and R. Stottlemyer. 1998. Nitrogen Excess in North American Ecosystem: Predisposing Factors, Ecosystem Responses, and Management Strategies. *Ecological Applications* 8:706–733.

Galloway, J. N., J. D. Aber, J. W. Erisman, S. P. Seitzinger, R. W. Howarth, E. B. Cowling, and B. J. Cosby. 2003. The Nitrogen Cascade. *BioScience* 53:341–356.

Matson, P. K., A. Lohse, et al. 2002. The Globalization of Nitrogen Deposition: Consequences for Terrestrial Ecosystems. *AMBIO: A Journal of the Human Environment* 31(2): 113–119.

Pardo, L. H., M. J. Robin-Abbott, and C. T. Driscoll (eds.). 2011. *Assessment of Nitrogen Deposition Effects and Empirical Critical Loads of Nitrogen for Ecoregions of the United States*. U.S. Department of Agriculture, Forest Service, Northern Research Station, General Technical Report NRS-80.

Weiss, S. B. 2006. *Impacts of Nitrogen Deposition on California Ecosystems and Biodiversity*. California Energy Commission, PIER Energy-Related Environmental Research. CEC-500-2005-165. Appendix B is available from: <www.energy.ca.gov/.../CEC-500.../CEC-500-2005-165-APB.XLS>.

Attachment 5J.B
Natural Community Restoration and Protection Contributing to Covered Species Conservation

Attachment 5J.B

Natural Community Restoration and Protection Contributing to Covered Species Conservation

Contents

Tables

Attachment 5J.B
Natural Community Restoration and Protection Contributing to Covered Species Conservation

The biological goals and objectives have been designed to provide species conservation through the protection and restoration of the natural communities on which those species depend. Planning at the natural community scale benefits species by protecting ecosystem processes that maintain species' habitat and by preserving connectivity between species' habitat types (e.g., between foraging and breeding habitat). However, species habitat is often comprises portions of one or more natural communities. This approach makes calculating total, net benefits for any one species difficult when there are no species-specific habitat conservation requirements. There are two main complications with estimating net benefits: 1) how to determine what portion of any given natural community conservation commitment will benefit any one species, and 2) to what species can you apply any given natural community conservation commitment. As an example, Swainson's hawk forages in many different habitat types (e.g., cultivated lands, managed wetlands, grasslands). There are specific Swainson's hawk conservation commitments for cultivated lands and grasslands but not for managed wetlands. Swainson's hawk will most assuredly benefit from managed wetland protection, but quantifying the benefit is difficult. The approach used to estimate species-specific benefits from a natural community objective is described in the paragraphs below. Table 5J.B–1 and Table 5J.B-2 provide the restoration and protection benefit estimates for wildlife, respectively, and Table 5J.B-3 and Table 5J.B-4 present these same results for plants. The species-specific benefit conclusion for each natural community model type is presented in bold text.in one of the last three columns of each table.

The approach to estimating net benefits included the five basic steps described below.

1. Of the total modeled habitat acreage, quantify the contribution of each natural community. This is done in GIS where the habitat model is intersected with the natural community layer. These results are presented in each table below in the *Acres of Modeled Habitat Comprising the Natural Community* column.

2. Determine what proportion (or percentage) of the natural community is included in the species modeled habitat. This is done by dividing the amount of the natural community that overlaps with the species model, described in step 1 above, by the total amount of the natural community in the Plan Area (presented in the *Total Acres of Natural Community is the Plan Area* column of each table below). The result is presented in the column titled *Percentage of Modeled Habitat Comprising the Natural Community*.

3. Identify whether a natural community restoration or protection objective will contribute to conservation of the species in question. For example, there is a managed wetland objective to protect 8,100 acres of managed wetlands in Suisun Marsh. The greater sandhill crane habitat model includes managed wetlands; however, the crane's range does not extend to Suisun Marsh, so this natural community objective would not be applied to the greater sandhill crane.

4. Calculate the estimated contribution of natural community protection or restoration to species conservation. This is done by multiplying the acreage of natural community restoration and

protection by the *Percentage of Modeled Habitat Comprising the Natural Community*. The result is presented in the fifth column.

5. Identify the natural community or species-specific objectives that were created specifically to benefit the species in question. These acreages are placed in one of the last two columns in each table, depending on whether the objective is specific to a natural community or species.

Whenever a natural community or species-specific objective is identified as benefiting a species, the entirety of that acreage commitment is counted as a benefit for the species. The estimated contribution of natural community restoration or protection is only used in the absence of a specific natural community or species objective. The acreage number chosen to estimate total benefits is presented in bold text.

The natural community benefit estimates for each model type are totaled and carried forward to the *BDCP Conservation* columns of the wildlife and plant net effects tables in Chapter 5, *Effects Analysis*, Table 5.6-7 and Table 5.6-8, respectively. Estimated benefits are also discussed in the *Beneficial Effects* section of each covered wildlife and plant species (see Section 5.6, *Effects on Covered Wildlife and Plant Species,* for more details).

1 **Table 5J.B-1. Natural Community Restoration Contributing to Covered Species Conservation—Wildlife**

Resource	Acres of Modeled Habitat Comprising the Natural Community	Total Acres of Natural Community in the Plan Area	Percentage of Modeled Habitat Comprising the Natural Community (%)	Total Acres of Natural Community Restoration	Estimated Contribution of Natural Community Restoration to Species Habitat Restoration	Minimum Restoration Commitment from Natural Community BGOs	Minimum Restoration Commitment from Species-Specific BGOs
Mammals							
Riparian brush rabbit							
Riparian Habitat							
Valley/Foothill Riparian	2,909	17,966	16.2	5,000	809		**800**
Grassland Habitat							
Grassland	3,094	78,047	4.0	2,000	**79**		
Riparian woodrat							
Habitat							
Valley/Foothill Riparian	2,166	17,966	12.1	5,000	603		**300**
Salt marsh harvest mouse							
Managed Wetland—Upland Low, Long-Term Conservation Value							
Managed Wetland	3,787	70,798	5.3	0	**0**		
Managed Wetland—Wetland Primary Low, Long-Term Conservation Value							
Managed Wetland	21,891	70,798	30.9	0	**0**		
Managed Wetland—Wetland Secondary Low, Long-Term Conservation Value							
Managed Wetland	2,800	70,798	4.0	0	**0**		
Tidal Brackish Emergent Wetland Primary							
Tidal Brackish Emergent Wetland	3,342	8,501	39.3	1,500	590	**1,500**	
Tidal Brackish Emergent Wetland Secondary							
Tidal Brackish Emergent Wetland	2,718	8,501	32.0	4,500	1,439	**4,500**	
Upland Secondary							
Grassland	491	78,047	0.6	2,000	**13**		
Tidal Brackish Emergent Wetland	189	8,501	2.2	1,500	**33**		
San Joaquin kit fox							
Breeding, Foraging, and Dispersal Habitat							
Grassland	5,098	78,047	6.5	2,000	**131**		
Vernal Pool Complex	229	12,132	1.9	67	**1**		
Suisun shrew							
Primary Habitat							

Resource	Acres of Modeled Habitat Comprising the Natural Community	Total Acres of Natural Community in the Plan Area	Percentage of Modeled Habitat Comprising the Natural Community (%)	Total Acres of Natural Community Restoration	Estimated Contribution of Natural Community Restoration to Species Habitat Restoration	Minimum Restoration Commitment from Natural Community BGOs	Minimum Restoration Commitment from Species-Specific BGOs
Grassland	12	78,047	0.0	2,000	**0**		
Tidal Brackish Emergent Wetland	3,001	8,501	35.3	1,500	530	**1,500**	
Secondary Habitat							
Grassland	219	78,047	0.3	2,000	**6**		
Managed Wetland	1,825	70,798	2.6	0	**0**		
Tidal Brackish Emergent Wetland	2,181	8,501	25.7	4,500	1,155	**4,500**	
Birds							
California black rail							
Primary Habitat							
Nontidal Freshwater Perennial Emergent Wetland	715	1,509	47.4	800[a]	**379**		
Tidal Brackish Emergent Wetland	3,760	8,501	44.2	1,500	664	**1,500**	
Tidal Freshwater Emergent Wetland	1,458	8,856	16.5	24,000	3,951		**1,700**
Secondary Habitat							
Managed Wetland	12,957	70,798	18.3	0	**0**		
Nontidal Freshwater Perennial Emergent Wetland	66	1,509	4.4	800[a]	**35**		
Tidal Brackish Emergent Wetland	2,022	8,501	23.8	4,500	1,070	**4,500**	
Tidal Freshwater Emergent Wetland	2,797	8,856	31.6	24,000	**7,580**		
California clapper rail							
Primary Habitat							
Tidal Brackish Emergent Wetland	248	8,501	2.9	1,500	44	**1,500**	
Secondary Habitat							
Tidal Brackish Emergent Wetland	5,324	8,501	62.6	4,500	2,818	**4,500**	
Tidal Freshwater Emergent Wetland	753	8,856	8.5	0[b]	**0**		
Greater sandhill crane							
Roosting - Permanent							
Cultivated land	5,237	487,106	1.1	75	1		**75**
Grassland	628	78,047	0.8	0[c]	**0**		
Managed Wetland	1,097	70,798	1.5	500	8		**500**

Resource	Acres of Modeled Habitat Comprising the Natural Community	Total Acres of Natural Community in the Plan Area	Percentage of Modeled Habitat Comprising the Natural Community (%)	Total Acres of Natural Community Restoration	Estimated Contribution of Natural Community Restoration to Species Habitat Restoration	Minimum Restoration Commitment from Natural Community BGOs	Minimum Restoration Commitment from Species-Specific BGOs
Nontidal Freshwater Perennial Emergent Wetland	43	1,509	2.9	0[c]	**0**		
Nontidal Perennial Aquatic	121	5,567	2.2	0[c]			
Roosting - Temporary							
Cultivated land	14,573	487,106	3.0	0	**0**		
Grassland	341	78,047	0.4	0[c]	**0**		
Managed Wetland	1,008	70,798	1.4	0	**0**		
Nontidal Freshwater Perennial Emergent Wetland	73	1,509	8.3	0[d]	**0**		
Nontidal Perennial Aquatic	191	5,567	8.3	0[d]	**0**		
Foraging							
Cultivated land	135,413	487,106	27.8	0	**0**		
Alkali Seasonal Wetland Complex	22	3,723	0.6	0[c]	**0**		
Grassland	21,032	78,047	26.9	0[c]	**0**		
Managed Wetland	3,713	70,798	5.2	0[e]	**0**		
Nontidal Perennial Aquatic	0	5,567	0.0	400	**0**		
Other Natural Seasonal Wetland	184	842	21.9	0	**0**		
Vernal Pool Complex	1,799	12,132	14.8	0[c]	**0**		
Least Bell's vireo							
Nesting and Migratory Habitat							
Valley/Foothill Riparian	14,206	17,966	79.1	5,000	3,954		**1,000[f]**
Suisun song sparrow							
Primary Habitat							
Tidal Brackish Emergent Wetland	3,221	8,501	37.9	1,500	568	**1,500**	
Tidal Freshwater Emergent Wetland	339	8,856	3.8	0[g]	**0**		
Secondary Habitat							
Managed Wetland	18,125	70,798	25.6	0[h]	**0**		
Tidal Brackish Emergent Wetland	2,990	8,501	35.2	4,500	1,583	**4,500**	
Tidal Freshwater Emergent Wetland	2,455	8,856	27.7	0[g]	**0**		
Swainson's hawk							
Foraging Habitat							

Resource	Acres of Modeled Habitat Comprising the Natural Community	Total Acres of Natural Community in the Plan Area	Percentage of Modeled Habitat Comprising the Natural Community (%)	Total Acres of Natural Community Restoration	Estimated Contribution of Natural Community Restoration to Species Habitat Restoration	Minimum Restoration Commitment from Natural Community BGOs	Minimum Restoration Commitment from Species-Specific BGOs
Cultivated land	361,365	487,106	74.2	0	**0**		
Alkali Seasonal Wetland Complex	3,261	3,723	87.6	0[i]	**0**		
Grassland	71,343	78,047	91.4	2,000	1,828	**2,000**	
Managed Wetland	22,304	70,798	31.5	0	**0**		
Other Natural Seasonal Wetland	259	842	30.8	0	**0**		
Vernal Pool Complex	11,246	12,132	92.7	0[i]	**0**		
Nesting Habitat							
Valley/Foothill Riparian	9,388	17,966	52.3	5,000	**2,613**		
Tricolored blackbird							
Breeding Habitat—Ag Foraging							
Cultivated land	100,198	487,106	20.6	0	**0**		
Breeding Habitat—Foraging							
Alkali Seasonal Wetland Complex	3,463	3,723	93.0	72	**67**		
Grassland	38,819	78,047	49.7	2,000	**995**		
Managed Wetland	6,991	70,798	9.9	0[j]	**0**		
Other Natural Seasonal Wetland	188	842	22.3	0	**0**		
Tidal Brackish Emergent Wetland	773	8,501	9.1	6,000	**546**		
Vernal Pool Complex	7,940	12,132	65.4	67	**44**		
Breeding Habitat—Nesting							
Managed Wetland	57	70,798	0.1	500	**0**		
Nontidal Freshwater Perennial Emergent Wetland	279	1,509	18.5	800[a]	**148**		
Valley/Foothill Riparian	1,405	17,966	7.8	5,000	**391**		
Nonbreeding Habitat—Foraging Ag							
Cultivated land	194,251	487,106	39.9	0	**0**		
Nonbreeding Habitat—Roosting							
Managed Wetland	9,889	70,798	14.0	500	**70**		
Nontidal Freshwater Perennial Emergent Wetland	935	1,509	61.9	800[a]	**496**		
Tidal Brackish Emergent Wetland	4,880	8,501	57.4	6,000	**3,444**		
Tidal Freshwater Emergent Wetland	8,413	8,856	95.0	24,000	**22,800**		
Valley/Foothill Riparian	3,805	17,966	21.2	5,000	**1,059**		

Resource	Acres of Modeled Habitat Comprising the Natural Community	Total Acres of Natural Community in the Plan Area	Percentage of Modeled Habitat Comprising the Natural Community (%)	Total Acres of Natural Community Restoration	Estimated Contribution of Natural Community Restoration to Species Habitat Restoration	Minimum Restoration Commitment from Natural Community BGOs	Minimum Restoration Commitment from Species-Specific BGOs
Nonbreeding Habitat—Foraging							
Alkali Seasonal Wetland Complex	122	3,723	3.3	72	**2**		
Grassland	32,213	78,047	41.3	2,000	**825**		
Managed Wetland	1,588	70,798	2.2	500	**11**		
Tidal Brackish Emergent Wetland	145	8,501	1.7	6,000	**102**		
Vernal Pool Complex	228	12,132	1.9	67	**1**		
Western burrowing owl							
High-Value Habitat							
Cultivated land	68,761	487,106	14.1	0	**0**		
Alkali Seasonal Wetland Complex	3,081	3,723	82.8	72	**60**		
Grassland	59,437	78,047	76.2	2,000	**1,523**		
Managed Wetland	7,365	70,798	10.4	0	**0**		
Vernal Pool Complex	10,706	12,132	88.2	67	**59**		
Other Natural Seasonal Wetland	0	842	0.0	0	**0**		
Low-Value Habitat							
Cultivated land	235,559	487,106	48.4	0	**0**		
Alkali Seasonal Wetland Complex	122	3,723	3.3	72	**2**		
Grassland	28	78,047	0.0	2,000	**1**		
Managed Wetland	14,567	70,798	20.6	0	**0**		
Other Natural Seasonal Wetland	242	842	28.7	0	**0**		
Western Yellow-billed Cuckoo							
Breeding Habitat							
Valley/Foothill Riparian	1,970	17,966	11.0	5,000	548	**500**	
Migratory Habitat							
Valley/Foothill Riparian	10,409	17,966	57.9	5,000	**2,897**		
White-tailed kite							
Breeding/Roosting							
Valley/Foothill Riparian	13,655	17,966	76.0	5,000	**3,800**		
Foraging							
Cultivated land	357,626	487,106	73.4	0	**0**		
Alkali Seasonal Wetland Complex	3,450	3,723	92.7	72	**67**		
Grassland	74,961	78,047	96.0	2,000	**1,921**		
Managed Wetland	50,808	70,798	71.8	0	**0**		

Resource	Acres of Modeled Habitat Comprising the Natural Community	Total Acres of Natural Community in the Plan Area	Percentage of Modeled Habitat Comprising the Natural Community (%)	Total Acres of Natural Community Restoration	Estimated Contribution of Natural Community Restoration to Species Habitat Restoration	Minimum Restoration Commitment from Natural Community BGOs	Minimum Restoration Commitment from Species-Specific BGOs
Other Natural Seasonal Wetland	261	842	31.0	0	**0**		
Vernal Pool Complex	11,282	12,132	93.0	67	**62**		
Yellow-breasted chat							
Primary Nesting and Migratory Habitat							
Valley/Foothill Riparian	8,178	17,966	45.5	5,000	2,276	**1,000**	
Secondary Nesting and Migratory Habitat							
Valley/Foothill Riparian	5,528	17,966	30.8	5,000	**1,538**		
Suisun Marsh/Upper Yolo Bypass Nest and Migratory Habitat							
Valley/Foothill Riparian	520	17,966	2.9	5,000	**145**		
Reptiles							
Giant Garter Snake							
Aquatic—Tidal							
Tidal Perennial Aquatic	6,430	86,263	7.5	0	**0**		
Tidal Freshwater Emergent Wetland	5,667	8,856	64.0	24,000	15,357		**1,250**[k]
Aquatic—Nontidal							
Cultivated land	12,337	487,106	2.5	0	**0**		
Nontidal Freshwater Perennial Emergent Wetland	1,359	1,509	90.0	800	720		**733**[l]
Nontidal Perennial Aquatic	5,331	5,567	95.8	400	383		**1,467l**
Upland—High							
Cultivated land	5,071	487,106	1.0	0	**0**		
Alkali Seasonal Wetland Complex	644	3,723	17.3	72	**12**		
Grassland	14,490	78,047	18.6	2,000	371		**700**[m]
Managed Wetland	923	70,798	1.3	500[n]	**7**		
Vernal Pool Complex	454	12,132	3.7	67	**3**		
Upland—Moderate							
Cultivated land	3,406	487,106	0.7	0	**0**		
Alkali Seasonal Wetland Complex	230	3,723	6.2	72	**4**		
Grassland	8,375	78,047	10.7	2,000	**215**		
Managed Wetland	5,113	70,798	7.2	500	**36**		

Resource	Acres of Modeled Habitat Comprising the Natural Community	Total Acres of Natural Community in the Plan Area	Percentage of Modeled Habitat Comprising the Natural Community (%)	Total Acres of Natural Community Restoration	Estimated Contribution of Natural Community Restoration to Species Habitat Restoration	Minimum Restoration Commitment from Natural Community BGOs	Minimum Restoration Commitment from Species-Specific BGOs
Vernal Pool Complex	609	12,132	5.0	67	**3**		
Upland—Low							
Managed Wetland	31	70,798	0.0	500	**0**		
Vernal Pool Complex	1	12,132	0.0	67	**0**		
Western pond turtle							
Aquatic Habitat							
Cultivated land	15	487,106	0.0	0	**0**		
Grassland	0	78,047	0.0	2,000	**0**		
Managed Wetland	10,820	70,798	15.3	500	**76**		
Nontidal Freshwater Perennial Emergent Wetland	864	1,509	57.3	800	458	**1,200**	
Nontidal Perennial Aquatic	5,489	5,567	98.6	400	**394**		
Tidal Brackish Emergent Wetland	5,768	8,501	67.9	6,000	**4,071**		
Tidal Freshwater Emergent Wetland	8,855	8,856	100.0	24,000	**23,997**		
Tidal Perennial Aquatic	49,759	86,263	57.7	0	**0**		
Upland Nesting and Overwintering Habitat							
Cultivated land	150	487,106	0.0	0	**0**		
Grassland	13,983	78,047	17.9	2,000	**358**		
Managed Wetland	1,159	70,798	1.6	500	**8**		
Tidal Brackish Emergent Wetland	160	8,501	1.9	6,000	**113**		
Tidal Perennial Aquatic	1	86,263	0.0	0	**0**		
Valley/Foothill Riparian	2	17,966	0.0	6,000	**1**		
Upland Nesting and Overwintering Habitat—NHD							
Cultivated land	114	487,106	0.0	0	**0**[o]		
Grassland	31,186	78,047	40.0	2,000	**799**[o]		
Managed Wetland	2,923	70,798	4.1	500	**21**[o]		
Tidal Brackish Emergent Wetland	141	8,501	1.7	6,000	**100**[o]		
Valley/Foothill Riparian	74	17,966	0.4	5,000	**21**[o]		
Amphibians							
California red-legged frog							
Aquatic Habitat							
Managed Wetland	23	70,798	0.0	0[o]	**0**		

Resource	Acres of Modeled Habitat Comprising the Natural Community	Total Acres of Natural Community in the Plan Area	Percentage of Modeled Habitat Comprising the Natural Community (%)	Total Acres of Natural Community Restoration	Estimated Contribution of Natural Community Restoration to Species Habitat Restoration	Minimum Restoration Commitment from Natural Community BGOs	Minimum Restoration Commitment from Species-Specific BGOs
Nontidal Freshwater Perennial Emergent Wetland	34	1,509	2.3	0[p]	**0**		
Nontidal Perennial Aquatic	84	5,567	1.5	0[p]			
Tidal Freshwater Emergent Wetland	6	8,856	0.1	24,000	**16**		
Upland Cover and Dispersal Habitat							
Grassland	6,729	78,047	8.6	2,000	**172**		
Valley/Foothill Riparian	636	17,966	3.5	5,000	**177**		
Vernal Pool Complex	402	12,132	3.3	67	**2**		
California tiger salamander							
Aquatic Breeding Habitat							
Vernal Pool Complex	7,845	12,132	64.7	67	**43**		
Terrestrial Cover and Aestivation							
Alkali Seasonal Wetland Complex	2,352	3,723	63.2	72	**45**		
Grassland	23,342	78,047	29.9	2,000	**598**		
Invertebrates							
Valley elderberry longhorn beetle							
Riparian Vegetation							
Valley/Foothill Riparian	17,451	17,966	97.1	5,000	**4,857**		
Non-Riparian Channels and Grasslands							
Grassland	15,943	78,047	20.4	0[r]	**0**		
California linderiella							
High Quality Habitat							
Alkali Seasonal Wetland Complex	188	3,723	5.0	72	**4**		
Vernal Pool Complex	8,571	12,132	70.6	67	**47**		
Low Quality Habitat							
Vernal Pool Complex	2,713	12,132	22.4	0	**0**		
Conservancy fairy shrimp							
High Quality Habitat							
Alkali Seasonal Wetland Complex	188	3,723	5.0	72	**4**		
Vernal Pool Complex	8,571	12,132	70.6	67	**47**		

Resource	Acres of Modeled Habitat Comprising the Natural Community	Total Acres of Natural Community in the Plan Area	Percentage of Modeled Habitat Comprising the Natural Community (%)	Total Acres of Natural Community Restoration	Estimated Contribution of Natural Community Restoration to Species Habitat Restoration	Minimum Restoration Commitment from Natural Community BGOs	Minimum Restoration Commitment from Species-Specific BGOs
Low Quality Habitat							
Vernal Pool Complex	2,713	12,132	22.4	0	**0**		
Longhorn fairy shrimp							
High Quality Habitat							
Alkali Seasonal Wetland Complex	188	3,723	5.0	72	**4**		
Vernal Pool Complex	8,571	12,132	70.6	67	**47**		
Low Quality Habitat							
Vernal Pool Complex	2,713	12,132	22.4	0	**0**		
Midvalley fairy shrimp							
High Quality Habitat							
Alkali Seasonal Wetland Complex	188	3,723	5.0	72	**4**		
Vernal Pool Complex	8,571	12,132	70.6	67	**47**		
Low Quality Habitat							
Vernal Pool Complex	2,713	12,132	22.4	0	**0**		
Vernal pool fairy shrimp							
High Quality Habitat							
Alkali Seasonal Wetland Complex	188	3,723	5.0	72	**4**		
Vernal Pool Complex	8,571	12,132	70.6	67	**47**		
Low Quality Habitat							
Vernal Pool Complex	2,713	12,132	22.4	0	**0**		
Vernal pool tadpole shrimp							
High Quality Habitat							
Alkali Seasonal Wetland Complex	188	3,723	5.0	72	**4**		
Vernal Pool Complex	8,571	12,132	70.6	67	**47**		
Low Quality Habitat							
Vernal Pool Complex	2,713	12,132	22.4	0	**0**		

BGOs = Biological Goals and Objectives

[a] The 1,200-acre nontidal emergent wetland restoration under GGS1.1 assumes 2/3 nontidal perennial aquatic and 1/3 nontidal emergent wetland.

[b] Freshwater emergent wetland restoration under Objective TFEW1.1 is not likely to overlap with locations that benefit the California clapper rail.

[c] Grassland, vernal pool, and alkali seasonal wetland protection likely to occur outside the range of greater sandhill crane.

[d] The 1,200-acres of nontidal emergent wetland restoration under GGS1.1 do not overlap with the range of the greater sandhill crane.

[e] All 500 acres of managed wetland restoration under Objective GSHC1.4 will benefit roosting habitat.

Resource	Acres of Modeled Habitat Comprising the Natural Community	Total Acres of Natural Community in the Plan Area	Percentage of Modeled Habitat Comprising the Natural Community (%)	Total Acres of Natural Community Restoration	Estimated Contribution of Natural Community Restoration to Species Habitat Restoration	Minimum Restoration Commitment from Natural Community BGOs	Minimum Restoration Commitment from Species-Specific BGOs

[f] 1,000 acres of early- to mid-successional riparian maintained under Objective VFRN2.2 assumed to benefit least Bell's vireo.

[g] 24,000 acres of tidal freshwater emergent wetland restored under Objective TFEW1.1 are outside the range of the Suisun song sparrow.

[h] 500 acres of restored managed wetland under Objective GSHC1.4 are outside the range of the Suisun song sparrow.

[i] Assuming no benefit from vernal pool or alkali season wetland natural community restoration because Objective VPNC 1.2 and ASWNC1.2 commit to no net loss of habitat

[j] 500 acres of restored managed wetland under Objective GSHC1.4 are not likely to benefit tricolored blackbird.

[k] Objectives GGS1.4 and GGS2.3 provide for the conservation of 4,240 acres of rice or equivalent; assume 1,250 acres of muted tidal restoration (part of 65,00-acre commitment), 1,000 acres as nontidal restoration, 1,000 acres of rice protection, and 1,000 acres as upland protection.

[l] Objectives GGS1.4 and GGS2.3 provide for the conservation of 4,240 acres of rice or equivalent; assume 1,250 acres of muted tidal restoration (part of 65,00-acre commitment), 1,000 acres of nontidal wetland restoration, 1,000 acres of rice protection, and 1,000 acres as upland protection. In addition, 1,200 acres of nontidal marsh will be restored under Objective GGS1.1. This is a total of 2,200 acres of nontidal restoration, 1/3 of which is assumed to be nontidal emergent wetland and 2/3 of which is assumed to nontidal perennial aquatic.

[m] Of the 400 acres of grassland created or protected under Objectives GGS1.2 and 2.3, assume 200 acres protected and 200 acres restored. Additionally, for the 1,000 acres of grassland protected or created as "rice or equivalent" under Objectives GGS1.4 and GGS3.1 assume 500 acres are protected and 500 are restored.

[n] A portion of the managed wetlands restored for greater sandhill crane under Objective GSHC1.4 could potentially support GGS.

[o] 35% of total benefit calculated here will be carried forward to Table 5.6-7 *Net Effects, Wildlife*, see Appendix 2A.29 *Western Pond Turtle Species Account* for details.

[p] 500 acres of restored managed wetland under Objective GSHC1.4 are outside the range of the California red-legged frog.

[q] The 1,200-acres of nontidal emergent wetland restoration under GGS1.1 do not overlap with the range of the California red-legged frog.

[r] Grassland restoration under Objective GNC1.1 will not contribute habitat for valley elderberry longhorn beetle.

1 **Table 5J.B-2. Natural Community Protection Contributing to Covered Species Conservation—Wildlife**

Resource	Acres of Modeled Habitat Comprising the Natural Community	Total Acres of Natural Community in the Plan Area	Percentage of Modeled Habitat Comprising the Natural Community (%)	Total Acres of Natural Community Protection	Estimated Contribution of Natural Community Protection to Species Habitat Protection	Minimum Protection Commitment from Natural Community BGOs	Minimum Protection Commitment from Species-Specific BGOs
Mammals							
Riparian brush rabbit							
Riparian Habitat							
Valley/Foothill Riparian	2,909	17,966	16.2	750	121		**200**
Grassland Habitat							
Grassland	3,094	78,047	4.0	8,000	**317**		
Riparian woodrat							
Habitat							
Valley/Foothill Riparian	2,166	17,966	12.1	750	**90**		
Salt marsh harvest mouse							
Managed Wetland—Upland Low, Long-Term Conservation Value							
Managed Wetland	3,787	70,798	5.3	0[a]	**0**		
Managed Wetland—Wetland Primary Low, Long-Term Conservation Value							
Managed Wetland	21,891	70,798	30.9	1,500	464	**1,500**	
Managed Wetland—Wetland Secondary Low, Long-Term Conservation Value							
Managed Wetland	2,800	70,798	4.0	0[a]	**0**		
Tidal Brackish Emergent Wetland Primary							
Tidal Brackish Emergent Wetland	3,342	8,501	39.3		**0**		
Tidal Brackish Emergent Wetland Secondary							
Tidal Brackish Emergent Wetland	2,718	8,501	32.0	0	**0**		
Upland Secondary							
Grassland	491	78,047	0.6	8,000	**50**		
Tidal Brackish Emergent Wetland	189	8,501	2.2	0	**0**		
San Joaquin kit fox							
Breeding, Foraging, and Dispersal Habitat							
Grassland	5,098	78,047	6.5	8,000	523	**1,000**	
Vernal Pool Complex	229	12,132	1.9	600	**11**		
Suisun shrew							
Primary Habitat							
Grassland	12	78,047	0.0	8,000	**1**		
Tidal Brackish Emergent Wetland	3,001	8,501	35.3	0	**0**		

Resource	Acres of Modeled Habitat Comprising the Natural Community	Total Acres of Natural Community in the Plan Area	Percentage of Modeled Habitat Comprising the Natural Community (%)	Total Acres of Natural Community Protection	Estimated Contribution of Natural Community Protection to Species Habitat Protection	Minimum Protection Commitment from Natural Community BGOs	Minimum Protection Commitment from Species-Specific BGOs
Secondary Habitat							
Grassland	219	78,047	0.3	8,000	**22**		
Managed Wetland	1,825	70,798	2.6	8,100	**209**		
Tidal Brackish Emergent Wetland	2,181	8,501	25.7	0	**0**		
Birds							
California black rail							
Primary Habitat							
Nontidal Freshwater Perennial Emergent Wetland	715	1,509	47.4	0	**0**		
Tidal Brackish Emergent Wetland	3,760	8,501	44.2	0	**0**		
Tidal Freshwater Emergent Wetland	1,458	8,856	16.5	0	**0**		
Secondary Habitat							
Managed Wetland	12,957	70,798	18.3	1,500	**275**		
Nontidal Freshwater Perennial Emergent Wetland	66	1,509	4.4	0	**0**		
Tidal Brackish Emergent Wetland	2,022	8,501	23.8	0	**0**		
Tidal Freshwater Emergent Wetland	2,797	8,856	31.6	0	**0**		
California clapper rail							
Primary Habitat							
Tidal Brackish Emergent Wetland	248	8,501	2.9	0	**0**		
Secondary Habitat							
Tidal Brackish Emergent Wetland	5,324	8,501	62.6	0	**0**		
Tidal Freshwater Emergent Wetland	753	8,856	8.5	0	**0**		
Greater sandhill crane							
Roosting - Permanent							
Cultivated land	5,237	487,106	1.1	0[b]	**0**		
Grassland	628	78,047	0.8	0[c]	**0**		
Managed Wetland	1,097	70,798	1.5	0	**0**		
Nontidal Freshwater Perennial Emergent Wetland	43	1,509	2.9	0[d]	**0**		
Nontidal Perennial Aquatic	121	5,567	2.2	0[d]	**0**		
Roosting - Temporary							
Cultivated land	14,573	487,106	3.0	0[b]	**0**		
Grassland	341	78,047	0.4	0[c]	**0**		
Managed Wetland	1,008	70,798	1.4	0	**0**		

Resource	Acres of Modeled Habitat Comprising the Natural Community	Total Acres of Natural Community in the Plan Area	Percentage of Modeled Habitat Comprising the Natural Community (%)	Total Acres of Natural Community Protection	Estimated Contribution of Natural Community Protection to Species Habitat Protection	Minimum Protection Commitment from Natural Community BGOs	Minimum Protection Commitment from Species-Specific BGOs
Nontidal Freshwater Perennial Emergent Wetland	73	1,509	4.9	0[d]	**0**		
Nontidal Perennial Aquatic	191	5,567	3.4	0[d]	**0**		
Foraging							
Cultivated land	135,413	487,106	27.8	48,600	13,511		**7,300**
Alkali Seasonal Wetland Complex	22	3,723	0.6	0[c]	**0**		
Grassland	21,032	78,047	26.9	0[c]	**0**		
Managed Wetland	3,713	70,798	5.2	0	**0**		
Nontidal Perennial Aquatic	0	5,567	0.0	0	**0**		
Other Natural Seasonal Wetland	184	842	21.9	0	**0**		
Vernal Pool Complex	1,799	12,132	14.8	0[c]	**0**		
Least Bell's vireo							
Nesting and Migratory Habitat							
Valley/Foothill Riparian	14,206	17,966	79.1	750	**593**		
Suisun song sparrow							
Primary Habitat							
Tidal Brackish Emergent Wetland	3,221	8,501	37.9	0	**0**		
Tidal Freshwater Emergent Wetland	339	8,856	3.8	0	**0**		
Secondary Habitat							
Managed Wetland	18,125	70,798	25.6	1,500[e]	**384**		
Tidal Brackish Emergent Wetland	2,990	8,501	35.2	0	**0**		
Tidal Freshwater Emergent Wetland	2,455	8,856	27.7	0	**0**		
Swainson's hawk							
Foraging Habitat							
Cultivated land	361,365	487,106	74.2	48,600	36,054		**43,325**
Alkali Seasonal Wetland Complex	3,261	3,723	87.6	150	131		**150**
Grassland	71,343	78,047	91.4	8,000	7,313		**8,000**
Managed Wetland	22,304	70,798	31.5	8,100	**2,552**		
Other Natural Seasonal Wetland	259	842	30.8	0	**0**		
Vernal Pool Complex	11,246	12,132	92.7	600	556		**600**
Nesting Habitat							
Valley/Foothill Riparian	9,388	17,966	52.3	750	**392**		
Tricolored blackbird							
Breeding Habitat—Ag Foraging							
Cultivated land	100,198	487,106	20.6	48,600	9,997		**11,050**

Resource	Acres of Modeled Habitat Comprising the Natural Community	Total Acres of Natural Community in the Plan Area	Percentage of Modeled Habitat Comprising the Natural Community (%)	Total Acres of Natural Community Protection	Estimated Contribution of Natural Community Protection to Species Habitat Protection	Minimum Protection Commitment from Natural Community BGOs	Minimum Protection Commitment from Species-Specific BGOs
Breeding Habitat—Foraging							
Alkali Seasonal Wetland Complex	3,463	3,723	93.0	150	**140**		
Grassland	38,819	78,047	49.7	8,000	**3,979**		
Managed Wetland	6,991	70,798	9.9	8,100	**800**		
Other Natural Seasonal Wetland	188	842	22.3	0	**0**		
Tidal Brackish Emergent Wetland	773	8,501	9.1	0	**0**		
Vernal Pool Complex	7,940	12,132	65.4	600	**393**		
Breeding Habitat—Nesting							
Managed Wetland	57	70,798	0.1	8,100	**7**		
Nontidal Freshwater Perennial Emergent Wetland	279	1,509	18.5	0	0		**50**
Valley/Foothill Riparian	1,405	17,966	7.8	750	**59**		
Nonbreeding Habitat—Foraging Ag							
Cultivated land	194,251	487,106	39.9	48,600	19,381		**26,300**
Nonbreeding Habitat—Roosting							
Managed Wetland	9,889	70,798	14.0	8,100	**1,131**		
Nontidal Freshwater Perennial Emergent Wetland	935	1,509	61.9	0	**0**		
Tidal Brackish Emergent Wetland	4,880	8,501	57.4	0	**0**		
Tidal Freshwater Emergent Wetland	8,413	8,856	95.0	0	**0**		
Valley/Foothill Riparian	3,805	17,966	21.2	750	**159**		
Nonbreeding Habitat—Foraging							
Alkali Seasonal Wetland Complex	122	3,723	3.3	150	**5**		
Grassland	32,213	78,047	41.3	8,000	**3,302**		
Managed Wetland	1,588	70,798	2.2	8,100	**182**		
Tidal Brackish Emergent Wetland	145	8,501	1.7	0	**0**		
Vernal Pool Complex	228	12,132	1.9	600	**11**		
Western burrowing owl							
High-Value Habitat							
Cultivated land	68,761	487,106	14.1	48,600	6,860		**1,000**
Alkali Seasonal Wetland Complex	3,081	3,723	82.8	150	**124**		
Grassland	59,437	78,047	76.2	8,000	**6,092**		
Managed Wetland	7,365	70,798	10.4	8,100	**843**		
Vernal Pool Complex	10,706	12,132	88.2	600	**529**		
Other Natural Seasonal Wetland	0	842	0.0	0	**0**		

Resource	Acres of Modeled Habitat Comprising the Natural Community	Total Acres of Natural Community in the Plan Area	Percentage of Modeled Habitat Comprising the Natural Community (%)	Total Acres of Natural Community Protection	Estimated Contribution of Natural Community Protection to Species Habitat Protection	Minimum Protection Commitment from Natural Community BGOs	Minimum Protection Commitment from Species-Specific BGOs
Low-Value Habitat							
Cultivated land	235,559	487,106	48.4	48,600	**23,502**		
Alkali Seasonal Wetland Complex	122	3,723	3.3	150	**5**		
Grassland	28	78,047	0.0	8,000	**3**		
Managed Wetland	14,567	70,798	20.6	8,100	**1,667**		
Other Natural Seasonal Wetland	242	842	28.7	0	**0**		
Western Yellow-billed Cuckoo							
Breeding Habitat							
Valley/Foothill Riparian	1,970	17,966	11.0	750	**82**		
Migratory Habitat							
Valley/Foothill Riparian	10,409	17,966	57.9	750	**435**		
White-tailed kite							
Breeding/Roosting							
Valley/Foothill Riparian	13,655	17,966	76.0	750	**570**		
Foraging							
Cultivated land	357,626	487,106	73.4	48,600	**35,681**		
Alkali Seasonal Wetland Complex	3,450	3,723	92.7	150	**139**		
Grassland	74,961	78,047	96.0	8,000	**7,684**		
Managed Wetland	50,808	70,798	71.8	8,100	**5,813**		
Other Natural Seasonal Wetland	261	842	31.0	0	**0**		
Vernal Pool Complex	11,282	12,132	93.0	600	**558**		
Yellow-breasted chat							
Primary Nesting and Migratory Habitat							
Valley/Foothill Riparian	8,178	17,966	45.5	750	**341**		
Secondary Nesting and Migratory Habitat							
Valley/Foothill Riparian	5,528	17,966	30.8	750	**231**		
Suisun Marsh/Upper Yolo Bypass Nest and Migratory Habitat							
Valley/Foothill Riparian	520	17,966	2.9	750	**22**		
Reptiles							
Giant Garter Snake							
Aquatic—Tidal							
Tidal Perennial Aquatic	6,430	86,263	7.5	0	**0**		
Tidal Freshwater Emergent Wetland	5,667	8,856	64.0	0	**0**		
Aquatic—Nontidal							
Cultivated land	12,337	487,106	2.5	48,600	1,231		**1,500**[f]

Resource	Acres of Modeled Habitat Comprising the Natural Community	Total Acres of Natural Community in the Plan Area	Percentage of Modeled Habitat Comprising the Natural Community (%)	Total Acres of Natural Community Protection	Estimated Contribution of Natural Community Protection to Species Habitat Protection	Minimum Protection Commitment from Natural Community BGOs	Minimum Protection Commitment from Species-Specific BGOs
Nontidal Freshwater Perennial Emergent Wetland	1,359	1,509	90.0	25[g]	**23**		
Nontidal Perennial Aquatic	5,331	5,567	95.8	25[g]	**24**		
Upland—High							
Cultivated land	5,071	487,106	1.0	48,600	506		**200**[h]
Alkali Seasonal Wetland Complex	644	3,723	17.3	150	**26**		
Grassland	14,490	78,047	18.6	8,000	1,485		**700**[i]
Managed Wetland	923	70,798	1.3	0[j]	**0**		
Vernal Pool Complex	454	12,132	3.7	600	**22**		
Upland—Moderate							
Cultivated land	3,406	487,106	0.7	48,600	**340**		
Alkali Seasonal Wetland Complex	230	3,723	6.2	150	**9**		
Grassland	8,375	78,047	10.7	8,000	**858**		
Managed Wetland	5,113	70,798	7.2	0[j]	**0**		
Vernal Pool Complex	609	12,132	5.0	600	**30**		
Upland—Low							
Managed Wetland	31	70,798	0.0	0[j]	**0**		
Vernal Pool Complex	1	12,132	0.0	600	**0**		
Western pond turtle							
Aquatic Habitat							
Cultivated land	15	487,106	0.0	48,600	**2**		
Grassland	0	78,047	0.0	8,000	**0**		
Managed Wetland	10,820	70,798	15.3	8,100	**1,238**		
Nontidal Freshwater Perennial Emergent Wetland	864	1,509	57.3	25	**14**		
Nontidal Perennial Aquatic	5,489	5,567	98.6	25	**25**		
Tidal Brackish Emergent Wetland	5,768	8,501	67.9	0	**0**		
Tidal Freshwater Emergent Wetland	8,855	8,856	100.0	0	**0**		
Tidal Perennial Aquatic	49,759	86,263	57.7	0	**0**		
Upland Nesting and Overwintering Habitat							
Cultivated land	150	487,106	0.0	48,600	**15**		
Grassland	13,983	78,047	17.9	8,000	**1,433**		
Managed Wetland	1,159	70,798	1.6	0	**0**		
Tidal Brackish Emergent Wetland	160	8,501	1.9	0	**0**		
Tidal Perennial Aquatic	1	86,263	0.0	0	**0**		

Resource	Acres of Modeled Habitat Comprising the Natural Community	Total Acres of Natural Community in the Plan Area	Percentage of Modeled Habitat Comprising the Natural Community (%)	Total Acres of Natural Community Protection	Estimated Contribution of Natural Community Protection to Species Habitat Protection	Minimum Protection Commitment from Natural Community BGOs	Minimum Protection Commitment from Species-Specific BGOs
Valley/Foothill Riparian	2	17,966	0.0	750	**0**		
Upland Nesting and Overwintering Habitat—NHD[k]							
Cultivated land	114	487,106	0.0	48,600	**11[k]**		
Grassland	31,186	78,047	40.0	8,000	**3,197[k]**		
Managed Wetland	2,923	70,798	4.1	8,100	**334[k]**		
Tidal Brackish Emergent Wetland	141	8,501	1.7	0	**0[k]**		
Valley/Foothill Riparian	74	17,966	0.4	750	**3[k]**		
Amphibians							
California red-legged frog							
Aquatic Habitat							
Managed Wetland	23	70,798	0.0	8,100	**3**		
Nontidal Freshwater Perennial Emergent Wetland	34	1,509	2.3	25[g]	**0**		
Nontidal Perennial Aquatic	84	5,567	1.5	25[g]			
Tidal Freshwater Emergent Wetland	6	8,856	0.1	0	**0**		
Upland Cover and Dispersal Habitat							
Grassland	6,729	78,047	8.6	8,000	690	**1000[l]**	
Valley/Foothill Riparian	636	17,966	3.5	750	**27**		
Vernal Pool Complex	402	12,132	3.3	600	**20**		
California tiger salamander							
Aquatic Breeding Habitat							
Vernal Pool Complex	7,845	12,132	64.7	600	388	**600**	
*Terrestrial Cover and Aestivation**							
Alkali Seasonal Wetland Complex	2,352	3,723	63.2	150	95	**150**	
Grassland	23,342	78,047	29.9	8,000	2,393	**5,000[m]**	
Invertebrates							
Valley elderberry longhorn beetle							
Riparian Vegetation							
Valley/Foothill Riparian	17,451	17,966	97.1	750	**729**		
Non-Riparian Channels and Grasslands							
Grassland	15,943	78,047	20.4	8,000	**1,634**		
California linderiella							
High Quality Habitat							
Alkali Seasonal Wetland Complex	188	3,723	5.0	150	**8**		
Vernal Pool Complex	8,571	12,132	70.6	600	424	**600**	

Resource	Acres of Modeled Habitat Comprising the Natural Community	Total Acres of Natural Community in the Plan Area	Percentage of Modeled Habitat Comprising the Natural Community (%)	Total Acres of Natural Community Protection	Estimated Contribution of Natural Community Protection to Species Habitat Protection	Minimum Protection Commitment from Natural Community BGOs	Minimum Protection Commitment from Species-Specific BGOs
Low Quality Habitat							
Vernal Pool Complex	2,713	12,132	22.4	0	**0**		
Conservancy fairy shrimp							
High Quality Habitat							
Alkali Seasonal Wetland Complex	188	3,723	5.0	150	**8**		
Vernal Pool Complex	8,571	12,132	70.6	600	424	**600**	
Low Quality Habitat							
Vernal Pool Complex	2,713	12,132	22.4	0	**0**		
Longhorn fairy shrimp							
High Quality Habitat							
Alkali Seasonal Wetland Complex	188	3,723	5.0	150	**8**		
Vernal Pool Complex	8,571	12,132	70.6	600	424	**600**	
Low Quality Habitat							
Vernal Pool Complex	2,713	12,132	22.4	0	**0**		
Midvalley fairy shrimp							
High Quality Habitat							
Alkali Seasonal Wetland Complex	188	3,723	5.0	150	**8**		
Vernal Pool Complex	8,571	12,132	70.6	600	424	**600**	
Low Quality Habitat							
Vernal Pool Complex	2,713	12,132	22.4	0	**0**		
Vernal pool fairy shrimp							
High Quality Habitat							
Alkali Seasonal Wetland Complex	188	3,723	5.0	150	**8**		
Vernal Pool Complex	8,571	12,132	70.6	600	424	**600** [e]	
Low Quality Habitat							
Vernal Pool Complex	2,713	12,132	22.4	0	**0**		
Vernal pool tadpole shrimp							
High Quality Habitat							
Alkali Seasonal Wetland Complex	188	3,723	5.0	150	**8**		
Vernal Pool Complex	8,571	12,132	70.6	600	424	**600** [e]	
Low Quality Habitat							
Vernal Pool Complex	2,713	12,132	22.4	0	**0**		

BGOs = Biological Goals and Objectives

[a] Managed wetland benefit attributed to Managed Wetland—Wetland primary Low, Long-Term Conservation Value

[b] All cultivated land natural community protection benefit applied to foraging model type.

Resource	Acres of Modeled Habitat Comprising the Natural Community	Total Acres of Natural Community in the Plan Area	Percentage of Modeled Habitat Comprising the Natural Community (%)	Total Acres of Natural Community Protection	Estimated Contribution of Natural Community Protection to Species Habitat Protection	Minimum Protection Commitment from Natural Community BGOs	Minimum Protection Commitment from Species-Specific BGOs

[c] Grassland, vernal pool, and alkali seasonal wetland protection likely to occur outside the range of greater sandhill crane.

[d] Nontidal freshwater emergent wetland and aquatic habitat protected for tricolored blackbird unlikely to overlap with greater sandhill crane range.

[e] Given uncertainty of benefits on managed wetlands managed for waterfowl and shorebird foraging, nesting, and brooding, only 1,500 acres of managed wetland protection to benefit the salt marsh harvest mouse is applied.

[f] Objectives GGS1.4 and GGS2.3 provide for the conservation of 4,240 acres of rice or equivalent; assume 1,250 acres of muted tidal restoration (part of 65,00-acre commitment), 1,000 acres as nontidal restoration, 1,000 acres of rice protection, and 1,000 acres as upland protection. Additionally, 500 of 700 acres of cultivated land protection required under Objective GGS2.3 assumed to be rice.

[g] 25 acres of emergent wetland and 25 acres nontidal perennial aquatic assumed for 50-acre tricolored blackbird nontidal emergent wetland protection commitment under Objective TRBL1.1.

[h] 200 acres of the 700-acre commitment under Objective GGS2.3 assumed to be a non-rice crop type.

[i] Of the 400 acres of grassland created or protected under Objectives GGS1.2 and 2.3, assume 200 acres protected and 200 acres restored. Additionally, for the 1,000 acres of grassland protected or created as "rice or equivalent" under Objectives GGS1.4 and GGS3.1 assume 500 acres are protected and 500 are restored.

[j] Managed wetland protection will be in Suisun Marsh, outside the range of the giant garter snake.

[k] 35% of total benefit calculated here will be carried forward to Table 5.6-7 *Net Effects, Wildlife*, see Appendix 2A.29 *Western Pond Turtle Species Account* for details.

[l] Under Objective GNC1.1, minimum grassland protection commitment in CZ8 where California red-legged frog habitat overlaps 100% with areas targeted for grassland protection.

[m] Under Objective GNC1.1, total minimum commitments for CZs 1, 8, and 11 where grassland protection overlaps with California tiger salamander habitat.

1 **Table 5J.B-3. Natural Community Restoration Contributing to Covered Species Conservation—Plants**

Resource	Acres of Modeled Habitat Comprising the Natural Community	Total Acres of Natural Community in the Plan Area	Percentage of Modeled Habitat Comprising the Natural Community (%)	Total Acres of Natural Community Restoration	Estimated Contribution of Natural Community Restoration to Species Habitat Restoration	Minimum Restoration Commitment from Natural Community BGOs	Minimum Restoration Commitment from Species-Specific BGOs
Plants							
Brittlescale							
Habitat							
Alkali Seasonal Wetland Complex	23	3,723	0.6	72	**0**		
Grassland	174	78,047	0.2	2,000	**4**		
Vernal Pool Complex	182	12,132	1.5	67	**1**		
Heartscale							
Habitat							
Alkali Seasonal Wetland Complex	541	3,723	14.5	72	**10**		
Grassland	3,189	78,047	4.1	2,000	**82**		
Vernal Pool Complex	2,721	12,132	22.4	67	**15**		
San Joaquin spearscale							
Habitat							
Alkali Seasonal Wetland Complex	2,561	3,723	68.8	72	**50**		
Grassland	7,126	78,047	9.1	2,000	**183**		
Vernal Pool Complex	4,790	12,132	39.5	67	**26**		
Carquinez goldenbush							
Habitat							
Alkali Seasonal Wetland Complex	19	3,723	0.5	72	**0**		
Grassland	536	78,047	0.7	2,000	**14**		
Vernal Pool Complex	616	12,132	5.1	67	**3**		
Delta button celery							
Habitat							
Alkali Seasonal Wetland Complex	94	3,723	2.5	72	**2**		
Grassland	1,547	78,047	2.0	2,000	**40**		
Valley/Foothill Riparian	768	17,966	4.3	5,000	**214**		
Vernal Pool Complex	370	12,132	3.1	67	**2**		
Delta mudwort							
Habitat							
Tidal Brackish Emergent Wetland	364	8,501	4.3	6,000	**257**		
Tidal Freshwater Emergent	762	8,856	8.6	24,000	**2,065**		

Resource	Acres of Modeled Habitat Comprising the Natural Community	Total Acres of Natural Community in the Plan Area	Percentage of Modeled Habitat Comprising the Natural Community (%)	Total Acres of Natural Community Restoration	Estimated Contribution of Natural Community Restoration to Species Habitat Restoration	Minimum Restoration Commitment from Natural Community BGOs	Minimum Restoration Commitment from Species-Specific BGOs
Wetland							
Valley/Foothill Riparian	954	17,966	5.3	5,000	**265**		
Mason's lilaeopsis							
Habitat							
Tidal Brackish Emergent Wetland	364	8,501	4.3	6,000	**257**		
Tidal Freshwater Emergent Wetland	762	8,856	8.6	24,000	**2,065**		
Valley/Foothill Riparian	954	17,966	5.3	5,000	**265**		
Delta tule pea							
Habitat							
Tidal Brackish Emergent Wetland	5,185	8,501	61.0	6,000	**3,659**		
Valley/Foothill Riparian	477	17,966	2.7	5,000	**133**		
Suisun marsh aster							
Habitat							
Tidal Brackish Emergent Wetland	5,185	8,501	61.0	6,000	**3,659**		
Valley/Foothill Riparian	477	17,966	2.7	5,000	**133**		
Side-flowering skullcap							
Habitat							
Valley/Foothill Riparian	2,497	17,966	13.9	5,000	**695**		
Slough thistle							
Habitat							
Valley/Foothill Riparian	768	17,966	4.3	5,000	**214**		
Soft bird's-beak							
Habitat							
Tidal Brackish Emergent Wetland	1,129	8,501	13.3	1,500	199	**1,500**	
Suisun thistle							
Habitat							
Tidal Brackish Emergent Wetland	1,281	8,501	15.1	1,500	226	**1,500**	
Vernal Pool Plants							
Alkali milk-vetch							
Alkali Seasonal Wetland							
Alkali Seasonal Wetland Complex	188	3,723	5.0	72	**4**		
Degraded Vernal Pool Complex							
Vernal Pool Complex	2,576	12,132	21.2	67	**14**		

Resource	Acres of Modeled Habitat Comprising the Natural Community	Total Acres of Natural Community in the Plan Area	Percentage of Modeled Habitat Comprising the Natural Community (%)	Total Acres of Natural Community Restoration	Estimated Contribution of Natural Community Restoration to Species Habitat Restoration	Minimum Restoration Commitment from Natural Community BGOs	Minimum Restoration Commitment from Species-Specific BGOs
Vernal Pool Complex		3					
Vernal Pool Complex	8,709	12,132	71.8	67	**48**		
Legenere							
Alkali Seasonal Wetland							
Alkali Seasonal Wetland Complex	188	3,723	5.0	72	**4**		
Degraded Vernal Pool Complex							
Vernal Pool Complex	2,576	12,132	21.2	67	**14**		
Vernal Pool Complex							
Vernal Pool Complex	8,709	12,132	71.8	67	**48**		
Heckard's peppergrass							
Alkali Seasonal Wetland							
Alkali Seasonal Wetland Complex	188	3,723	5.0	72	**4**		
Degraded Vernal Pool Complex							
Vernal Pool Complex	2,576	12,132	21.2	67	**14**		
Vernal Pool Complex							
Vernal Pool Complex	8,709	12,132	71.8	67	**48**		
Boggs lake hedge-hyssop							
Alkali Seasonal Wetland							
Alkali Seasonal Wetland Complex	188	3,723	5.0	72	**4**		
Degraded Vernal Pool Complex							
Vernal Pool Complex	2,576	12,132	21.2	67	**14**		
Vernal Pool Complex							
Vernal Pool Complex	8,709	12,132	71.8	67	**48**		
Dwarf downingia							
Alkali Seasonal Wetland							
Alkali Seasonal Wetland Complex	188	3,723	5.0	72	**4**		
Degraded Vernal Pool Complex							
Vernal Pool Complex	2,576	12,132	21.2	67	**14**		
Vernal Pool Complex							
Vernal Pool Complex	8,709	12,132	71.8	67	**48**		

BGOs = Biological Goals and Objectives.

1 **Table 5J.B-4. Natural Community Protection Contributing to Covered Species Conservation—Plants**

Resource	Acres of Modeled Habitat Comprising the Natural Community	Total Acres of Natural Community in the Plan Area	Percentage of Modeled Habitat Comprising the Natural Community (%)	Total Acres of Natural Community Protection	Estimated Contribution of Natural Community Protection to Species Habitat Protection	Minimum Protection Commitment from Natural Community BGOs	Minimum Protection Commitment from Species-Specific BGOs
Plants							
Brittlescale[a]							
Habitat							**75**
Alkali Seasonal Wetland Complex	23	3,723	0.6	150	**1**		
Grassland	174	78,047	0.2	8,000	**18**		
Vernal Pool Complex	182	12,132	1.5	600	**9**		
Heartscale[a]							
Habitat							**75**
Alkali Seasonal Wetland Complex	541	3,723	14.5	150	**22**		
Grassland	3,189	78,047	4.1	8,000	**327**		
Vernal Pool Complex	2,721	12,132	22.4	600	**135**		
San Joaquin spearscale							
Habitat							
Alkali Seasonal Wetland Complex	2,561	3,723	68.8	150	**103**		
Grassland	7,126	78,047	9.1	8,000	**730**		
Vernal Pool Complex	4,790	12,132	39.5	600	**237**		
Carquinez goldenbush							
Habitat							
Alkali Seasonal Wetland Complex	19	3,723	0.5	150	**1**		
Grassland	536	78,047	0.7	8,000	**55**		
Vernal Pool Complex	616	12,132	5.1	600	**30**		
Delta button celery							
Habitat							
Alkali Seasonal Wetland Complex	94	3,723	2.5	150	**4**		
Grassland	1,547	78,047	2.0	8,000	**159**		
Valley/Foothill Riparian	768	17,966	4.3	750	**32**		
Vernal Pool Complex	370	12,132	3.1	600	**18**		
Delta mudwort							
Habitat							
Tidal Brackish Emergent Wetland	364	8,501	4.3	0	**0**		
Tidal Freshwater Emergent Wetland	762	8,856	8.6	0	**0**		
Valley/Foothill Riparian	954	17,966	5.3	0[a]	**0**		

Resource	Acres of Modeled Habitat Comprising the Natural Community	Total Acres of Natural Community in the Plan Area	Percentage of Modeled Habitat Comprising the Natural Community (%)	Total Acres of Natural Community Protection	Estimated Contribution of Natural Community Protection to Species Habitat Protection	Minimum Protection Commitment from Natural Community BGOs	Minimum Protection Commitment from Species-Specific BGOs
Mason's lilaeopsis							
Habitat							
Tidal Brackish Emergent Wetland	364	8,501	4.3	0	**0**		
Tidal Freshwater Emergent Wetland	762	8,856	8.6	0	**0**		
Valley/Foothill Riparian	954	17,966	5.3	0[a]	**0**		
Delta tule pea							
Habitat							
Tidal Brackish Emergent Wetland	5,185	8,501	61.0	0	**0**		
Valley/Foothill Riparian	477	17,966	2.7	0[a]	**0**		
Suisun marsh aster							
Habitat							
Tidal Brackish Emergent Wetland	5,185	8,501	61.0	0	**0**		
Valley/Foothill Riparian	477	17,966	2.7	0[a]	**0**		
Side-flowering skullcap							
Habitat							
Valley/Foothill Riparian	2,497	17,966	13.9	0[a]	**0**		
Slough thistle							
Habitat							
Valley/Foothill Riparian	768	17,966	4.3	750	32	**750**	
Soft bird's-beak							
Habitat							
Tidal Brackish Emergent Wetland	1,129	8,501	13.3	0	**0**		
Suisun thistle							
Habitat							
Tidal Brackish Emergent Wetland	1,281	8,501	15.1	0	**0**		
Vernal Pool Plants							
Alkali milk-vetch							
Alkali Seasonal Wetland							
Alkali Seasonal Wetland Complex	188	3,723	5.0	150	**8**		
Degraded Vernal Pool Complex							
Vernal Pool Complex	2,576	12,132	21.2	0	**0**		
Vernal Pool Complex							
Vernal Pool Complex	8,709	12,132	71.8	600	431	**600**	

Resource	Acres of Modeled Habitat Comprising the Natural Community	Total Acres of Natural Community in the Plan Area	Percentage of Modeled Habitat Comprising the Natural Community (%)	Total Acres of Natural Community Protection	Estimated Contribution of Natural Community Protection to Species Habitat Protection	Minimum Protection Commitment from Natural Community BGOs	Minimum Protection Commitment from Species-Specific BGOs
Legenere							
Alkali Seasonal Wetland							
Alkali Seasonal Wetland Complex	188	3,723	5.0	150	**8**		
Degraded Vernal Pool Complex							
Vernal Pool Complex	2,576	12,132	21.2	0	**0**		
Vernal Pool Complex							
Vernal Pool Complex	8,709	12,132	71.8	600	431	**600**	
Heckard's peppergrass							
Alkali Seasonal Wetland							
Alkali Seasonal Wetland Complex	188	3,723	5.0	150	**8**		
Degraded Vernal Pool Complex							
Vernal Pool Complex	2,576	12,132	21.2	0	**0**		
Vernal Pool Complex							
Vernal Pool Complex	8,709	12,132	71.8	600	431	**600**	
Boggs lake hedge-hyssop							
Alkali Seasonal Wetland							
Alkali Seasonal Wetland Complex	188	3,723	5.0	150	**8**		
Degraded Vernal Pool Complex							
Vernal Pool Complex	2,576	12,132	21.2	0	**0**		
Vernal Pool Complex							
Vernal Pool Complex	8,709	12,132	71.8	600	431	**600**	
Dwarf downingia							
Alkali Seasonal Wetland							
Alkali Seasonal Wetland Complex	188	3,723	5.0	150	**8**		
Degraded Vernal Pool Complex							
Vernal Pool Complex	2,576	12,132	21.2	0	**0**		
Vernal Pool Complex							
Vernal Pool Complex	8,709	12,132	71.8	600	431	**600**	
BGOs = Biological Goals and Objectives.							
[a] Riparian protection under Objective 2.4 unlikely to overlap with the range of Delta mudwort, Mason's lilaeopsis, Delta tule pea, Suisun Marsh aster, or side-flowering skullcap.							

Attachment 5J.C
Analysis of Potential Bird Collisions at Proposed BDCP Powerlines

Date:	September 3, 2013
To:	Laura King Moon, Project Manager, BDCP California Department of Water Resources
Cc:	
From:	Paola Bernazzani Senior Conservation Biologist, ICF International Gary L. Ivey Research Associate, International Crane Foundation
Subject:	**Analysis of Potential Bird Collisions at Proposed BDCP Powerlines**

This memo describes the potential risk to avian species from collision with electrical powerlines that would be installed as part of the Bay Delta Conservation Plan (BDCP) and provides additional analysis of risk and mitigation for the greater sandhill crane (*Grus canadensis tabida*). The following specific factors are addressed.

- Assessment of vulnerability for covered birds.
- Mortality estimates and population-level effects for greater sandhill crane.
- Minimization and mitigation measures for greater sandhill crane based on anticipated levels of take.

1.0 Introduction

1.1 Definitions

Powerlines are rated and categorized by the voltage carried and the purpose served (Avian Power Line Interaction Committee 2006). Because voltages carried by powerlines are typically large, voltage is specified by the kilovolt (kV).

- **Distribution lines:** Electrical lines that are energized at lower voltages (60 kV or below). Up to 3.3 miles of temporary, 34.5-kV distribution lines would be installed under the BDCP; additional distribution lines could be used for mitigation. Typically, distribution lines range in height from 35 to 40 feet (11 to 12 meters) (Figure 1) (Avian Power Line Interaction Committee 2006).
- **Transmission lines:** Electrical lines that are energized at higher voltages (60 kV or above). Under the BDCP, 69-kV and 230-kV transmission lines would be installed. Typically, the higher-voltage (230-kV) lines vary in height from 90 to 110 feet (27 to 34 meters), while the “sub”

transmission (69-kV) lines vary from 50 to 70 feet (15 to 21 meters). (Figure 1) (Avian Power Line Interaction Committee 2006).

- **Ground wire:** An overhead static wire that is installed for protection from lightening (Avian Power Line Interaction Committee 2006).
- **Powerlines:** Electrical lines that include both distribution and transmission lines. Overhead powerlines are often equipped with a ground wire. For purposes of assessing risk from covered activities in the discussion below, ground wires are included as "powerlines."

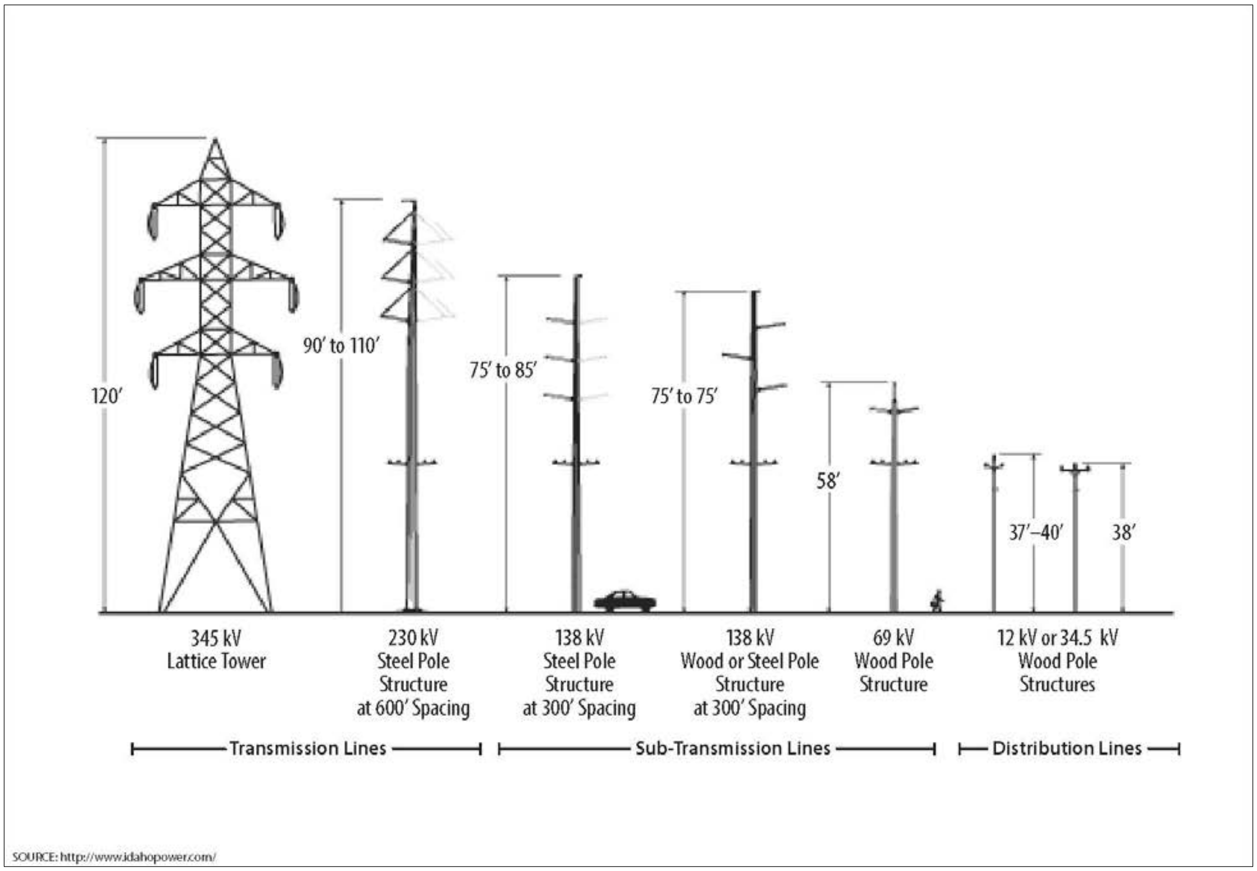


Figure 1. Typical Powerline Structures and Heights

1.2 Background

Implementation of the BDCP would require installation of powerlines to provide temporary power for construction of new tunnels and pumping facilities. Permanent power is also needed to operate three new intakes on the Sacramento River. Risks to birds from powerlines are described in this memo.

Millions of birds are thought to be injured or killed by powerline interactions each year (Erickson et al. 2005; Hunting 2002a). Two main sources of powerline mortality are collision and electrocution. Electrocution occurs when a bird, usually one with a large wingspan, touches two conductors of different phases or a conductor and a ground at the same time (Avian Power Line Interaction Committee 2006). This typically happens when a bird attempts to perch on a structure with insufficient clearance between these elements, often on distribution lines with voltages less than 60 kV (Avian Power Line Interaction Committee 2006). Because the majority of the lines that BDCP is constructing are higher-voltage transmission lines (no permanent lines below 69 kV are proposed) and because adequate clearance would be provided between conductors or between conductors and ground wires (e.g., 60 inches [1.5 meters] of horizontal separation and 40 inches [1 meter] of vertical separation), electrocution is anticipated to be a negligible source of mortality and therefore is not analyzed further here. Covers on phases or grounds will be installed where adequate separation is not feasible (Avian Power Line Interaction Committee 2006).

Bird mortality is also caused by direct collision with powerlines that can be difficult for birds to see, particularly in bad weather. Collision mortality is commonly associated with ground wires, which are found above transmission lines and are thinner and less visible. Ground wires would be installed, under the BDCP, and risks associated with ground wires are included as part of the risk analysis described below. Over 80% of collision fatalities at transmission lines occur through collision with the ground wire (James and Haak 1979; Hunting 2002b). Collision risk at powerlines can be exacerbated by factors that are biological (e.g., age and sex of birds), physical (e.g., topography), meteorological (e.g., winds, fog), and structural (e.g., line location and design) (Avian Power Line Interaction Committee 1994; Bevanger 1994). Cranes, bustards, flamingos, waterfowls, shorebirds, game birds, and some falcons are the bird groups most frequently affected by transmission line collisions (Jenkins et al. 2010).

Despite the fact that several studies have established a strong correlation between powerlines, including ground wires, and collisions risk (e.g., Avian Power Line Interaction Committee 1994; Bevanger 1994, 1998; Janss and Ferrer 2000; Erickson et al. 2005), few estimates of collision mortality exist, and most are based on extrapolations from individual or small-scale studies. A quantitative estimate of powerline mortality requires dedicated surveys (Bevanger 1998), which are time-consuming and costly to undertake. Absent specific information on the mortality rates of covered bird species at transmission lines, this memorandum provides a qualitative discussion of the relative vulnerability of each covered bird species to assess the potential for significant effects from transmission line strikes. Subsequently, this memorandum provides a species-specific risk assessment for greater sandhill crane, the species identified by the vulnerability analysis as at high risk from collision mortality. Powerline collision is thought to be an influential factor in ongoing population declines in several species of cranes (Jenkins et al. 2010), which have large body size, fast flight, flocking behavior, long appendages, and low maneuverability—all risk factors for powerline collision (Bevanger 1998; Hunting 2002b). This memorandum provides a collision risk map, mortality assessment for individuals and populations of cranes, and a mitigation strategy.

1.3 Location and Extent of Facilities

Additional powerlines would provide permanent electric power for new intakes, pumping plants, operable barriers, and gate control structures constructed as part of the BDCP. Also, temporary powerlines would provide power during construction of water conveyance facilities. All proposed permanent lines within the Plan Area are transmission lines (230- and 69-kV and associated ground wires). Temporary lines are both transmission (230-kV) and distribution (34.5-kV).

Under the proposed powerline alignment, power would be delivered to the water conveyance facilities using a "split" system that connects to the existing grid at two different locations. The northern point of interconnection would be located north of Lambert Road and west of Highway 99. From that location, a 230-kV transmission line would run west along Lambert Road for approximately 5 miles, at which point one segment would run south to the intermediate forebay on Glannvalle Tract and then on to tunnel shaft locations on Staten Island. Those segments extending south of the intermediate forebay on McCormack-Williamson Tract and Staten Island are temporary and would be removed following construction of associated tunnel facilities. The other segment would run north to a substation, where permanent, 69-kV lines would connect to the intake pumping plants.

In the south, the interconnection would be either southeast of Brentwood near Brentwood Boulevard or adjacent to the Jones Pumping Plant. A 230-kV line would stretch from one of these locations to a tunnel shaft northwest of Clifton Court Forebay and continue north following tunnel shaft locations to Bouldin Island, where a 34.5-kV line would continue to the southern end of Staten Island. All of the power lines extending from the southern point of interconnection would be temporary, limited to the construction schedule for the relevant tunnel reaches and features associated with Clifton Court Forebay.

The proposed alignment requires the installation of approximately 20 miles (32 kilometers) of permanent transmission line (14 miles [23 kilometers] of 230-kV lines and 6 miles [10 kilometers] of 69-kV lines) (Table 1).

Table 1. Proposed Powerlines in the Plan Area

Powerlines	Voltage (kV)	Length (Miles)
Permanent	230	14
	69	6
Total Permanent		20
Temporary	230	35
	34.5	3
Total Temporary		38
Total		**58**

The length of temporary lines is approximately 38 miles (61 kilometers) (3 miles [56 kilometers] of 34.5-kV line and 35 miles [5 kilometers] of 230-kV line). Temporary lines will be removed after construction of the water conveyance facilities, within 10 years.

2.0 Vulnerability Analysis

Covered bird species were individually assessed to determine the relative risk of collision with the proposed BDCP powerlines and to evaluate whether this risk should be further analyzed, quantified, and mitigated for in the BDCP. The BDCP covers 12 bird species (information on the habitat and distribution of these species in the Plan Area is summarized in Exhibit 1). To assess the risk of powerline collision for each species, a brief analysis of physiological and behavior characteristics is provided. This information is synthesized and, using best professional judgment, a recommendation is made regarding the need for additional analyses.

As discussed above, many factors contribute to the risk of bird collisions with powerlines, including characteristics of the facility. However, all non-biological factors being equal, the relative vulnerability of a bird species to collision mortality depends primarily on its level of exposure (or proximity of the bird's habitat and resources to the powerline) and its sensitivity (morphological and behavioral characteristics that influence the bird's propensity to collide with a line).

For all species, exposure was determined by overlaying occurrences and modeled habitat with the proposed powerline alignment (Exhibit 2, Figures 2-1 through 2-12), using geographic information systems (GIS) (California Department of Fish and Game 2010). Results indicate that 8 of the 11 covered species have been observed within 6 kilometers of the proposed alignment. Species that were at farther distances were the California clapper rail, Suisun song sparrow, and least Bell's vireo. However, all species are discussed below, because covered birds may become more abundant in the Plan Area as the result of enhancement activities, and occurrence data may not accurately reflect species presence.

In addition, factors such as maneuverability, flight altitude, flight times, foraging, flocking, eyesight, and migration behavior were considered, to the extent that this information was available for each species.

Maneuverability

A bird's maneuverability is influenced by wing morphology and size. Maneuverability is one of the most important factors influencing the risk of powerline collision, because it determines a bird's ability to negotiate an obstacle while in flight (Rayner 1988; Bevanger 1994, 1998; Savereno et al. 1996). Different wing shapes correspond to different tradeoffs between speed, energy use, and agility (Bevanger 1998). Wing shape can be described in terms of wing loading—the ratio of bird weight to wing area (a small bird with large wings has low wing loading, while a large bird with small wings has high loading) and wing aspect ratio—the ratio of wing length to wing breadth.

The particular combination of wing loading and aspect ratio determines the type of flight that is possible, as discussed in detail in Rayner (1988) and Bevanger (1998). In general, birds with *low wing loading* and *high aspect-ratio wings* can maneuver relatively quickly around an obstacle. These wings allow rapid flight and quick, evasive actions. Birds with a *high wing loading* and *low aspect-ratio wings* have limited maneuverability and are therefore more susceptible to collision. Body size, in combination with wing morphology, influences a bird's maneuverability, with larger body sizes corresponding to reduced maneuverability, especially in species with relatively small wings.

Rails, followed by cranes, display the greatest vulnerability based on wing-shape morphology, with low-aspect and high- or moderate-loading wings, respectively. The remaining covered bird species show a range of low (owls, hawks), medium (cuckoo), and high (kites, falcons, terns, some passerines) wing aspect ratios, but all have relatively low loading, which decreases their general risk of collision (Bevanger 1998). Maneuverability is discussed for each species.

Flight Altitude

Collision risk associated with flight altitude depends on the heights of the lines and ground wires and the flight behavior of a given species. (Meyer 1978; James and Haak 1979; Beaulaurier 1981). As mentioned above, the powerlines that will be installed by the BDCP range from 50 to 110 feet.

For discussion purposes, the risk of collision is higher if birds commute to foraging areas within the range of the anticipated height of BDCP distribution and transmission lines. Migration altitudes are typically higher than 110 feet (33.5 meters) as noted in the descriptions below.

Flight Times

Species that are active at dawn or dusk and nocturnally active species are more susceptible to collision because of low light conditions and reduced visibility (Bevanger 1994; Crowder and Rhodes 2001). In addition, in the Central Valley, the collision risk is elevated for overwintering birds because visibility is greatly reduced during the frequent dense fog and rains that occur in winter.

Foraging

Collisions are more likely where powerlines transect or parallel areas used for foraging (Scott et al. 1972; Brown et al. 1987; Morkill and Anderson 1991; Brown and Drewien 1995; Murphy et al. 2009).

Flocking

Birds in large flocks have less maneuverability and visibility when at the back of the flock (Scott et al. 1972). Daily flock movements between feeding, breeding, and roosting areas place flocking species at high risk of collision compared to species that do not flock (Avian Power Line Interaction Committee 1994).

Vision

Raptors, and other birds of prey, have excellent eyesight and tend not to fly in low-visibility conditions, making them less likely to collide with powerlines (Olendorff and Lehman 1986). Vision is discussed as it pertains to reducing collision risk for relevant species below.

Migration

During migration, birds may collide with overhead wires; however, collisions are more likely associated with taller structures such as communications towers or smoke stacks (Avian Power Line Interaction Committee 1994). Nocturnal migration is the most common contributing factors to these collisions (Avian Power Line Interaction Committee 1994). In general, daytime migrations do not create major collision risk with overhead wires for birds. Except for landing and taking off, most migrants fly well above powerlines (Avian Power Line Interaction Committee 1994). Rather, most powerline collisions occur during flights in daily use areas associated with commuting or foraging (Avian Power Line Interaction Committee 1994). However, during migration, migratory species cross numerous powerlines on the way to and from their wintering grounds and, in general, may be expected to experience greater risk of collisions than resident species (Bevanger 1994).

2.1 California Black Rail

The California black rail is found in the Plan Area year-round. Unlike other subspecies of black rail, the California black rail is largely sedentary and is either nonmigratory or only locally migratory (Eddleman et al. 1994). Migratory and juvenile dispersal movements tend to be localized (Trulio and Evens 2000) with seasonal migratory and dispersal movement occurring within the breeding range of the species. For example, black rails that nest in the north San Francisco Bay area have been reported to winter in the south San Francisco Bay area (Trulio and Evens 2000).

In the Bay-Delta region, California black rail populations are restricted primarily to the remaining tidal marshlands of the northern San Francisco Bay estuary, the vicinity of Suisun and Napa Marshes, and the midchannel islands in the Delta. In Suisun Marsh, a high abundance of black rails has been found at east Mallard Island, with moderate abundances at South Joice Island, Pacheco Creek, East Peyton Slough, Cutoff Island, Peytonia Slough, and Southampton Bay. Spautz et al. (2005) estimate a population of 12,000 black rails in the Suisun Bay region. Surveys conducted by the California Department of Water Resources (DWR) from 2010 and 2011 document California black rail occurrences in 21 discrete habitat patches located in the central Delta portion of the Plan Area.

This elusive species spends the majority of its life on the ground and hidden in the wetland and adjacent upland canopy, where it forages, breeds, and winters (Evens et al. 1991). The species is not particularly social and does not congregate or flock. While little information is available on its foraging behavior, it is assumed to be an opportunistic daytime feeder that forages exclusively in wetland habitat, presumably on or near the ground at the edges of emergent vegetation (Evens et al. 1991). Daily movements are apparently restricted to the breeding or wintering territory and thus are highly localized and below the wetland and adjacent upland canopy. Movement above the wetland canopy occurs primarily during local, seasonal migration and juvenile dispersal, which occurs from August to October (Trulio and Evens 2000).

The Suisun Marsh population is at least 15 miles (24 kilometers) from the north-south powerline right-of-way and unlikely to be affected by its presence. While the proposed north-south powerline right-of-way does not intersect or is immediately adjacent to any known California black rail occurrences, many of the small populations found in the central Delta are within 4 miles (6 kilometers) of the proposed right-of-way (Exhibit 2, Figure 2-1). These sites represent a relatively small proportion of the population in the Bay-Delta region; however, these populations may contribute to the overall range and dispersal capabilities of the species.

As a taxon, rails are known to suffer mortality from powerline collision, likely associated with transit between foraging areas and/or local, seasonal migration (Eddleman et al. 1994). Due to their wing shape and body size, rails also have low to moderate flight maneuverability (Rayner 1988; Bevanger

1998), increasing susceptibility to collision mortality. However, there are relatively few occurrences of California black rail collisions with overhead wires. Several factors contribute to the relatively low collision susceptibility in this subspecies. Most important among these are daytime site fidelity and a lack of long-distance night migration, considered a principal factor contributing to collision mortality of the species (Eddleman et al. 1994). Movements within the Plan Area are likely short, seasonal, and at low altitudes, typically less than 16 feet (5 meters) (Eddleman et al. 1994). Therefore, while the species may have low to moderate flight maneuverability, its behavior (e.g., sedentary, nonmigratory, ground-nesting and foraging, solitary, no flocking, secretive) reduces potential exposure to overheard wires and vulnerability to collision mortality. No further analysis of California black rail is recommended.

2.2 California Clapper Rail

There are very few occurrences of California clapper rails in the Plan Area. Surveys in Suisun Marsh between 2005 and 2008 found rails only at First Mallard Branch, Rush Ranch, and Goodyear Slough. These surveys estimated the California clapper rail population at less than 13 individuals. The closest occurrence is 20 miles (32 kilometers) from the proposed powerline location. The closest modeled habitat is a little over 11 miles (18 kilometers) from the proposed powerlines, with 1,493 acres of modeled habitat within 20 miles (32 kilometers) (Exhibit 2, Figure 2-2). Isolated patches of suitable habitat may occur in the Plan Area as far east as (but not including) Sherman Island. Home range and territory of the California clapper rail is not known, but in locations outside of California, clapper rail territory ranges 0.3 acre to 8 acres (0.1 to 3.2 hectares) (Rush et al. 2012), indicating that known occurrences are not likely to intersect with the proposed lines. The California clapper rail is nonmigratory; however, some local, seasonal movements occur (e.g., between the north San Francisco Bay area and the south San Francisco Bay area), probably in response to seasonal hydrologic changes and their effect on habitat availability and quality. The location of the current population and suitable habitat for the species make collision with the proposed powerlines highly unlikely. No further analysis of California clapper rail is recommended.

2.3 Greater Sandhill Crane

Greater sandhill cranes overwinter in the Plan Area, including large roost sites on Staten, Bouldin and Tyler Islands, Stone Lakes National Wildlife Refuge (NWR), and Brack and Canal Ranch Tracts (Pogson and Lindstedt 1991; Littlefield and Ivey 2000; Ivey and Herziger 2003). Most of the Delta winter range of the species occurs in the Plan Area. During the winter months (October through March) approximately 2,000 greater sandhill cranes forage and roost in proximity to the proposed powerlines (Exhibit 2, Figure 2-4). Ivey and Herziger (2003) estimated average winter home range sizes of greater sandhill cranes in the Delta to be 0.66 square mile (1.7 square kilometers), varying from 0.07 to 2.12 square miles (0.18 to 5.5 square kilometers). Average distance between roost sites and feeding areas was estimated by Pogson (1990) to be 1.74 miles (2.8 kilometers) and by Ivey and Herziger (2003) to be 0.88 mile (1.4 kilometer) (range 0.17 to 1.89 miles [0.27 to 3 kilometers]). Active during the day, sandhill cranes fly frequently between roost and foraging areas, after which they settle down at traditional roost sites for the night.

Several aspects of the species' behavior and morphology make greater sandhill cranes particularly susceptible to collisions with overhead wires. Most importantly, flight altitudes during daytime movements are within the range of heights for the proposed lines (50 to 110 feet [15 to 33.5 meters]). Therefore, the species is frequently in the risk zone, which increases collision potential.

Because most crane movement occurs within 2 miles (3.2 kilometers) of their primary roost, the proximity of the powerlines is a key issue in evaluating collision risk for cranes. Several known roosting sites are less than 2 miles (3.2 kilometers) from the proposed alignment (Exhibit 2, Figure 2-4) and are known to intersect with traditional flight patterns (Ivey pers. comm.). Delta wintering cranes are also regularly exposed to dense fog, which limits visibility and increases mortality risk from collision with powerlines. While overall movement may decrease during foggy conditions, greater sandhill cranes are known to fly in the fog, increasing their susceptibility to collision with overhead wires. In addition, this species flies in flocks moving several times a day between feeding and roosting areas. Flocking behavior increases collision risk compared to non-flocking species due to decreased visibility toward the end of the flock. Lastly, the crane's large body size, with high wing loading/low aspect ratio, limits maneuverability making cranes vulnerable to collision relative to more agile species.

In addition to collision as a result of daytime travel between roosts and foraging areas, cranes also experience nighttime mortality when flushed from their roosts (e.g., by coyotes), further contributing to an increased risk of collision when powerlines are located near roost sites.

Migration flight could cause limited risks for cranes. Cranes arrive in the Delta region beginning in early September, where they reside until late February to early March, when they begin their northward migration back to the breeding grounds. Migration flights usually begin after mid-morning, when thermals develop and finish before or just after sunset. During migration, birds fly at altitudes of up to 11,800 feet. (3,600 meters), with most flights between 490 and 2,500 feet. (150 and 760 meters), far above the height of proposed powerlines (Tacha et al. 1992). However, cranes are exposed to collision risk during takeoff and landing associated with migration.

Collectively, the species' foraging and flocking behavior, its presence during winter months of reduced visibility, and its lack of maneuverability make this species highly vulnerable to powerline collision. This assessment concurs with findings in the published literature describing crane mortality as a result of powerline collision (Avian Power Line Interaction Committee 1994; Bevanger 1994; Bevanger 1998; Brown et al. 1987; Brown and Drewien 1995; Hunting 2002a; Yee 2008). Because of the crane's high level of vulnerability to powerline collision, an additional assessment of mortality, minimization, and mitigation is provided below.

2.4 Least Bell's Vireo

Least bell's vireo is not currently found in the Plan Area and there are no records of least Bell's vireos breeding in the Plan Area since at least the 1970s. Two singing males were detected in the Yolo Bypass Wildlife Area in mid-April 2010, and again in 2011; no least Bell's vireos were detected in the Yolo Bypass Wildlife Area in 2012 (California Department of Fish and Game 2012). The species typically occurs in early to mid-successional riparian habitat, which is used to meet all of its life requisites. Least Bell's vireo are rarely observed in open habitats away from riparian vegetation. The species does not form flocks and generally remains at or below the riparian canopy. Other than narrow and sparse patches along watercourses, suitable early-to mid-successional riparian habitat is relatively uncommon the Plan Area and particularly in the vicinity of the proposed powerlines. While the species is expected to recolonize the Plan Area during the permit term, this is expected to occur primarily in response to BDCP riparian restoration, which will occur largely in Conservation Zone 7, outside the 6-km buffer zone for the new powerlines (Exhibit 2, Figure 2-5). Territory size ranges from 0.5 to 7.5 acres (0.2 to 3 hectares), but on average are between 1.5 and 2.5 acres (0.6 and 1 hectare) in California (U.S. Fish and Wildlife Service 1998). The lack of occurrences in the Plan Area, the lack of current and future higher value habitat patches in the vicinity of the proposed powerlines, and the behavior and habitat requirements of the species make collision with the proposed powerlines highly unlikely. No further analysis of least Bell's vireo is recommended.

2.5 Suisun Song Sparrow

The range of the Suisun song sparrow extends eastward into the Plan Area to approximately Kimball Island. There are several reported occurrences from Kimball Island, Browns Island, and in the Suisun Marsh in the western portion of the Plan Area. These known occurrences, along with areas of suitable habitat, are far from both of the proposed North-South and East-West powerline routes (Exhibit 2, Figure 2-6). During the breeding season, the Suisun song sparrow occupies small territories (approximately 0.1 acre [0.04 hectares] in optimal habitat), usually adjacent to the territories of other Suisun song sparrows in a single linear arrangement along the edges of sloughs and bays. During the fall and winter, adults and young may range up to 600 feet (183 meters) from the territory and occupy adjacent seasonal marshes or grasslands, while continuing to occupy the same general area and return to the same breeding territory each year (Marshall 1948; Walton 1975), indicating that known occurrences are not likely to intersect with the proposed lines. Location of the current population, behavior, range, and suitable habitat in the plan area make collision with the proposed powerlines highly unlikely. No further analysis of Suisun song sparrow is recommended.

2.6 Swainson’s Hawk

Swainson’s hawks are found in the Plan Area from early March through mid-September. A small number, from approximately 16 to 30 individuals, is also known to overwinter in the Delta (Exhibit 2, Figure 2-7) (Herzog 1996). A relatively common breeding raptor in the Plan Area, the nesting distribution extends throughout most of the Plan Area, and foraging is likely to occur in agricultural and grassland habitats. At least 85 nests were documented throughout the Delta during limited surveys in 2009, and a total nesting population of at least 300 nesting pairs is estimated within the Plan Area, including occurrences near proposed powerline facilities. A very dense nesting population occurs immediately west of the Plan Area boundary in Yolo and Solano Counties (Estep 2008; LSA 2004). The species is territorial during the breeding season, particularly near the nest site but will also forage communally with other Swainson’s hawks away from its nest. During migratory and wintering periods, the species is more social, foraging and migrating in groups (Estep 1989; Babcock 1995; England et al. 1997). However, while the species does congregate in foraging and premigratory groups, individual movements are independent of the group, thereby minimizing collision risk for groups of Swainson's hawks, as opposed to typical flocking behavior where individual movements are more interdependent and thus may increase collision risk for birds within the flock.

The species is an aerial predator that hunts primarily from the wing typically at altitudes ranging from 98 to 295 feet (30 to 90 meters) (Estep 1989; England et al 1997), although higher altitudes have been reported (Fitzner 1980). Circling above grassland and farmland foraging habitats, prey are captured by rapidly diving or stooping toward the ground. Other typical flight behaviors include high-elevation courtship flight and high-elevation, midday soaring. While Swainson's hawks hunt within the range of heights proposed for the new powerlines (50 to 110 feet [15 to 33.5 meters]), their keen vision and high maneuverability substantially reduce powerline collision risk for the species. Like other diurnal raptors, Swainson's hawks have highly developed eyesight (Jones et al. 2007), allowing them to detect small prey while hunting from relatively high altitudes. Keen eyesight also allows for detection and avoidance of other aerial objects, including aboveground utility lines. Like many other Falconiformes, Swainson's hawk has a long, narrow, tapered wings and body size that allow for efficient soaring flight and highly developed aerial maneuverability. In addition, Swainson's hawks are rarely active during inclement weather and are not typically observed in flight during rainy or foggy conditions (Fiztner 1980).

The species' general maneuverability, its keen eyesight, and fair-weather flight behavior, make it a low relative risk for powerline collision mortality. Mortality associated with powerline collision is not anticipated to affect the Plan Area population, and no further analysis of Swainson's hawk is recommended.

2.7 Tricolored Blackbird

Historical records indicate breeding colonies of the tricolored blackbird have occurred within the Plan area along the eastern edge of the Suisun Marsh in Bird's Landing, west of French Camp along the south eastern edge of the plan area, and locations outside of the Plan Area including areas near Davis, Napa, Elk Grove, Vernalis, and two occurrences just north of the Plan Area boundary (California Department of Fish and Game 2012). More recent surveys conducted in the last 15 years have documented tricolored blackbird breeding colonies throughout the Plan Area at sites near Yolo Bypass; near Stockton, Manteca, and Tracy in the southeastern corner of the Plan Area; north of Bradford Island; and along the eastern edge of Suisun Marsh; and along the Sacramento River Deep Water Ship Channel (Information Center for the Environment 2011; Meese 2011). Breeding colonies have also been recorded just outside of the plan area within the past 15 years south of the Plan Area along the San Joaquin River, just outside of the southwest Plan Area boundary, near Vallejo, and east of Woodland outside of the northwest Plan Area boundary (Information Center for the Environment 2011; Meese 2011).

A single nesting colony of about 1,000 breeding adults was recorded during the 2011 statewide survey in the Plan Area along the northern edge of Suisun Marsh (Information Center for the Environment 2011). Between 2009 and 2011, DWR biologists surveyed several thousand acres of potentially suitable tricolored blackbird nesting habitat in the Plan Area (excluding Suisun Marsh and the Potrero Hills area) during the optimal breeding period and detected no nesting colonies (Delta Habitat Conservation and Conveyance Program 2011). There are 31 occurrences within 5 miles (8 kilometers) (Exhibit 2, Figure 2-8). All observations appeared to be foraging birds; no nesting by tricolored blackbirds was confirmed. Although recent nesting colonies in the Plan Area have generally been small (comprising less than 2,000 breeding adults), several larger colonies have been reported from just outside the Plan Area, including colonies of 35,000, 57,000 and 18,900 breeding adults on the Conaway Ranch in the Yolo Bypass north of Interstate 80 in 2007, 2009, and 2010, respectively.

In the Central Valley some tricolored blackbird populations are resident, residing all year in the Central Valley, while some migrate, moving in large flocks from inland breeding locations to wintering habitats in the Delta and coastal areas. Generally, overwintering birds roost in areas dominated by emergent wetland vegetation in and around Bird's Landing in southern Solano County and forage primarily in association with cultivated lands (e.g., irrigated and non-irrigated pasture, rice, corn) between Sacramento and Stockton.

Tricolored blackbirds exhibit different flight behaviors during the nesting and wintering seasons. When nesting, tricolored blackbirds are likely to travel shorter distances between the nesting site and foraging grounds. In order to transport food items back to the nest, they make multiple trips a day between the nest site and foraging grounds. The nature of foraging behavior during the nesting season naturally results in lower flight heights, more direct flight patterns, and smaller, more loosely formed flocks. Lower flight heights means most breeding birds are flying beneath the height of most wires and, where lower wires exist, individuals or small flocks of birds can maneuver to avoid them without issue (Meese pers. comm.).

During the winter, tricolored blackbirds migrate into the Plan Area in large flocks. Altitude during migration is not known, but it is likely that birds have greater potential to strike the proposed powerlines (50 to 110 feet [15 to 33.5 meters]) during migration than during nesting. Wintering birds make daily flights between roosting sites, which are located primarily near Bird's Landing in southern Solano County, and foraging grounds, which are cultivated land types found throughout the Plan Area. Although tricolored blackbirds leave from and return to wintering roost sites in very large flocks, they forage throughout the day in smaller flocks. These smaller flocks move between foraging locations primarily through low-altitude flights. While tricolored blackbirds are likely more vulnerable during migration and overwintering due to larger flock size, likely increased flight altitudes, and dense fog that is common to the area, there has been no evidence of mortality due to collision with overhead wires (Meese pers. comm.).

In summary, tricolored blackbirds have the potential to intersect the proposed powerline routes largely due to winter movements throughout the Plan Area. While migratory flight behavior may increase the risk of strike hazard, daily movements associated with winter foraging likely occur below the height of the lines. In addition, tricolored blackbirds are considered strong and agile flyers with moderately maneuverability (i.e., low wing loading/low aspect ratio) (Beedy et al. 1999) and therefore physically equipped to avoid collision with powerlines. Current scientific evidence and best professional judgment suggest that powerlines are not a significant cause of mortality for tricolored blackbirds (Meese pers. comm.). Mortality associated with powerline collision is not anticipated to affect the Plan Area population, and no further analysis of tricolored blackbird is recommended.

2.8 Western Burrowing Owl

While nesting and wintering burrowing owls could occur in grassland, pastureland, and agricultural habitats throughout most of the Plan Area, the majority of reported occurrences indicate that the species is concentrated in grassland and pasturelands west of the Sacramento Deep Water Ship Channel in Yolo and Solano Counties and in the grassland habitats along the western edge of the Plan Area (roughly between Brentwood/Antioch and Tracy). The species is also found in lower densities elsewhere in the Plan Area, with documented occurrences on Brannan Island and near Suisun Bay and Clifton Court Forebay, and the species may occur elsewhere where habitat, such as grassland and pastureland, is available. Burrowing owls persist in some cultivated or ruderal habitats, such as near Stockton where they are typically found along levees, canals, field edges, and some ruderal habitats or idle fields. However, few burrowing owls have been reported from the central portion of the Delta and the northern Delta east of the Sacramento Deep Water Ship Channel, probably due to regular cultivation, lack of undisturbed habitats, and lack of ground-squirrel populations. The few active sites in this area are generally restricted to levee embankments and along irrigation canals. The species is a year-round resident in the Plan Area; however, local migratory patterns and the extent to which migrants occupy the Plan Area during the non-breeding season are unclear.

Twenty five occurrences are within 1 mile of the southern end of the proposed powerline alignment, and 115 known occurrences are within 5 miles (8 kilometers) of the east-west segment of the northern end (Exhibit 2, Figure 2-9). Potential habitat consisting of high- and low-value grassland is mapped along both the northern and southern portions of the line.

Western burrowing owls forage throughout the day but are largely crepuscular, hunting mostly at dusk and dawn. Hunting in low light can be a risk factor for powerline collision. However owls have acute eyesight adapted to low-light conditions and a wide range of vision. In addition, the species feeds primarily on the ground where it catches insects by walking and hopping or catching from burrow mound or perch (Haug et al. 1993). Burrowing owls may hunt vertebrates from both perch and by hovering low to the ground. Hunting typically occurs at about 33 feet (10 meters) above ground, while direct flights back to the nest (prey delivery) were 3 to 6 feet (1 to 2 meters) above ground and at a flight speed of 33 miles per hour (53 kilometers per hour), keeping the owl out of the range of proposed powerlines (Poulin et al. 2011).

The species is large-bodied but with relatively long and rounded wings, making it moderately maneuverable. While burrowing owls may nest in loose colonies, they do not flock or congregate in roosts or foraging groups. Collectively, the species' keen eyesight and largely ground-based hunting behavior make it a relatively low-risk species for powerline collision. While the species in not widespread in the Plan Area, it may become more widely distributed as grassland enhancement improves habitat for the species. Even so, the risk of effects on the population are low, given its physical and behavioral characteristics. No further analysis of western burrowing owl is recommended.

2.9 Western Yellow-Billed Cuckoo

The western yellow-billed cuckoo is a rare summer resident in California with a disjunct breeding distribution extending through the interior of the Central Valley. While the Plan Area is within the species' breeding range, there have been no confirmed breeding records for the Plan Area or vicinity for several decades (Exhibit 2, Figure 2-10). Studies conducted since the 1970s indicate that there may be fewer than 50 breeding pairs in California (Gaines 1974; Halterman 1991; Laymon et al. 1997). While a few occurrences have been detected elsewhere recently, the only locations in California that currently sustain breeding populations include the Colorado River system in southern California, the South Fork Kern River east of Bakersfield, and isolated sites in remnant riparian patches along the Sacramento River in Glenn, Butte, and Tehama Counties (Laymon and Halterman 1989; Laymon 1998).

While there are few historical records from the Plan Area, presumably the species nested along the Sacramento, San Joaquin, and Mokelumne Rivers and along smaller tributary drainages, including Lost Slough, White Slough, and Disappointment Slough. In 2009, DWR detected one and possibly two western yellow-billed cuckoos in a remnant patch of riparian forest near Mandeville Island. However, breeding status was not confirmed. The Plan Area supports several remnant riparian patches in the vicinity of Mandeville and Medford Islands that provide suitable riparian vegetation for cuckoos but may not provide sufficiently large patch size to support breeding cuckoos.

Portions of both the Sacramento and Mokelumne Rivers are very near to the proposed powerline, with several sections occurring less than 1 mile from these rivers. One occurrence is within one mile (2 kilometers) of the proposed powerline alignment and another is within five miles (8 kilometers). However, based on the species' current status and distribution in the Plan Area, risk of collision with proposed powerlines is very low. Habitat in the Plan Area will be enhanced and the status of the western yellow-billed cuckoo may improve.

Because the western yellow-billed cuckoo uses riparian forests to meet all of its breeding and wintering life requisites, the species remains primarily within the canopy of riparian forests and rarely ventures into open spaces except during migration, limiting its opportunity to encounter the proposed powerlines. As a summer resident, the species occurs in the Plan Area during periods of relatively high visibility and clear weather conditions, thus further reducing collision risk from daily use patterns or seasonal migration flights. Finally, western yellow-billed cuckoo wing shape is characterized by low wing loading and a moderate aspect ratio, making the species moderately maneuverable (Bevanger 1998) and presumably able to avoid collisions, especially during high-visibility conditions.

Because of its rarity in the Plan Area, its proclivity to remain in the riparian canopy, its presence during periods of relative high visibility, and its overall ability to successfully negotiate around overhead wires that it may encounter, the western yellow-billed cuckoo is considered to have a very low susceptibility to collision with overhead wires. No further analysis of the western yellow-billed cuckoo is recommended.

2.10 White-Tailed Kite

The white-tailed kite is a year-round resident in the Plan Area, although relatively few nesting locations have been documented. The California Natural Diversity Database (CNDDB) reports only five locations within the Plan Area (California Department of Fish and Game 2011). Nesting occurrences have been reported in the Delta, along the Sacramento River west of Stone Lake, and in the north-central and east-central Delta. Recent surveys in the Yolo and Sacramento County portions of the Plan Area have documented active nests sites in riparian habitats in the Yolo Bypass and along Steamboat and Georgiana sloughs, and the Sacramento River (Estep 2007, 2008). Surveys from 2009 to 2011 documented 10 active white-tailed kite nest sites (Delta Habitat Conservation and Conveyance Program 2011).

Several of the known occurrences are within 5 miles of both the proposed powerline North-South and East-West routes. Along the north-south route, known occurrence locations have been recorded within 1 mile of the proposed powerline (Exhibit 2, Figure 2-11). Nesting distribution is limited by the dearth of suitable trees in much of the central Delta, and nesting density in that area is likely significantly lower than that found in the northern and southern portions of the Plan Area. The species is territorial, defending relatively small home ranges ranging from approximately 4 to 296 acres (1.6 to 120 hectare) (Dunk and Cooper 1994; Waian 1973; Henry 1983). While tolerant of conspecifics, the species does not flock or typically engage in communal foraging except during the winter when communal roosts will form.

The white-tailed kite is an aerial predator that hunts primarily from the wing at altitudes ranging from 5 to 25 meters. Hovering, or kiting, the kite captures prey by dropping or stooping vertically toward the ground. Other flight behaviors include aerial courtship displays and territorial defense, which the kite engages in near the nest. While white-tailed kite flight behavior puts them regularly within the range of heights proposed for the new transmission lines (50 to 110 feet), their keen vision and high maneuverability substantially reduce powerline collision risk for the species. Like other diurnal raptors, white-tailed kites have highly developed eyesight (Jones et al. 2007), allowing them to detect small prey while hunting from relatively high altitudes. Keen eyesight also allows for detection and avoidance of other aerial objects, including above-ground utility lines. Like many other Falconiformes, the white-tailed kite has long, narrow, tapered wings and body size that allow for efficient soaring flight and highly developed aerial maneuverability. While kites occur in the Central Valley during the winter months when dense fog can reduce visibility, the species is not usually active during inclement weather and not typically observed in flight during rainy or foggy conditions.

Therefore, while the species may be frequently within the risk zone of the proposed powerlines, its general maneuverability, its keen eyesight, and lack of flocking behavior make it a low relative risk for powerline collision mortality. Mortality associated with the proposed powerlines is not anticipated to affect the Plan Area population.

2.11 Yellow-Breasted Chat

The yellow-breasted chat is a neotropical migrant songbird whose range extends from southern Canada to Mexico. Comrack (2008) includes the central Delta within the current breeding range of the yellow-breasted chat. There are few breeding records of the species in the Plan Area. Most occurrences are fall and winter migrants found along Putah Creek near the northern edge of the Plan Area in Yolo and Solano Counties or along the Cosumnes River in the Cosumnes River Preserve. In 2008, the National Audubon Society noted pairs of yellow-breasted chat at Liberty Island, Sherman Island, and Piper Slough in the central Delta. Recent field surveys have confirmed late spring and summer occurrences of chats in the Plan Area (Delta Habitat Conservation and Conveyance Program 2011). Ten occurrences are within one mile (2 kilometers) of the proposed powerlines and 18 are within 5 miles (Exhibit 2, Figure 2-12).

A total of 51 nest sites were identified from 2009 to 2011 (Delta Habitat Conservation and Conveyance Program 2011) within the Plan Area. Territory size ranges from 0.3 to 3.2 acres (0.1 to 1.3 hectares) (Zeiner et al. 1990). Territory sizes have not been measured in California, but in California riparian habitat, breeding densities ranged from 6.5 to 27 males per 247 acres (100 hectares) (Eckerle and Thompson 2001) and Gaines (1974) reported a breeding density from the Sacramento Valley of one chat per 10 acres (4 hectares).

Yellow-breasted chats nest and forage in dense riparian thickets of willows, vines, and brush associated with streams and other wetland habitats. With moderate wing loading and a moderate aspect ratio, the species usually flies through dense vegetation, starting from a high perch and ending on a higher perch or in low, dense vegetation and only occasionally crosses open fields, flying at altitudes of less than 3.2 feet (less than 1 meter), virtually eliminating the risk of collision with proposed powerlines. When foraging, the solitary species gleans prey from foliage of low, dense shrubs or from the ground.

Yellow-breasted chats are migratory and usually arrive at California breeding grounds in April from their wintering grounds in Mexico and Guatemala. Departure for wintering grounds occurs from August to September. These are periods of relative high visibility when the risk of powerline collisions will be low. The species' small, relatively maneuverable body; its foraging behavior; and its presence in the Plan Area during the summer contribute to a low risk of collision with the proposed powerlines. No further analysis of the yellow-breasted chat is recommended.

3.0 Greater Sandhill Crane Effects Analysis

Based on the vulnerability analysis developed above, the greater sandhill crane is the only covered species to exhibit a high risk for collision with proposed powerlines, using the criteria of exposure and sensitivity. This is consistent with the published literature and expert opinion. Therefore, additional efforts to contextualize and quantify risks were developed for the greater sandhill crane.

3.1 Collision Risk Map

A map of the distribution and risk of greater sandhill crane from powerline collisions in the Plan Area was developed to represents the risk of collision spatially and to help identify powerline routes that minimize risk to greater sandhill crane. Over time, the powerline alignment has been significantly shortened to reduce the potential loss of greater sandhill crane due to strikes. DWR engineers, greater sandhill crane experts, and conservation land managers continue to discuss alignment optimization alternatives to further reduce impacts to individuals as well as to roosting and foraging habitat.

Surveys of greater sandhill cranes were conducted during the winters of 2006–2007, 2007–2008, and 2008–2009 by automobile, aircraft, and on foot (Ivey et al. in preparation [a]), and birds outfitted with transmitters were tracked to identify roosting and foraging areas. These efforts quantify the approximate number of night-roosting greater sandhill cranes, with estimates in a roost site complex ranging from 10 to 1,500 birds (Staten Island).

Greater sandhill cranes outfitted with radio transmitters (n = 33) were used to determine the distance between roost sites and foraging areas and the proportion of birds that foraged within different distance intervals of the roost. In other words, studies determined the proportion of the roosting population that can be expected to forage within 1, 2, and 3.7 miles (2, 4, and 6 kilometers) of the roost. Results indicate that all greater sandhill cranes (100%) forage within 1.2 miles (2 kilometers) of the roost site, 18% between 1.2 and 2.5 miles (2 and 4 kilometers) of the roost, 9% between 4 and 5 kilometers, and 5% between 3 and 3.7 miles (5 and 6 kilometers) (Ivey et al. in preparation [b]). In order to weight risk relative to the size of a given roosting site, the number of birds at each roost was divided by 1,500 (the maximum number of greater sandhill crane at a roost-site complex). Using this method, the largest roost site would be standardized to a value of 1 and the smallest roost site (10 birds) would be assigned a value of 0.0067 (10/1500). This value was then multiplied by the percentages derived above to determine the relative risk in a given area based on roost size and distance from the roost. This final number is the collision risk index value. Results were made spatially explicit in ArcGIS, where each cluster of roost sites was buffered by a radius of 1,2, 3, and 3.7 miles (2, 4, 5, and 6 kilometers), and collision risk index values were mapped within those distance categories. In cases where the roost-site buffers overlapped, the values were added together (i.e., risk in that area increased). The final collision risk index values were grouped in the following ranges: 0.001 to 0.01, 0.01 to 0.1, 0.1 to 0.2, 0.2 to 0.4, 0.4 to 0.6, 1.0 to 1.2, and 1.2 to 1.4 (no values between 0.6 and 1.0 were found) and are color coded in Figure 2, which visually represents collision risk within the Plan Area.

3.2 Estimated Collision Mortality of Greater Sandhill Crane

To calculate mortality in the Plan Area, the collision risk index numbers for polygons associated with a particular roost were used to estimate “crossings” where proposed powerlines intersect mapped polygons (Figure 2). Some of these risk polygons overlap and have higher collision risk values because birds from adjacent roosts use the same areas to forage. The values for polygons that intersect a potential line segment associated with a particular roost were averaged, weighted by length of line crossing them, to estimate the number of cranes expected to cross those lines on a daily basis.

Using this approach, an average population size was determined for each line segment, which was then multiplied by 130 days (the mean number of days that greater sandhill crane spend in the Delta wintering area) and by four flights per day (birds going between foraging areas and roost sites twice a day, crossing the lines twice in the morning and twice in the evening). Based on the assumption that the probability of flying out of the roost in a given cardinal direction is 25%, this number was then divided by four, resulting in a crossing estimate for each segment and for the total line (Table 2.). The number of crossings was then multiplied by collision mortality rates that were calculated for greater sandhill crane in the Rocky Mountains of Colorado (Brown and Drewien 1995). These data were used because local or regional data are not available. Brown and Drewien (1995) estimated that annual collision mortality of greater sandhill crane at unmarked lines was between 2.5×10^{-5} (low estimate) and 30.4×10^{-5} collisions per crossing (high estimate). For the purposes of this analysis, the high estimate was used to ensure that all potential impacts were captured.

Because lack of visibility is one of the most commonly implicated causes of collision mortality, live or ground wires can be marked to increase their visibility. While it hasn't been studied, the efficacy of bird flight diverters are likely diminished with reduced visibility associated with the new moon or fog. However, it is reasonable to assume that bird flight diverters still reduce mortality. Other markers also include dampers, hanging plates, and spheres. Marking lines has been shown to decrease collision risk substantially. Brown and Drewien (1995) estimated that annual collision mortality rates of birds at marked lines were reduced by 62 and 66% for two types of markers, and it is likely that birds found dead in these studies were also flying at night. Morkill and Anderson (1991) indicated a 54% reduction in crane mortality at marked lines. In addition to the risk map derived above, collision risk and mortality in the Plan Area were estimated relative to the proposed powerline locations. This was done for both marked and unmarked lines.

Absent line marking, which increases visibility and reduces collision risk (i.e., without minimization measures), the potential annual take of greater sandhill crane is estimated at 18 per year at permanent lines and 120 per year at temporary lines. Assuming a reduction of 66% (Brown and Drewien 1995), potential mortality at marked lines is estimated at 7 per year at permanent lines and 41 per year at temporary lines.

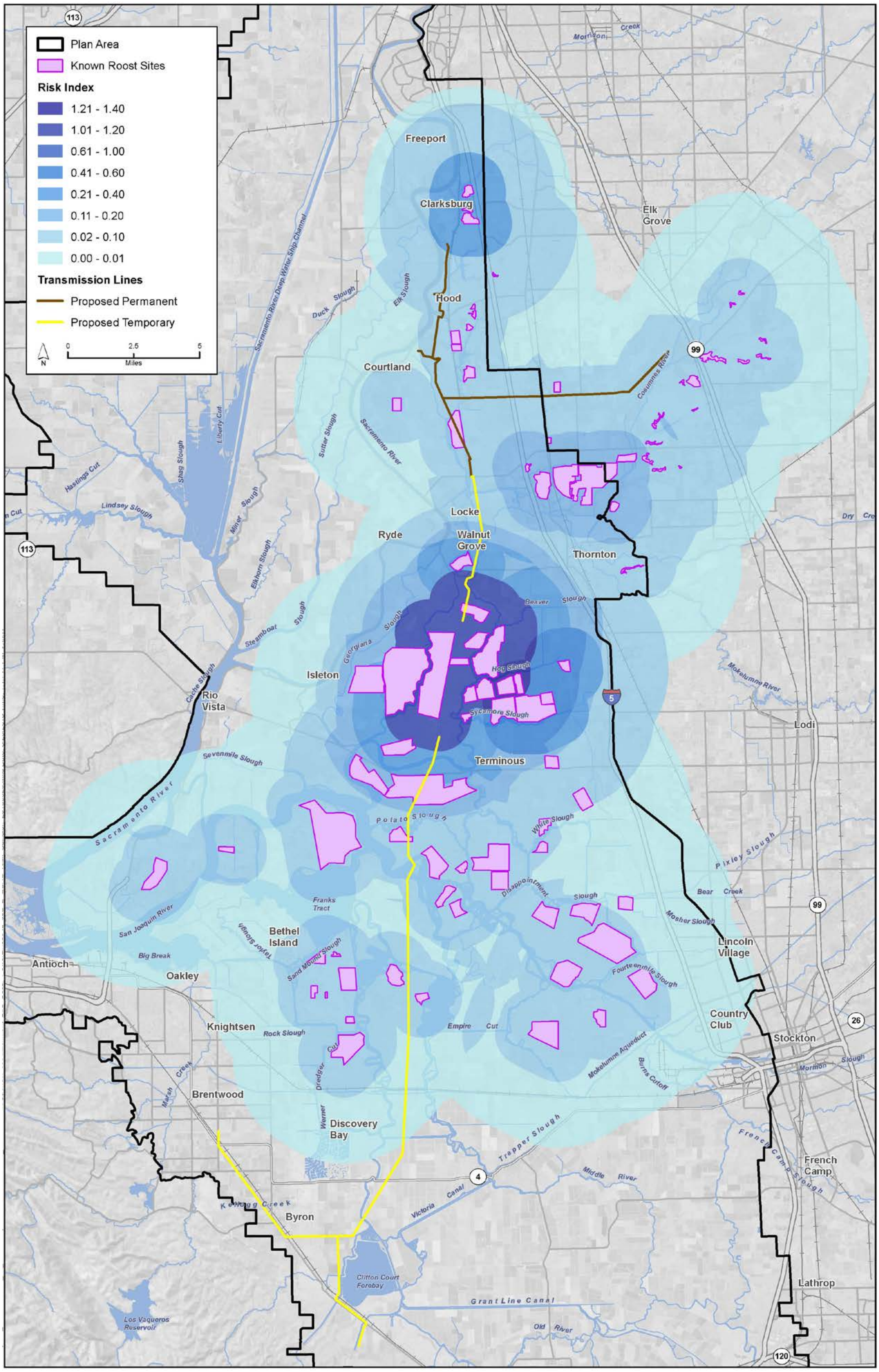


Figure 2. Collision Risk Index Map for Greater Sandhill Crane

Table 2. Estimated Collision Mortality of Greater Sandhill Crane at BDCP Marked and Unmarked Powerlines

Powerline Type	Crossings/Year[a]	Deaths/Year[b] (unrounded) Unmarked Lines	Marked Lines[c]
69-kV line (permanent)	749,949	16 (15.18)	6 (5.16)
230-kV line (permanent)	6,586	2 (2.00)	1 (0.68)
230-kV line (temporary)	321,120	96 (95.89)	33 (32.60)
34.5-kV line (temporary)	76,862	24 (23.37)	8 (7.95)

[a] Baseline mortality = 30.4 x 10^{-5} x crossings/year.
[b] Values have been rounded up to the nearest integer unless otherwise specified.
[c] 66% reduction based on Brown and Drewien (1995) for sandhill cranes in Colorado.

Based on the analysis above, the cumulative mortality associated with marked temporary lines is estimated to be 410 birds over a 10-year period. While it is possible to calculate cumulative impacts from permanent lines over the permit term, mortality will continue at these lines as long as they are present. Therefore, deaths per year is a better metric for describing mortality at permanent lines. Note that mitigation is also calculated on an annual, ongoing basis.

4.0 Population Impacts

Greater sandhill cranes that winter in the Plan Area are designated as the Central Valley population (Pacific Flyway Council 1997). Although there is no current estimate for the Central Valley population, recent counts of summering cranes in California, Oregon, and Washington total approximately 4,200 (Ivey and Herziger 2000, 2001), and a recent estimate of summering cranes in interior British Columbia totaled an additional 4,000 (Breault pers. comm.). These birds are all within the same regional population; resulting in a total population of approximately 8,200 birds (also see Littlefield 2002).

Assuming a population of 500 birds in 1945 (based on literature reporting less than 200 pairs in Oregon and California) (Gabrielson and Jewett 1940; Walkinshaw 1949) and 8,200 birds in 2012 (Littlefield 2002), the overall annual rate of increase is 1.4% per year. Because cranes are long-lived with relatively low recruitment rates and high annual survival rates (usually greater than 90%) (Tacha et al. 1992; Drewien et al. 1995), additional mortality is unlikely to be compensated by population growth, and losses could directly affect population dynamics. Also, greater sandhill cranes are highly faithful to wintering sites and are primarily sedentary during winter, so birds that roost close to proposed powerlines are particularly vulnerable. Note that the current rate of growth accounts for existing sources of mortality for greater sandhill crane, such as collision at existing lines. We do not make predictions about future changes in other sources of mortality outside the Plan Area other than covered activities.

Table 3 summarizes the impacts of the estimated annual take (Table 2) on the Central Valley greater sandhill crane population as a percentage of the total population. A population decline is expected if the impact exceeds the estimated rate of population increase (1.4%). Table 2 provides the percent impact for marked and unmarked lines using the high estimated collision mortality rates derived by Brown and Drewien (1995). The table displays the effect of proposed powerlines during project initiation, when only the temporary lines affect cranes, and subsequently during operations, after the temporary lines are removed and the permanent lines are in place. There may be a period of time during project construction when both temporary and permanent lines impact cranes. In this case, the impacts from temporary and permanent lines are additive for the period of time that both temporary and permanent lines exist. Using the higher collision mortality rate, the level of take from temporary lines has the potential to exceed the growth rate of the Central Valley population if lines are unmarked.

Table 3. Estimated Impacts on the Central Valley Population of Greater Sandhill Cranes from Collisions with Proposed BDCP Power Lines

Line Type	Annual Impact (%)	
	Unmarked Lines	Marked Lines[a]
Temporary	1.46	0.50
Permanent	0.21	0.07

A population decline is expected if the annual impact is greater than the assumed average rate of population increase (1.4%), marked in dark grey.
[a] 66% reduction based on Brown and Drewien (1995) for sandhill cranes in Colorado

An estimated 2,000 to 3,000 cranes wintered in the Delta in 2008–2009 (Ivey et al. in preparation [a]). Assuming a population of 2,500, the impacts on this subpopulation of greater sandhill cranes will be proportionally greater than impacts on the larger Central Valley population.

Based on the same annual growth rate used above (1.4%), absent line marking, the temporary lines will result in a net decline of this subpopulation (losses greater than 1.4%) (Table 4).

The most important roost site area in the Delta is Staten Island, where approximately 1,500 greater sandhill cranes have been counted. Therefore, the losses will come largely from this group of birds. The cranes at Staten Island will only be affected by the temporary lines. Other roost sites along the proposed lines support 10 to 300 birds. The second-most important roosts are the Stone Lakes NWR roost sites near the north end of the proposed permanent lines, which support approximately 300 birds. The new permanent lines as proposed will affect birds using Stone Lake NWR and Cosumnes River Preserve roost sites.

Table 4. Estimated Impacts on the Delta Wintering Population of Greater Sandhill Cranes from Collisions with Proposed BDCP Power Lines

Line Type	Annual Impact (%)	
	Unmarked Lines	Marked Lines[a]
Temporary	4.78	1.62
Permanent	0.69	0.24

A population decline is expected if the annual impact is greater than the assumed average rate of population increase (1.4%), marked in dark grey.
[a] 66% reduction based on Brown and Drewien (1995) for sandhill cranes in Colorado.

5.0 Minimization and Mitigation

The analysis above documents potential impacts on greater sandhill crane from the installation of new temporary and permanent powerlines as part of the BDCP. However, the proposed lines are a small portion of the existing lines in the Plan Area. Collectively, 4,491 miles of distribution, sub-transmission, and transmission lines currently exist in the Plan Area (Table 5). New, permanent lines proposed by the BDCP represent less than 0.5% of the amount of existing lines in the Plan Area.

Table 5. Existing Powerlines in the Plan Area

Line Type	Voltage (kV)	Length (Miles)
Distribution	<1	35
	4	57
	11	1,655
	12	131
	17	120
	21	1,309
	22	504
	60	170
Sub Total		**3,981**
Transmission	69	43
	70	2
	115	209
	230	156
	500	100
Sub Total		**510**
Plan Area Total		**4,491**

Although the risk posed by new lines is small relative to existing lines, any additional impacts to cranes could be detrimental, as described above. There are several options for minimizing impacts, including the placement of the proposed lines (which has been revised iteratively reducing impacts), removal of the ground wire, and fitting the ground wire with markers—brightly colored "aviation" balls, thickened wire coils, or luminescent, shiny, or hinged flashing or flapping devices. All of these marker options have the potential to reduce bird collision frequency by as much as 89% (Avian Power Line Interaction Committee 1994).

In order to minimize impacts on cranes, the Implementation Office will install bird diverters on all new lines erected as part of the BDCP. Line marking with bird diverters will follow Avian Power Line Interaction Committee protocols.

While marking lines substantially decreases collision risk for cranes, it does not eliminate it. Based on our estimates, using the higher collision risk estimate of 30.4 x 10-5 collisions per crossing, a loss of 7 birds per year for permanent lines and 41 birds per year for temporary lines will need to be mitigated to maintain no net loss of greater sandhill cranes (Table 2). In order to compensate for this loss, bird diverters may be placed on existing lines within 2 kilometers of existing roost sites, with priority given to those lines adjacent to larger roost sites.

The mitigation value of a given length of powerline can be determined using the same methods described in Section 3.2, *Estimated Collision Mortality of Greater Sandhill Crane*. Instead of using the location of the proposed lines to estimate mortality, as was done above, the location of existing lines is used to quantify the benefit of installing bird flight diverters (BFDs) at a given location. For purposes of analyzing the feasibility and cost of this option, we assume that the mitigation value of retrofitting an existing line with BFDs increases with proximity to a roost site. This effect of the mitigation is scaled to the size of the roost (i.e., the larger the roost population, the greater the mitigation value).

To inform feasibility discussions and costing, several potential mitigation sites were identified. This analysis should be rerun at the time that mitigation is implemented. If roost sites, available line segments, collision rates, or other factors differ at that time, the values used below can and should be replaced with improved estimates. The methodology outlined herein and in Box 1 provides the information necessary to adjust mitigation at the time of project implementation.

These sites selected below consist of currently unmarked distribution lines near two of the largest greater sandhill crane roosts in the Plan Area: Staten Island and Isenberg Reserve (or Woodbridge Ecological Reserve), along Staten Island and Woodbridge Roads, respectively. However, these mitigation sites may not be available at project implementation, in which case the needed mitigation may be acquired at other lines, using the methods developed in this assessment.

Table 6 summarizes the location of these lines and the calculated mitigation value of each, and Box 1 provides an example mitigation calculation. The mitigation approach, like the impact approach described in Section 3.2, *Estimated Collision Mortality of Greater Sandhill Crane*, assumes a 66% reduction in mortality based on the installation of BFDs (Brown and Drewien 1995). For temporary lines, the proposed approach significantly over-mitigates impacts to greater sandhill crane because new BFDs on existing lines will be retained long after the temporary lines are removed, and risk of collision is removed.

Box 1: Example Calculation

Assume a line adjacent to the roost sites at Staten Island spans 12 kilometers within 2 kilometers of the roost complex and supports an estimated 1,500 greater sandhill cranes. Then:

- 1,500 cranes x 130 days = 195,000 crossings/year, and
- 195,000 crossings/year x 0.000304 = estimated 59.28 (60) deaths/year at the unmarked line segment.

If the annual reduction in these losses is 66% (Brown and Drewien 1995), then the number of greater sandhill crane deaths avoided is:

- 59.28 mortalities/year x 0.66 = 39.12 (40) mortalities avoided/year.

Table 6. Mitigation for Greater Sandhill Crane Mortality on BDCP Powerlines

Line Segment	Maximum Allowable Take (Per Year for New Marked Lines)	Proposed Mitigation: Mark Existing Lines		Mitigation Example*
		Miles of Line	Reduced Mortality (Cranes/Year)	
Permanent	7	1.5	7	4.3 miles (6.8 kilometers) of line on Staten Island Road, adjacent to the primary crane roost site = 20 cranes/year
Temporary	41	4.4	38	5.5 miles (8.9 kilometers) of line on Staten Island Road, adjacent to the primary crane roost sites= 23 cranes/year. 1 mile of the line on Woodbridge Road, beginning at the entrance road to North Isenberg Reserve, (east for 1 mile; 1.6 kilometers) = 10 cranes. 0.4 miles (0.6 kilometers) of the line that runs east-west along Hog Slough, north of North Isenberg Reserve = 5 cranes.
Total		**5.9**		

* Mitigation example only to demonstrate feasibility. Actual mitigation would be determined during implementation using this approach to calculating an equivalent reduction of mortality probability.

Total minimization and mitigation costs are based on the types of lines on which BFDs are placed. BFDs cost approximately $40 per unit (Pleiss pers. comm.). For optimum results, the recommended spacing distance for BFDs is 15 to 16.5 feet (4.5 to 5 meters) (Avian Power Line Interaction Committee 1994). Installation of BFDs in 15-foot (4.5-meter) intervals requires 325 units per mile (222 units per kilometer), or $13,000 per mile ($8,880 per kilometer). For distribution lines, installation of BFDs requires a lineman who can install approximately 1 mile of BFDs per day. For transmission lines a helicopter and crew are required (price TBD). The existing high-risk lines proposed for mitigation are all distribution lines. The total cost of mitigation is $84,180, based on 6.1 miles of distribution. The total cost of minimizing and mitigating the distribution lines through placement of diverters on existing lines is $122,820 (Table 7). The cost to minimize the transmission lines is to be determined (Table 7). As mentioned above, the mitigation sites proposed in Table 6 were chosen to inform feasibility discussions and costing. While impacts from new lines will be minimized by the addition of BFDs, the location and required length of mitigation lines will need to be determined at the time of implementation based on field-verified information.

Table 7. Costs Associated with Minimization and Mitigation of Temporary and Permanent Lines

	Miles of Proposed Lines	Miles of Existing Lines (Mitigation)	Costs ($/mile)		Total Costs		
	Minimization	Mitigation	Materials	Installation	Materials	Installation	Total
Distribution	3	5.9	$13,000	$800	$115,700	$7,120	$122,820
Transmission	55	NA	$13,000	TBD	$715,000	TBD	TBD

Placement of BFDs on existing lines is one of several options that may be implemented to meet a performance standard of no net increase in bird strike risk for greater sandhill cranes in the Plan Area. Other options include designing the transmission line alignment to further minimize risk; removing, relocating, or undergrounding existing lines; and managing cultivating land roost sites to shift roosting areas away from high risk areas. A combination of options may be implemented to achieve the standard of no net increase in bird strike risk for greater sandhill cranes in the Plan Area.

6.0 Summary

New powerlines proposed by the BDCP have the potential to affect birds in the Plan Area. For all species except greater sandhill crane, this effect is unlikely to pose high levels of potential risk. Because of the physical and behavioral characteristics of greater sandhill crane, the species' propensity to collide with and suffer mortality from powerlines is high. Mortality estimates vary with the location of the proposed lines relative to roost sites and on the use of line markers, which reduce collisions. To minimize mortality from the proposed powerlines, the Implementation Office will install line markers on all BDCP powerlines as they are established, thereby reducing future risk of mortality by approximately 66%. To compensate for remaining risks and achieve a performance standard of no net increase in bird strike risk for greater sandhill cranes in the Plan Area, a combination of options may be implemented. These options may include siting new lines to minimize risk; removing, relocating, or undergrounding existing lines; managing cultivating land roost sites to shift roosting areas away from high risk areas; and installing BFDs on existing lines using the methods described here.

7.0 References Cited

7.1 Literature Cited

Avian Power Line Interaction Committee. 1994. *Mitigating Bird Collisions with Power Lines: State of the Art in 1994*. Edison Electric Institute. Washington, D.C.

Avian Power Line Interaction Committee. 2006. *Suggested Practices for Avian Protection on Power Lines: State of the Art in 2006*. Edison Electric Institute, APLIC, and the California Energy Commission. Washington, DC and Sacramento, CA.

Babcock, K. W. 1995. Home Range and Habitat Use of Breeding Swainson's Hawks in the Sacramento Valley of California. *Journal of Raptor Research* 29:193–197.

Beaulaurier, D. L. 1981. *Mitigation of Bird Collisions with Transmission Lines*. Bonneville Power Administration, Portland, OR.

Beedy, E. C. and W. J. Hamilton. 1999. Tricolored Blackbird (*Agelaius tricolor*). In: *The Birds of North America, No. 423*. American Ornithologists' Union.

Bevanger, K. 1994. Bird Interactions with Utility Structures: Collision and Electrocution, Causes and Mitigating Measures. *Ibis* 136:412–425.

Bevanger, K. 1998. Biological and Conservation Aspects of Bird Mortality Caused by Electricity Power Lines: A Review. *Biological Conservation* 86: 67–76.

Brown, W. M., and R. C. Drewien. 1995. Evaluation of Two Power Line Markers to Reduce Crane and Waterfowl Collision Mortality. *Wildlife Society Bulletin* 23:217–227.

Brown, W. M., R. C. Drewien, and E. G. Bizeau. 1987. Mortality of Cranes and Waterfowl from Powerline Collisions in the San Luis Valley, Colorado. In: J. C. Lewis (ed.). *Proceedings of the Crane Workshop, 1985*. Platte River Whooping Crane Maintenance Trust, Grand Island, Nebraska. Pages 128–136.

California Department of Fish and Game. 2010. *California Natural Diversity Database (CNDDB).* Available: <http://dfg.ca.gov/biogeodata/cnddb/>.

California Department of Fish and Game. 2012. *California Natural Diversity Database (CNDDB).* Available: <http://dfg.ca.gov/biogeodata/cnddb/>.

Comrack, L. A. 2008. Yellow-Breasted Chat (*Icteria virens*), California Bird Species of Special Concern: A Ranked Assessment of Species, Subspecies, and Distinct Populations of Birds of Immediate Conservation Concern in California. In: W. D. Shuford, and T. Gardali (eds.). *Studies of Western Birds 1*. Western Field Ornithologists, Camarillo, California, and California Department of Fish and Game, Sacramento.

Crowder, M. R., and O. E. Rhodes. 2001. Avian Collisions with Power Lines: A Review. In: R. G. Carlton (ed). *Proceedings of a Workshop on Avian Interactions with Utility and Communication Structures, Charleston, SC*. Electric Power Research Institute, Palo Alto, California. Pages 139–168

Delta Habitat Conservation and Conveyance Program. 2011. *2009 to 2011 Bay Delta Conservation Plan EIR/EIS Environmental Data Report*. Review Draft 1. December. Prepared for consideration by the Lead Agencies.

Drewien, R. C., W. M. Brown, and W. L. Kendall. 1995. Recruitment in Rocky Mountain GSCs and Comparison with Other Crane Populations. *Journal of Wildlife Management* 59:339–356.

Eckerle, K. P. and C. F. Thompson. 2001. Yellow-Breasted Chat (*Icteria virens*). A. Poole (ed.). *The Birds of North America Online*,. Ithaca: Cornell Lab of Ornithology. Available: <http://bna.birds.cornell.edu/bna/species/575>.

Eddleman, W. R., R. E. Flores, and M. Legare. 1994. Black Rail (*Latterallus jamaicensis*). In: A. Poole (ed.). *The Birds of North America.* Cornell Lab of Ornithology, Ithaca, NY. Retrieved from the Birds of North American Online: <http://bna.birds.cornell.edu/bna/species/123>.

England, A. S., M. J. Bechard, and C. S. Houston. 1997. Swainson's Hawk (*Buteo swainsoni*). In *Birds of North America* no. 265. A. Poole and F. Gill (eds.). The Academy of Natural Sciences, Philadelphia, PA, and The American Ornithologists' Union, Washington, D.C.

Erickson, W. P., G. D. Johnson, and D.P. Young Jr. 2005. *A Summary and Comparison of Bird Mortality from Anthropogenic Causes with an Emphasis On Bird Collision.* USDA Forest Service Technical Report. PSW-GTR-191. 2005.

Estep, J. A. 1989. *Biology, Movements, and Habitat Relationships of the Swainson's Hawk in the Central Valley of California, 1986-87.* California Department of Fish and Game. Unnumbered Report.

Estep, J. A. 2008. *The Distribution, Abundance, and Habitat Associations of the Swainson's Hawk (*Buteo swainsoni*) in Yolo County.* Prepared by Estep Environmental Consulting for Technology Associates International Corporation and the Yolo County Habitat/Natural Community Conservation Plan JPA.

Evens, J., G. W. Page, S.A. Layman and R. W. Stallcup. 1991. Distribution, relative abundance and status of the California black rail in western North America. Condor 93: 952–966.

Fiztner, R. E. 1980. Behavioral ecology of the Swainson's hawk (*Buteo swainsoni*) in southeastern Washington. Pac. NW Lab PLN-2754.

Gabrielson, I. N., and S. G. Jewett. 1940. *Birds of Oregon*. Oregon State College, Corvallis, OR.

Gaines, D. 1974. A New Look at the Nesting Riparian Avifauna of the Sacramento Valley, California. *Western Birds* 5: 61–79.

Halterman, M. D. 1991. *Distribution and Habitat Use of the Yellow-Billed Cuckoo (*Coccyzus americanus occidentalis*) on the Sacramento River, California,* 1987-90, MS Thesis: California State University: Chico, CA.

Haug, E. A., B. A. Millsap, and M. S. Martell. 1993. Burrowing Owl (*Speotyto cunicularia*). In: *The Birds of North America, No. 61.* A. Poole and F. Gill (eds.). Philadelphia: The Academy of Natural Sciences; Washington D.C.: The American Ornithologist's Union.

Herzog, S. K. 1996. Wintering Swainson's Hawks in California's Sacramento-San Joaquin River Delta. *Condor* 98:876–879.

Hunting, K. 2002a. *Avian Power Line Collisions: Potential Impact on Central Valley Bird Populations.* Available: <http://www.cvbirds.org/CVBC_Bull/V.5no.4/V5no.4pp62-65.pdf>.

Hunting, K. 2002b. *A Roadmap for PIER Research on Avian Collisions with Power Lines in California*. PIER 500-03=2-071F.

Information Center for the Environment. December 12, 2011. University of California, Davis. Tricolored Blackbird Portal. Available: <http://tricolor.ice.ucdavis.edu/>.

Ivey, G. L., and C. P. Herziger. 2000. *Distribution of GSC Pairs in Oregon, 1999/00*. Oregon Department of Fish and Wildlife Nongame Technical Report #03-01-00. Salem, OR.

Ivey, G. L., and C. P. Herziger. 2001. *Distribution of GSC Pairs in California, 2000*. California Dept. Fish and Game, Sacramento, CA.

Ivey, G. L., and C. P. Herziger. 2003. Sandhill Crane Monitoring at Staten Island, San Joaquin County, California 2002-03. A survey for The Nature Conservancy, Galt, CA.

Ivey, G. L., B. E. Dugger, C. P. Herziger, M. L. Casazza, and J. P. Fleskes. In Preparation [a]. *Distribution, Abundance, and Timing of Arrival and Departure pf Greater and Lesser Sandhill Cranes Wintering in the Sacramento-San Joaquin River Delta Region Of California*. Proceedings of the 12th North American Crane Workshop.

Ivey, G. L., B. E. Dugger, C. P. Herziger, M. L. Casazza, and J. P. Fleskes. In Preparation [b]. *Survival, Movements, and Home Range Size of Greater and Lesser Sandhill Cranes Wintering the Sacramento-San Joaquin Delta Region of California.*

James, B. W., and B. A. Haak. 1979. *Factors Affecting Avian Flight Behavior and Collision Mortality at Transmission Lines.* Final Report of a Study for the Bonneville Power Administration, Portland, OR.

Janss, G. F. E., and M. Ferrer. 2000. Common Crane and Great Bustard Collision with Power Lines: Collision Rate and Risk Exposure. *Wildlife Society Bulletin* 28:675–680.

Jenkins, A. R., J. J. Smallie, and M. Diamond. 2010. Avian Collisions with Power Lines: A Global Review of Causes and Mitigation with a South African Perspective. *Bird Conservation International*.

Jones, K. A., Krebs J. R., Whittingham, M. J. 2007. Vigilance in the third dimension: head movement not scan duration varies in response to different predator models. *Animal Behavior* 74: 1181–1187.

Laymon, S. A. 1998. Yellow-Billed Cuckoo (*Coccycus americanus*). In *The Riparian Bird Conservation Plan: A Strategy for Reversing the Decline of Riparian-Associated Birds in California*. California

Partners in Flight. Available: <http://www.prbo.org/calpif/htmldocs/species/riparian/yellow-billed_cuckoo.htm>.

Laymon, S. A. and M. D. Halterman. 1989. *A Proposed Habitat Management Plan for Yellow-Billed Cuckoos in California.* U.S. Department of Agriculture, Forest Service General Technical Report PSW-110:272–277.

Laymon, S. A., P. L. Williams, and M. D. Halterman. 1997. *Breeding Status of the Yellow-billed Cuckoo in the South Fork Kern River Valley, Kern County, California: Summary Report 1985 - 1996.* Administrative Rep. U.S.D.A Forest Service, Sequoia National Forest, Cannell Meadow Ranger District, Challenge Cost-Share Grant #92-5-13.

Littlefield, C. D. 2002. Winter Foraging Habitat of Greater Sandhill Cranes In Northern California. *Western Birds* 33:51–60.

Littlefield, C.D., and G. L. Ivey. 2000. Conservation Assessment for Greater Sandhill Cranes Wintering on the Cosumnes River Floodplain and Delta Regions of California. The Nature Conservancy, Galt, CA.

LSA Associates, Inc. 2004a. Swainson's hawk population and habitat use assessment. Prepared for the Solano County Water Agency. Vacaville, California.

Marshall, J. T., Jr. 1948. Ecologic Races of Song Sparrows in the San Francisco Bay Region. Part 1: Habitat and Abundance. *Condor* 50:193–215.

Meyer, J. R. 1978. *Effects of Transmission Lines on Bird Flight Behavior and Collision Mortality*. Prepared for Bonneville Power Administration, Portland, OR.

Morkill, A. E., and S. H. Anderson. 1991. Effectiveness of Marking Powerlines to Reduce Sandhill Crane Collisions. *Wildlife Society Bulletin* 19:442–229.

Murphy, R. K., S. M. McPherron, G. D. Wright, and K. L. Serbousek. 2009. *Effectiveness of Avian Collision Averters in Preventing Migratory Bird Mortality from Powerline Strikes in the Central Platte River, Nebraska*. Nebraska Game and Parks Commission, U.S. Fish and Wildlife Service, and University of Nebraska, Kearney.

Olendorff, R.R and R.N. Lehman. 1986. *Raptor Collisions with Utility Lines: an Analysis using Subjective Field Observations*. Pacific Gas and Electric. San Ramon, CA.

Pacific Flyway Council. 1997. *Pacific Flyway Management Plan for the Central Valley Population of Greater Sandhill Cranes*. Pacific Flyway Study Committee (c/o Pacific Flyway Representative USFWS), Portland, Oregon, USA.

Pogson, T. H. 1990. *Distribution, Abundance and Behavior of Greater Sandhill Cranes (*Grus Canadensis Tabida*) Wintering in California's Central Valley.* Ms. Thesis, University of Alaska, September 1990.

Pogson, T. H. and S. M. Lindstedt. 1991. Distribution and Abundance of Large Sandhill Cranes, Grus Canadensis, Wintering in California's Central Valley. *Condor* 93:266–278

Poulin, R., L. D. Todd, E. A. Haug, B. A. Millsap, and M. S. Martell. 2011. Burrowing Owl (*Athene cunicularia*). In: A. Poole (ed.). *The Birds of North America.* Cornell Lab of Ornithology, Ithaca, NY. Retrieved from the *Birds of North American Online*: <http://bna.birds.cornell.edu/bna/species/061>.

Rayner, J. M. V., 1988. Form and Function in Avian Flight. *Current Ornithology* 5:1–66.

Rush, Scott A., Karen F. Gaines, William R. Eddleman and Courtney J. Conway. 2012. Clapper Rail (*Rallus longirostris*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America.

Savereno, A. J., L. A. Savereno, R. Boettcher, and S. M. Haig. 1996. Avian Behavior and Mortality at Power Lines in Coastal South Carolina. *Wildlife Society Bulletin* 24:636–648.

Scott, R. E., L. J. Roberts, and C. J. Cadbury. 1972. Bird Deaths from Power Lines at Dungeness. *British Birds* 65(7):273–286.

Spautz, H., N. Nur, and D. Stralberg. 2005. California black rail (*Laterallus jamaicensis coturniculus*) distribution and abundance in relation to habitat and landscape features in the San Francisco Bay estuary. USDA Forest Service General Technical Report PWS-GTR-191.

Tacha, T. C., S. A. Nesbit, and P. A. Vohs. 1992. Sandhill Crane (*Grus canadensis*). In: A. Poole, P. Stettenheim, and F. Gill (eds.). *The Birds of North America, No. 31* (The Academy of Natural Sciences of Philadelphia; The American Ornithologist's Union, Washington, DC.

Trulio, L. A. and J. G. Evens. 2000. California black rail. Pp. 341-345 In P. R. Olofson (ed.). Goals Project. Baylands Ecosystem Species and Community Profiles: Life histories and environmental requirements of key plants, fish and wildlife. Prepared by the San Francisco Bay Area Wetlands Ecosystem Goals Project. San Francisco Bay Regional Water Quality Control Board, Oakland, California.

U.S. Fish and Wildlife Service. 1998. *Draft Recovery Plan for the Least Bell's Vireo*. Portland, OR.

Walkinshaw, L. H. 1949. *The Sandhill Cranes*. Cranbrook Institute of Science Bulletin No. 29, Bloomfield Hills, MI.

Walton, B. J. 1975. *San Francisco Bay Region Salt Marsh Song Sparrow Survey, 1974.* Report to California Department of Fish and Game, Sacramento, CA.

Yee, M. L. 2008. *Testing the Effectiveness of an Avian Flight Diverter for Reducing Avian Collisions with Distribution Power Lines in the Sacramento Valley, California*. Pier Final Project Report. Prepared for the California Energy Commission Public Interest Energy Research Program. Available: <http://65.74.139.74/2007publications/CEC-500-2007-122/CEC-500-2007-122.PDF>.

Zeiner, D. C., W. F. Laudenslayer, Jr., K. E. Mayer, and M. White (eds). 1990. California's Wildlife. Volume 2. Birds. State of California, Department of Fish and Game. Sacramento, California.

7.2 Personal Communications

Best, Mike. Pacific Gas and Electric Avian Protection Program Manager. November 9, 2012—Email to Paola Bernazzani. ICF International.

Breault, A. Waterfowl and Habitat Biologist, Canadian Wildlife Service, Delta BC. March 2012—Presentation to the Pacific Flyway Study Committee.

Estep, Jim. September 11, 2012—Email to Elizabeth Strange and Rebecca Sloan, ICF International. Regarding: Bird species presence in Plan Area and collision vulnerability.

Ivey, G.L. Wildlife Biologist. Greater Sandhill Crane Specialist. 2010 assessment of greater sandhill crane use areas in the Sacramento-San Joaquin Delta.

Meese, R. J. Staff Research Associate, Department of Environmental Science and Policy (SEP) and Information Center for the Environment (ICE), University of California, Davis. December 20, 2011—GIS data transfer, in Access database format, detailing known, historic breeding colony sites in or near the Plan Area that had not yet been entered into ICE.

Pleiss, John. Sabre Industries. November 5, 2012—Phone conservation with Todd Jones, ICF International. Regarding bird flight diverters. See also <http://www.tessco.com/products/displayProducts.do?bgCategoryId=803926>.

Exhibit 1
Summary of Habitat, Distribution, and Occurrence of Covered Bird Species in the Plan Area

Common and Scientific Names	Status	Habitat and Distribution	Potential for Occurrence in the Plan Area
California black rail *Laterallus jamaicensis coturniculus*	BCC/T, FP	Nests and forages in saline, freshwater, or brackish emergent marshes with gently grading slopes and upland refugia with vegetative cover beyond the high-water line. Year-round range includes Suisun Marsh, San Pablo Bay, Morro Bay, a few patches in the Sierra Nevada foothills, and portions of southern California; winter range expands to include San Francisco Bay and the Marin County coast.	Several historic nesting occurrences documented in the southern half of the Plan Area. Survey in 2009 found one nest at White Slough and one in an instream island west of Stockton.
California clapper rail *Rallus longirostris obsoletus*	E/E, FP	Nests and forages in dense cordgrass and cattail marshes with vegetated refugia during the highest tides. Year-round near coastal range, surrounds San Francisco and San Pablo Bays, and documented at several locations in Suisun Bay.	Range does not include the Plan Area with the exception of Suisun Marsh.
Greater sandhill crane *Grus canadensis tabida*	–/T, FP (nesting, wintering)	Forages primarily in croplands with waste grain; also frequents grasslands and emergent wetlands. Winter range includes the Central Valley and Delta, Carrizo Plain, southern California south of the Salton Sea, and Colorado River. Breeds in northeastern California.	May forage during winter throughout the crane use area.
Least Bell's vireo *Vireo bellii pusillus*	E/E (nesting)	Nests and roosts in low riparian thickets of willows and shrubs, usually near water but sometimes along dry, intermittent streams. Formerly a common and widespread summer resident throughout Sacramento and San Joaquin Valleys, and in the coastal valleys and foothills from Santa Clara County south, but its numbers have drastically declined, and the species has vanished from much of its California range.	Does not occur in the Plan Area, but potentially could expand range with riparian restoration.

Common and Scientific Names	Status	Habitat and Distribution	Potential for Occurrence in the Plan Area
Suisun song sparrow *Melospiza melodia maxillaris*	BCC/SSC	Nests and forages in brackish water marshes dominated by cattails, tules, and pickleweed. Year-round range includes the marshes surrounding Suisun Bay, from the confluence of the Sacramento and San Joaquin Rivers to the Carquinez Strait.	Present in Suisun Marsh. However, not expected in the remainder of the Delta or Plan Area.
Swainson's hawk *Buteo swainsoni*	BCC/T (nesting)	Nests in isolated trees, open woodlands, and woodland margins; forages in grasslands and agricultural fields. Breeding range spans the Central Valley and Delta west of Suisun Marsh, northeastern California, and a few additional scattered sites. Most of the population migrates south of California in fall/winter, although a small number winters in the Delta.	A minimum of 85 nests were documented throughout the Delta during limited surveys in 2009; estimated total is over 300 pairs (Estep pers. comm.).
Tricolored blackbird *Agelaius tricolor*	BCC/SSC (nesting)	Nests colonially in large, dense stands of freshwater marsh, riparian scrub, and other shrubs and herbs; forages in grasslands and agricultural fields. Year-round resident throughout the Central Valley and the central and southern coasts, with additional scattered locations throughout California.	High potential to occur throughout the Plan Area.
Western burrowing owl *Athene cunicularia*	BCC/SSC (nesting)	Nests and forages in grasslands, agricultural fields, and low scrub habitats, especially where ground squirrel burrows are present; occasionally inhabits artificial structures and small patches of disturbed habitat. Year-round range includes the Central Valley and Delta and portions of the central coast, eastern California, and southern California.	May occur throughout the Plan Area where habitat is suitable; documented on Brannan Island and near Suisun Bay and Clifton Court Forebay.
Western yellow-billed cuckoo *Coccyzus americanus occidentalis*	FC, BCC/SE	Nests in valley, foothill, and desert riparian forest with densely foliaged deciduous trees and shrubs, especially willows. Historically common but now a rare summer resident at isolated sites in Sacramento Valley in northern California and along Kern and Colorado River systems in southern California; occasionally documented in Colusa, Glenn, Butte, Sutter, and Yolo Counties within the last 20 years.	One occurrence of unconfirmed breeding within the Plan Area during 2009 BDCP surveys at a location north of Walnut Grove, California.

Common and Scientific Names	Status	Habitat and Distribution	Potential for Occurrence in the Plan Area
White-tailed kite *Elanus leucurus*	–/FP (nesting)	Forages in ponds, marshes, slow-moving streams, sloughs, and irrigation/drainage ditches; nests in nearby uplands with low, sparse vegetation. Year-round range spans the Central Valley, Coast Ranges and coast, Sierra Nevada foothills, and Colorado River.	May nest and forage throughout the Plan Area; documented in the Delta along the Sacramento River west of Stone Lake, and in the north-central and east-central Delta.
Yellow-breasted chat *Icteria virens*	–/SSC (nesting)	Nests and forages in riparian thickets of willow and other brushy tangles near water and thick understory in riparian woodland. Breeding range includes the northern Sacramento Valley, Cascade Range, Sierra Nevada foothills, northwestern California, most of the Coast Ranges, the Colorado River, and other scattered sites. Migrates south of California in fall/winter.	Nests in patches of the Plan Area where habitat is suitable; surveys in 2009 found more nests than expected, but not in all available habitat.

Exhibit 2

Maps of Species Occurrences and Modeled Habitat Relative to Proposed Powerlines

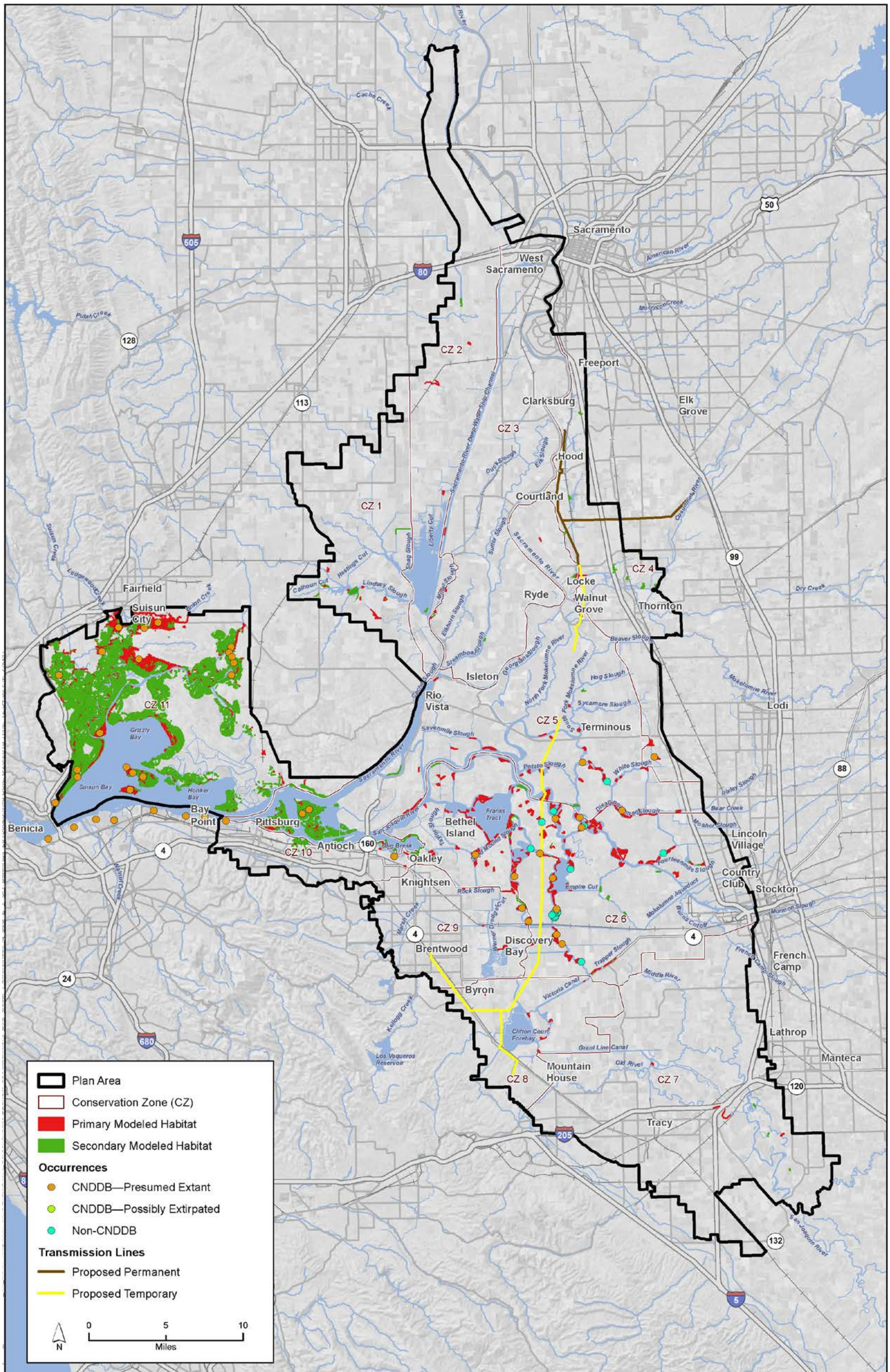


Figure 2-1. Map of California Black Rail Occurrences and Modeled Habitat Relative to Proposed Transmission Lines

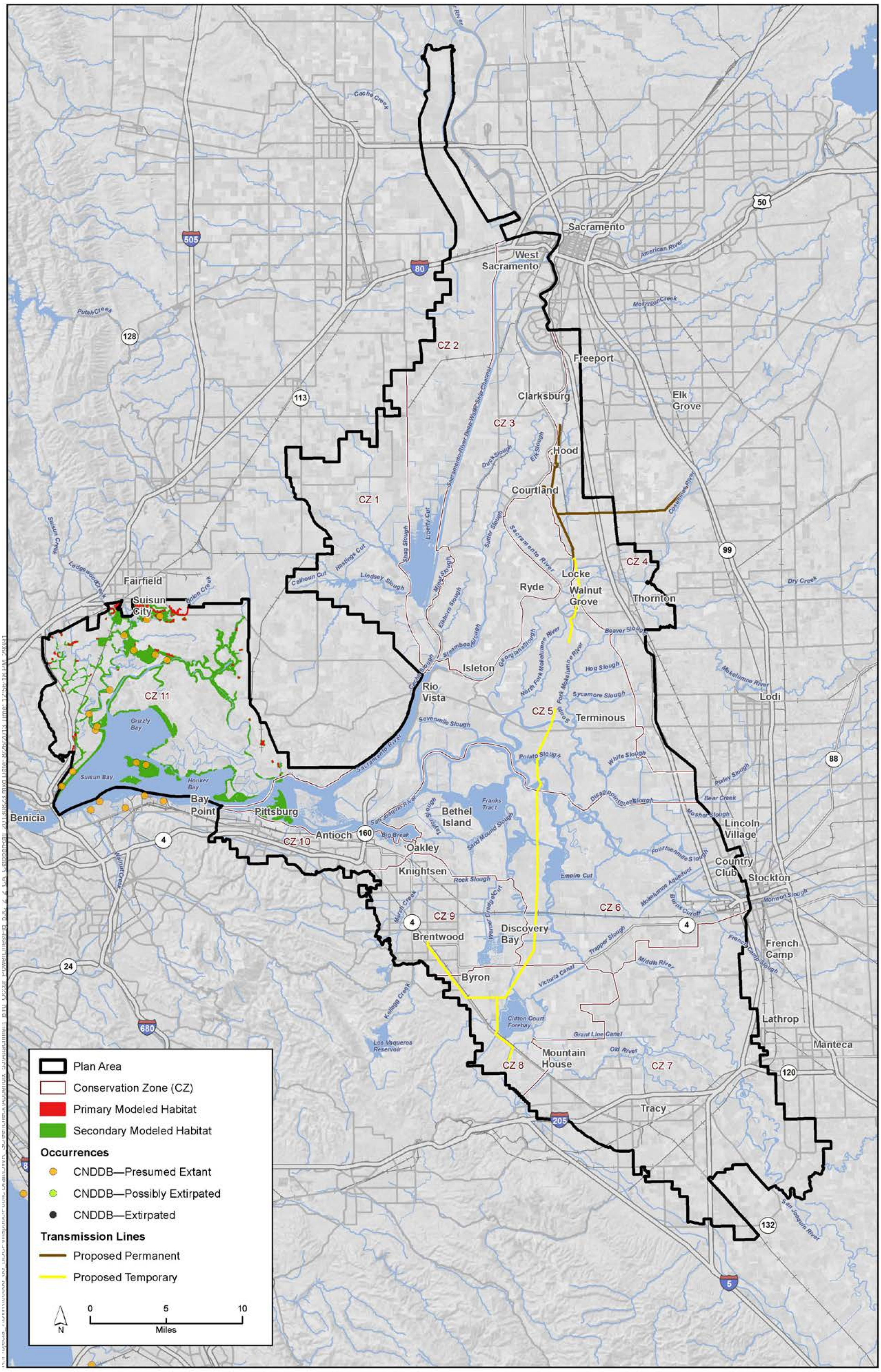


Figure 2-2. Map of Clapper Rail Occurrences and Modeled Habitat Relative to Proposed Transmission Lines

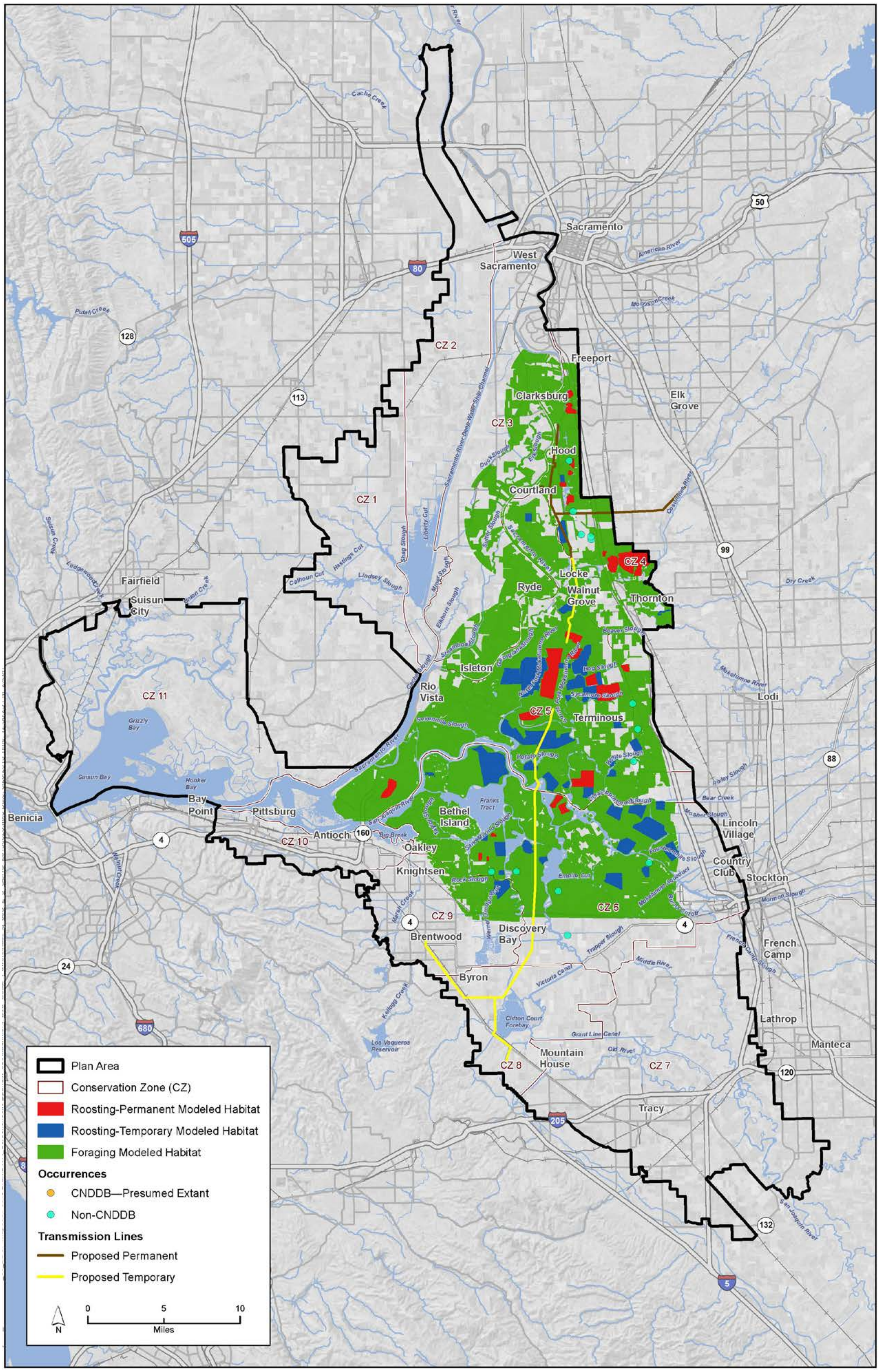


Figure 2-3. Map of Greater Sandhill Crane Occurrences and Modeled Habitat Relative to Proposed Transmission Lines

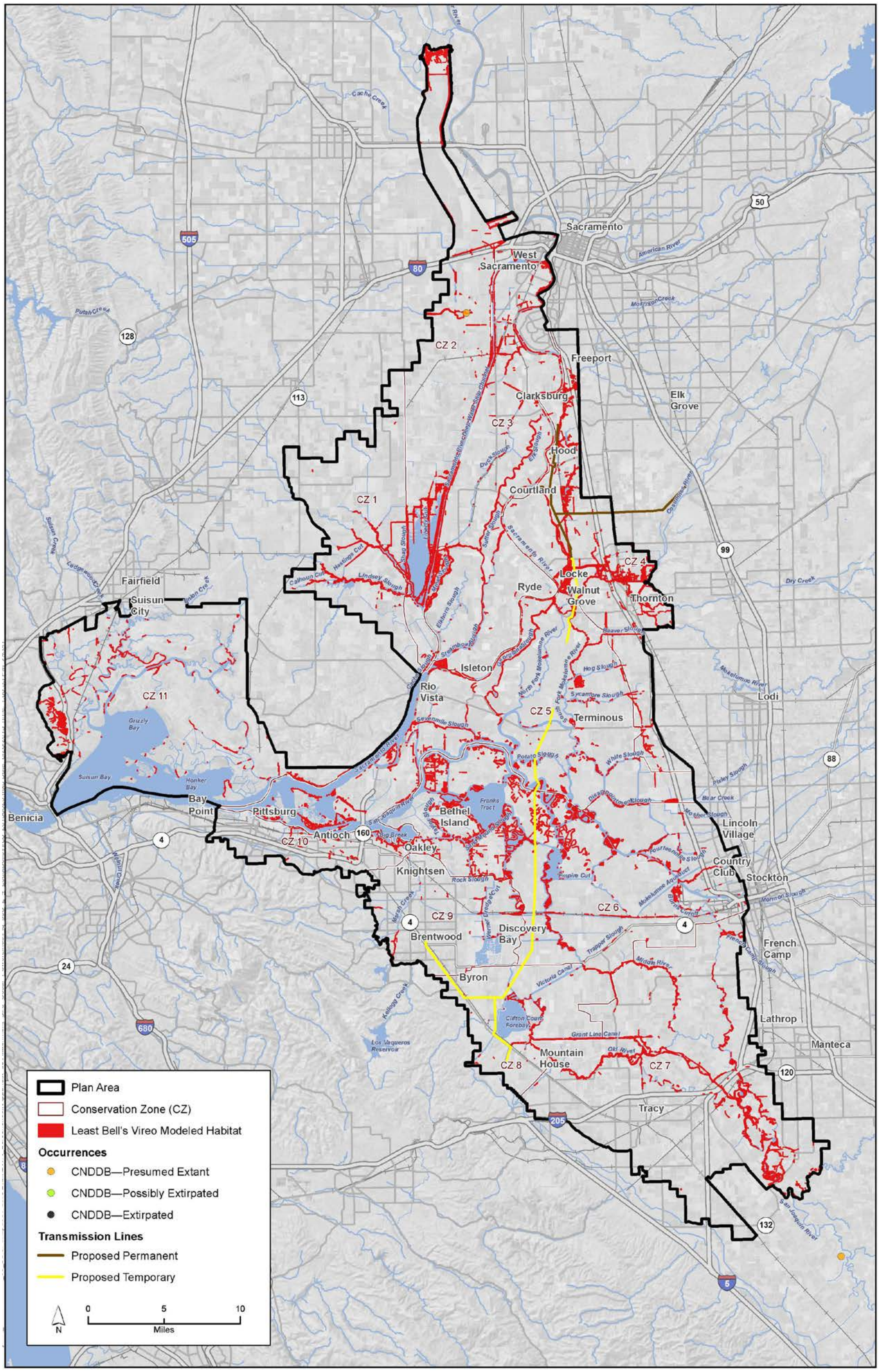


Figure 2-4. Map of Least Bell's Vireo Occurrences and Modeled Habitat Relative to Proposed Transmission Lines

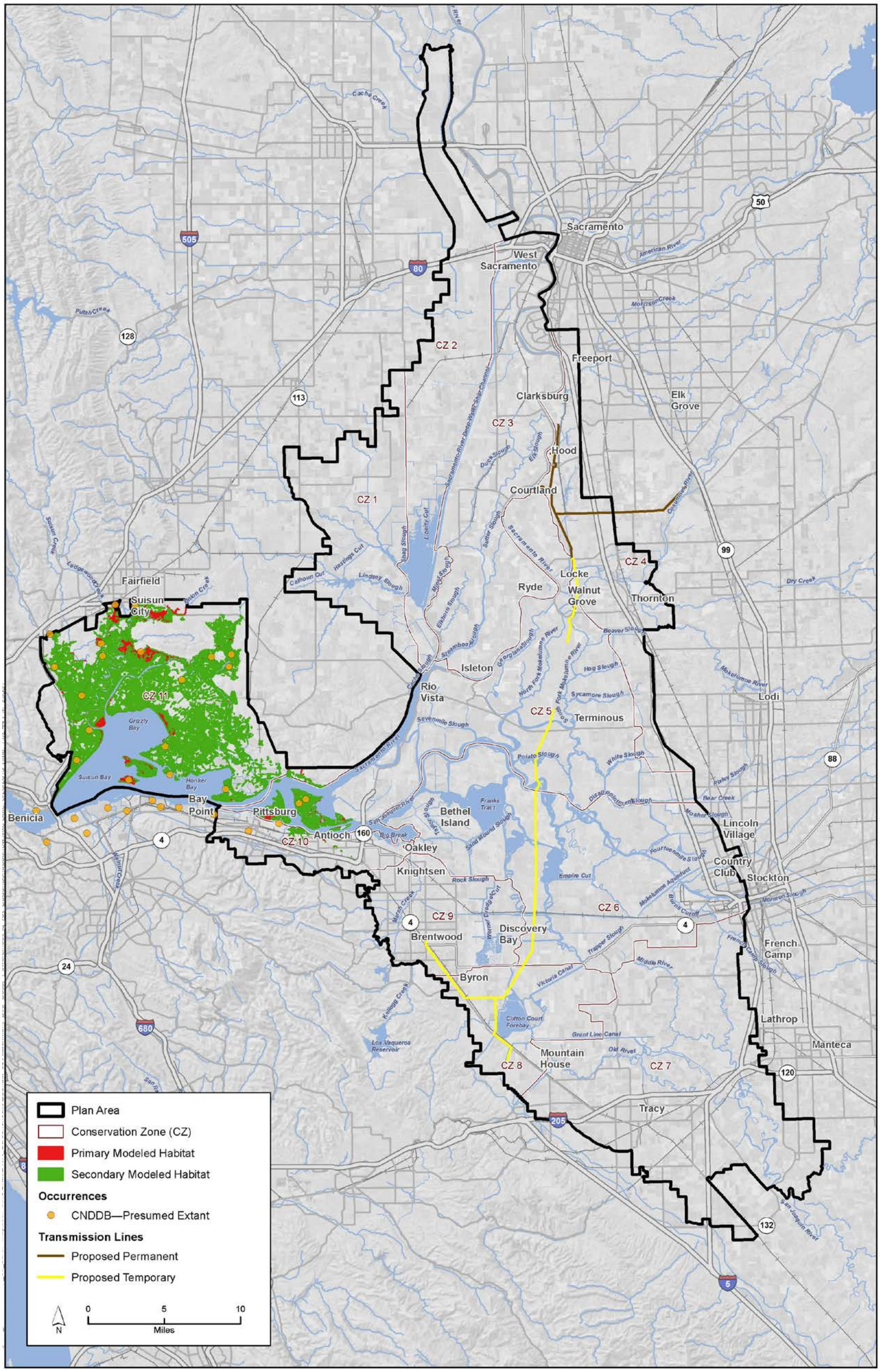


Figure 2-5. Map of Suisun Song Sparrow Occurrences and Modeled Habitat Relative to Proposed Transmission Lines

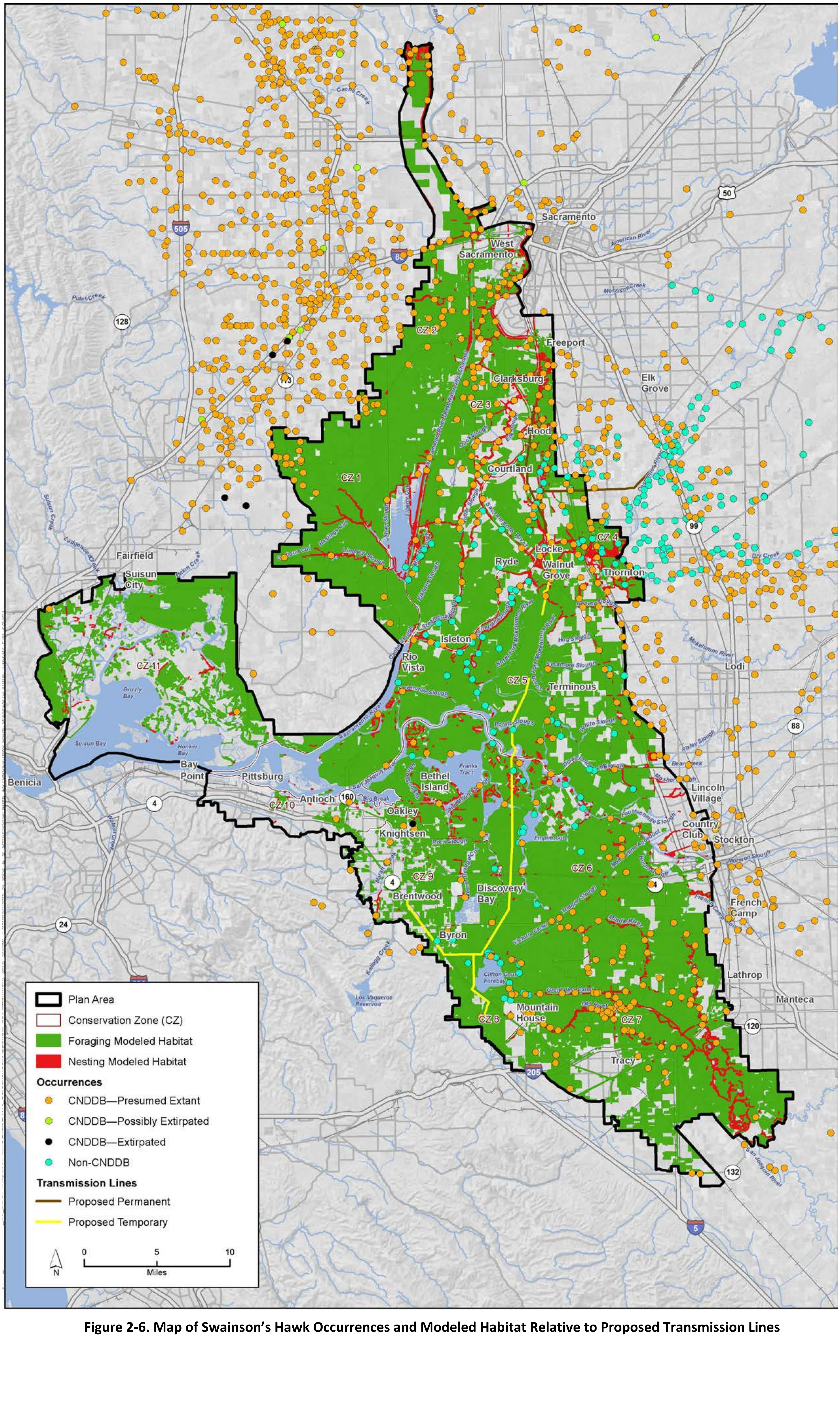


Figure 2-6. Map of Swainson's Hawk Occurrences and Modeled Habitat Relative to Proposed Transmission Lines

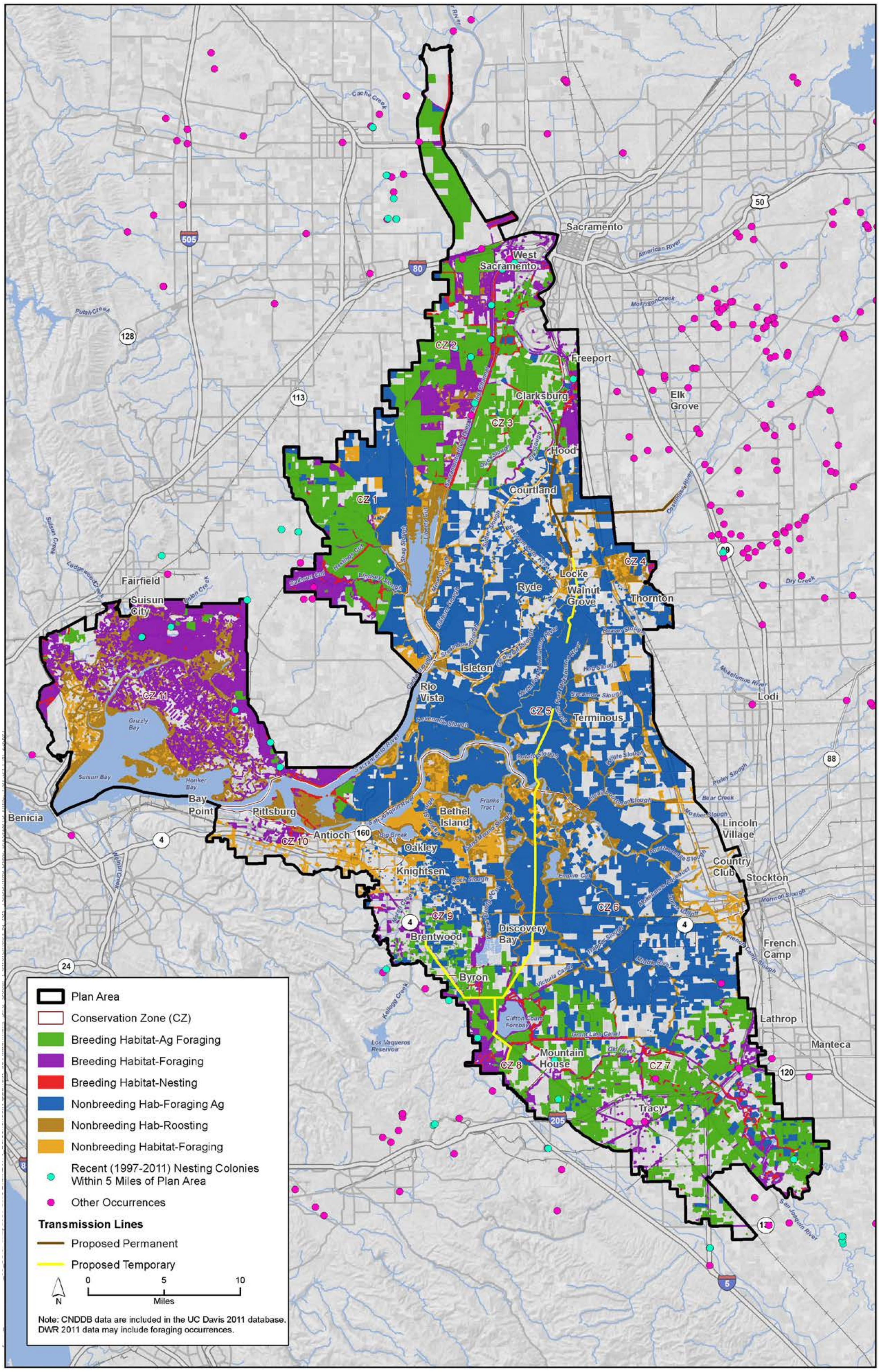


Figure 2-7. Map of Tricolored Blackbird Occurrences and Modeled Habitat Relative to Proposed Transmission Lines

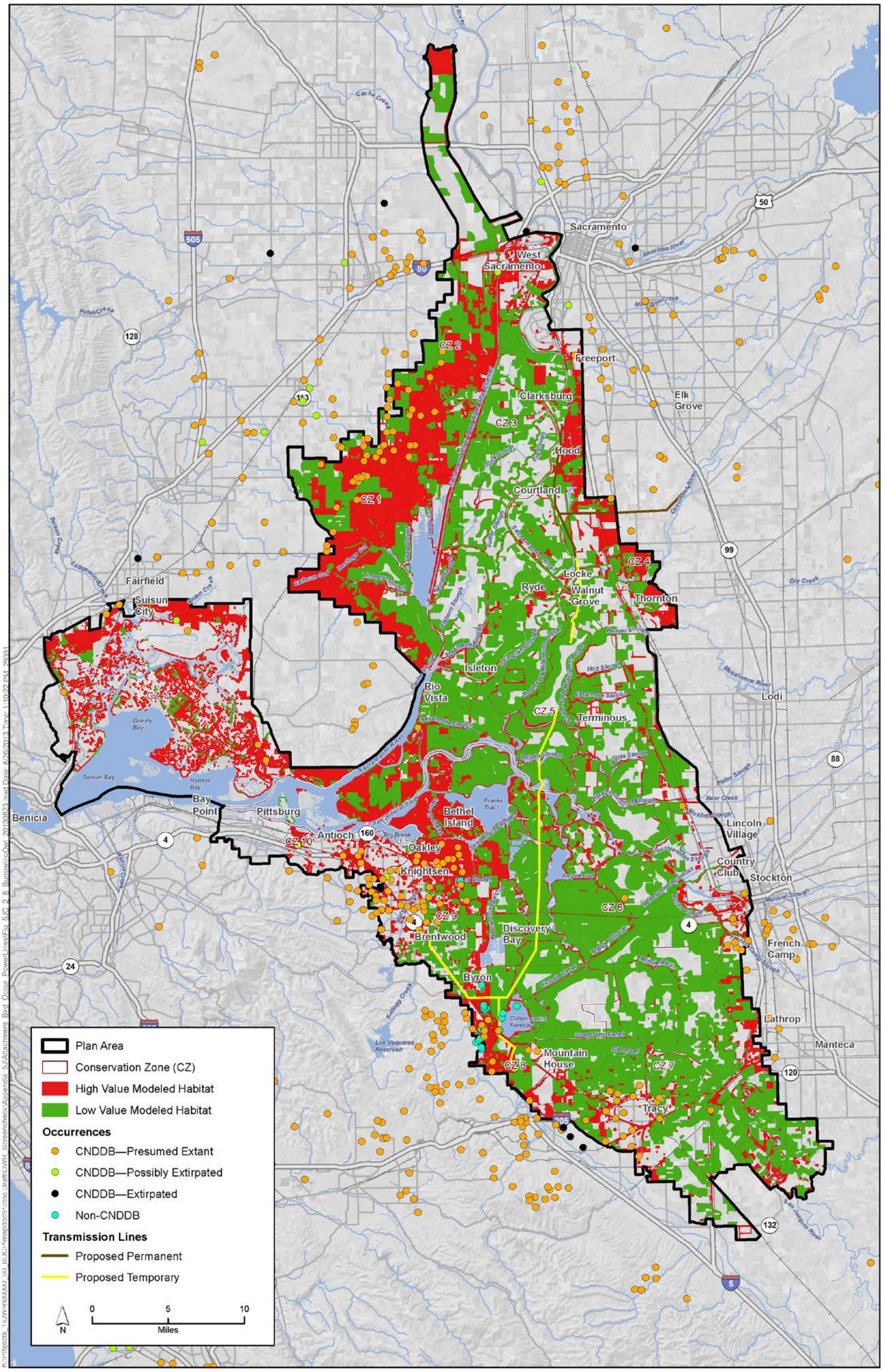


Figure 2-8. Map of Western Burrowing Owl Occurrences and Modeled Habitat Relative to Proposed Transmission Lines

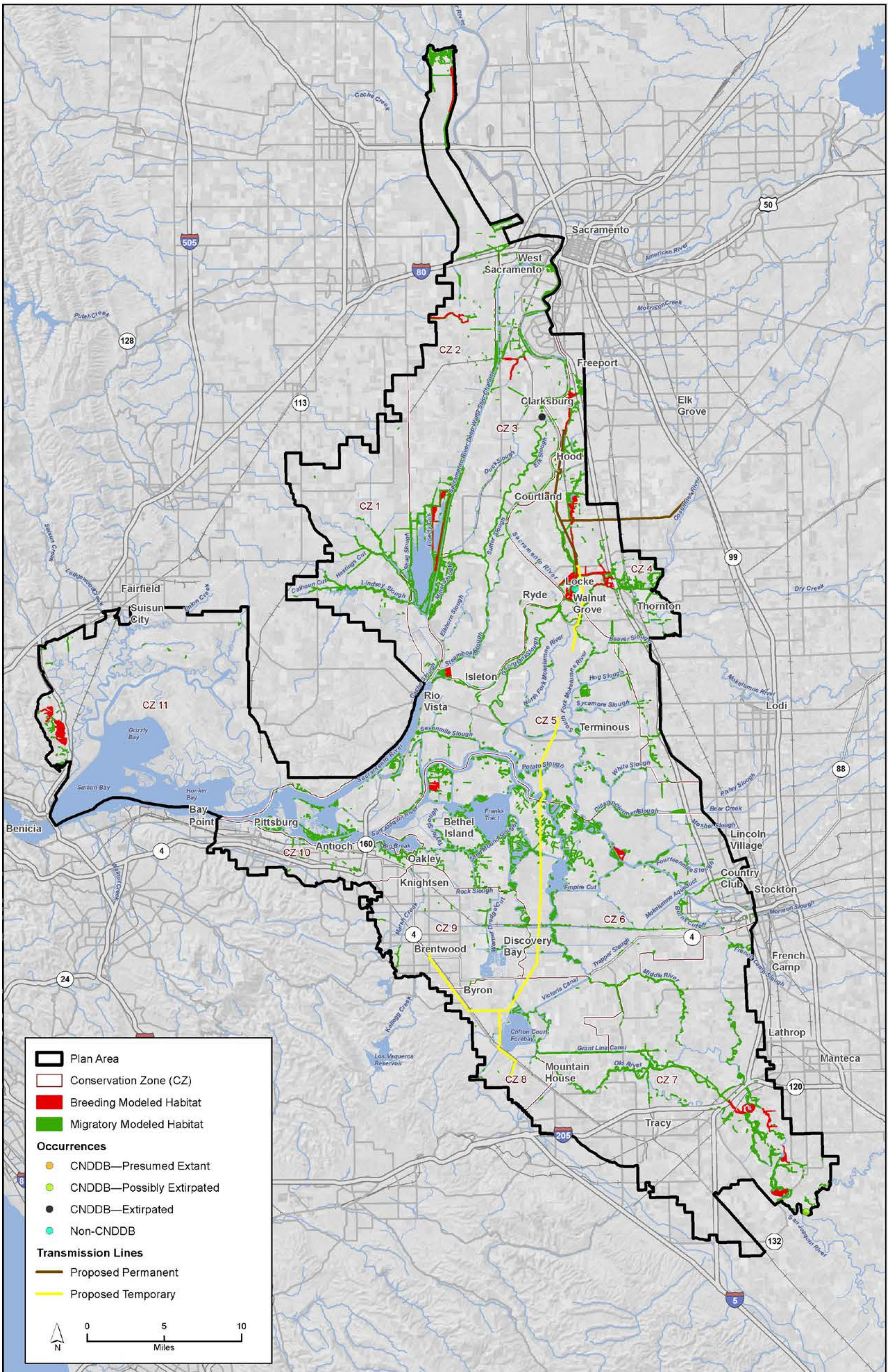


Figure 2-9. Map of Western Yellow-Billed Cuckoo Occurrences and Modeled Habitat Relative to Proposed Transmission Lines

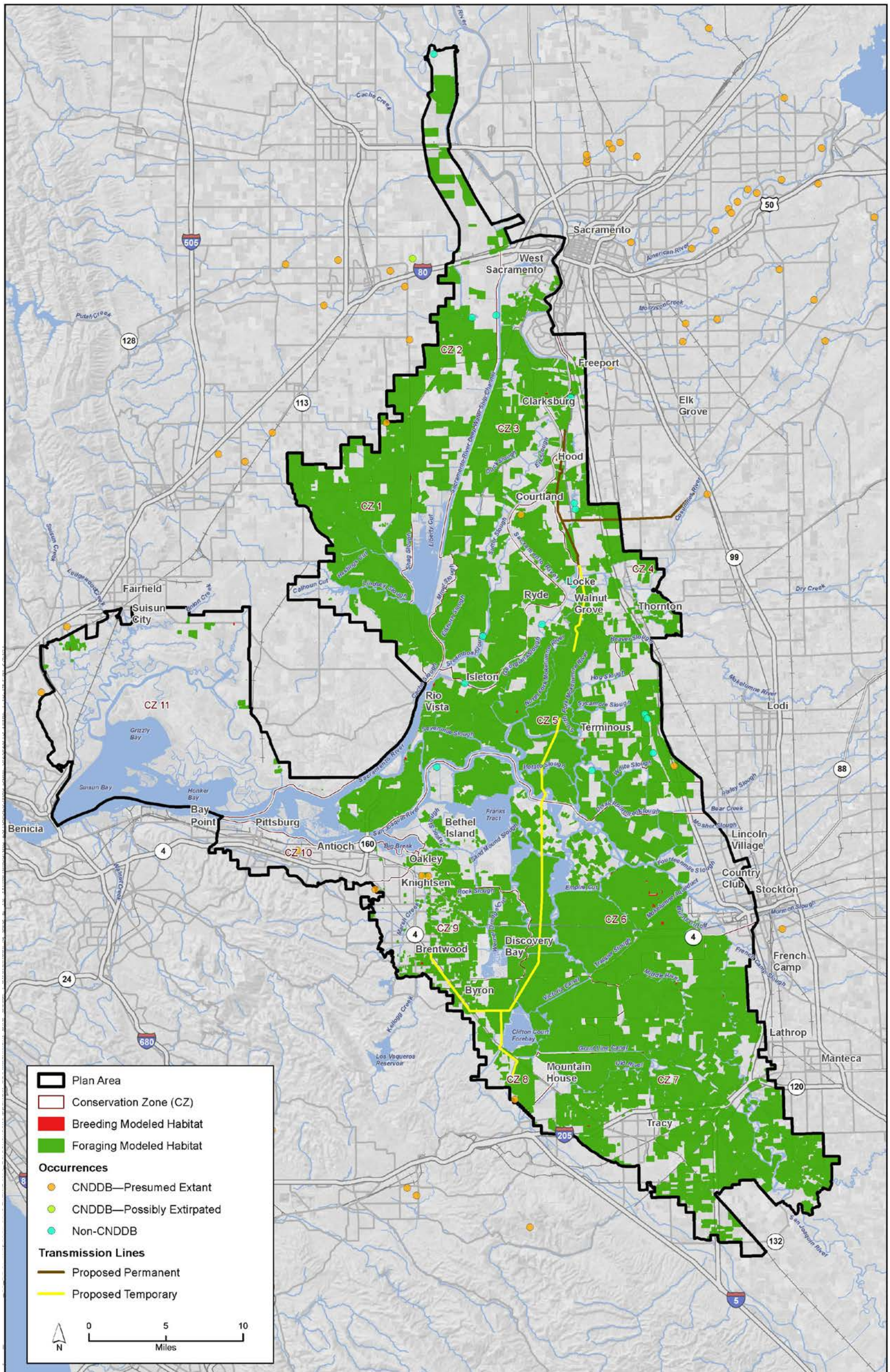


Figure 2-10 Map of White-Tailed Kite Occurrences and Modeled Habitat Relative to Proposed Transmission Lines

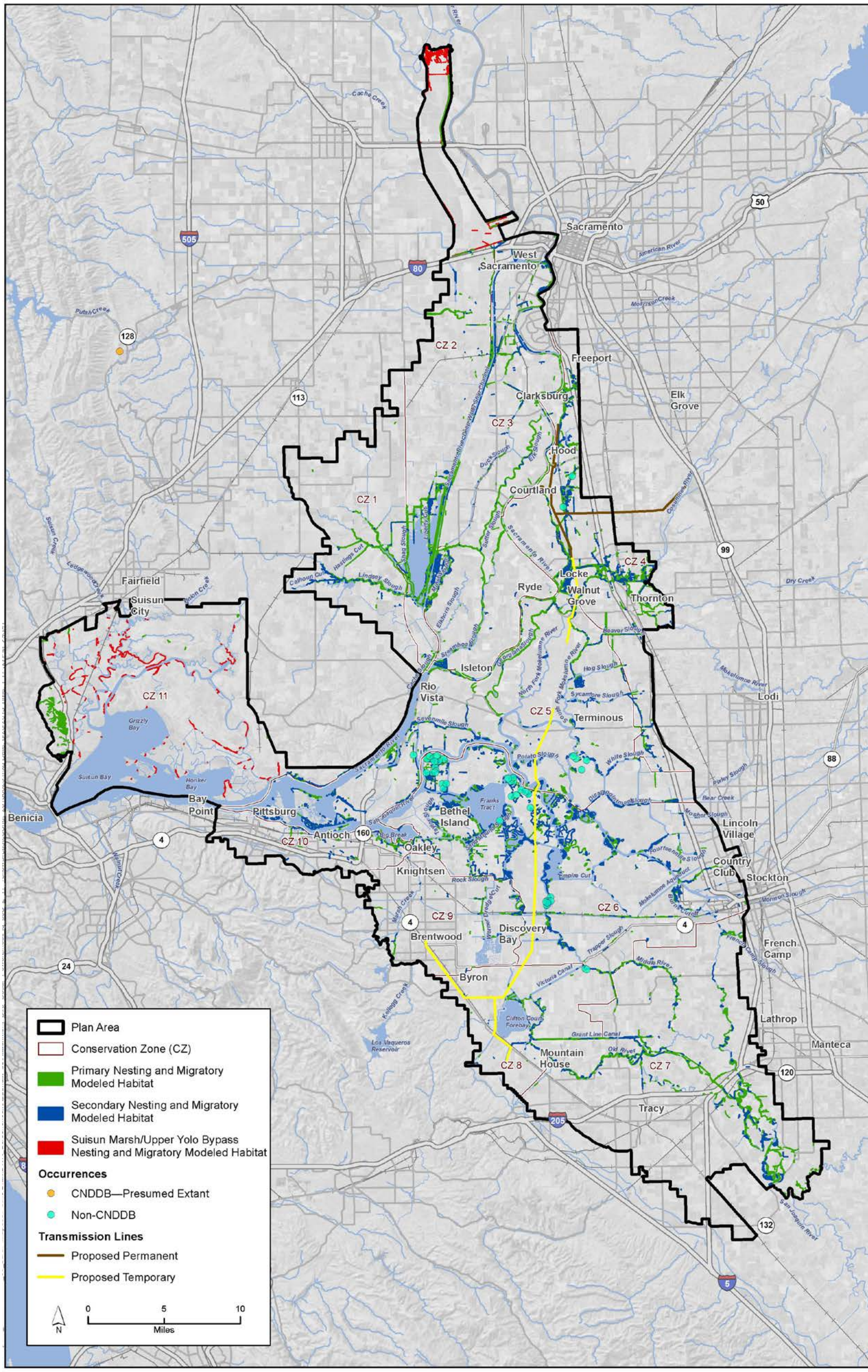


Figure 2-11. Map of Yellow-Breasted Chat Occurrences and Modeled Habitat Relative to Proposed Transmission Lines

Attachment 5J.D
Indirect Effects of the Construction of the BDCP Conveyance Facility on Sandhill Crane

Attachment 5J.D
Indirect Effects of the Construction of the BDCP Conveyance Facility on Sandhill Crane

Contents

Tables

Page

Figures

Acronym and Abbreviations

dB	decibel
dBA	A-weighted decibel
BDCP	Bay Delta Conservation Plan
DWR	CaliforniaDepartment of Water Resources
EIR/EIS	environmental impact report/environmental impact statement
GIS	geographic information system
IES	Illuminating Engineering Society
L_{dn}	day-night sound level
LOS	Level of Service
USFWS	U.S. Fish and Wildlife Service

Attachment 5J.D
Indirect Effects of the Construction of the BDCP Conveyance Facility on Sandhill Crane

5J.D.1 Introduction

This memo summarizes the research and analysis of potential indirect effects of the construction of the Bay Delta Conservation Plan (BDCP) conveyance facility on the greater and lesser sandhill cranes (*Grus canadensis tabida* and *Grus canadensis canadensis,* respectively), referred to collectively here as sandhill crane. The indirect effects that are the focus of this research are noise, lighting, and other visual disturbance. While each effect may act independently, the effects are often correlated (especially visual disturbance and noise). For this reason, indirect effects on sandhill cranes are often discussed in combination in the literature as "human disturbance."

The construction of the conveyance facility will require a substantial amount of heavy equipment over prolonged periods, and is expected to generate noise, require nighttime lighting, and create visual disturbance.

Two studies addressing human disturbance effects to sandhill cranes (Armbruster and Farmer 1981; Norling et al. 1990) were highlighted in the Platte River Recovery Implementation Program (U.S. Fish and Wildlife Service 2006). The former study (Armbruster and Farmer 1981) summarizes guidelines based on input from a team of crane experts and is expert professional opinion. The latter study (Norling et al. 1990) is based on empirical measurements of distances of flock locations to various types of human disturbance. These studies both indicate an effect of human disturbance on sandhill crane habitat use in roosting and foraging habitat. These reports did not include noise level or lighting measurements, but looked at the overall effect of proximity to human disturbance, which could include the combined potential effects of noise, visual disturbance, and other direct and indirect habitat modification associated with the edge effects of the man-made features (e.g., habitat loss, change in microclimate, increased frequency of humans and/or domestic animals, changes in hydrology, increases in nonnative/invasive species).

For roost sites, buffers ranged from 100 meters for activities such as sand and gravel operations to 800 meters for commercial and urban land use. For cropland foraging habitat, buffers ranged from 10 meters for powerlines to 500 meters for commercial and urban land uses. However, the Platte River document acknowledges that "there is no consensus on the influence of human disturbances to potential crane habitat, or even how the concept of disturbance should be evaluated" (U.S. Fish and Wildlife Service 2006). As part of the process of developing their document, the U.S. Fish and Wildlife Service (USFWS) (2006) used a geographic information system (GIS) analysis to apply disturbance buffers to roost sites. They found that in several cases, known roost sites used by sandhill cranes were located well within the disturbance features' described zones of influence. Conflicts in the body of research regarding sandhill cranes and human disturbance are further explored in Section 5J.D.8, *Human Presence/Visual Disturbance Impacts on Sandhill Cranes*.

5J.D.1.1 Sandhill Crane Habitat Use in the Plan Area

Sandhill cranes use the Plan Area primarily as winter habitat (September through March) and have many known habitat areas for roosting, foraging, and loafing behavior. These habitat areas occur in suitable croplands and wetlands, many of which are in close proximity to and directly within the proposed construction areas. Cranes spend the nighttime hours (dusk to dawn) at roost sites; the morning and evening hours in foraging habitat (generally, sunrise to 10:30 AM and 2:30 PM to sunset); and the midday (generally 10:30 AM to 2:30 PM) loafing in these areas and other areas without optimal foraging, but away from active human disturbances. Of particular interest are the habitat areas on the Stone Lakes National Wildlife Refuge and on Staten Island. Figures 5J.D-1 and 5J.D-2 show the location of known permanent and temporary roosts in croplands and wetlands along with modeled potential roosting and foraging habitat.

5J.D.1.2 Noise Impacts on Sandhill Cranes

The evaluation of noise impacts on birds and their behavior is difficult. A summary of the effects of highway noise on birds in a Caltrans report (Caltrans 2007) provides a useful list of variables that could affect how noise is perceived by birds, resulting in the outcome of any noise-related indirect effects. As described in the Caltrans report, there are many complications in assessing the effects of noise independent of several confounding variables, many of which are relevant to this analysis.

> Without taking each of these potential variables (and others) into consideration, appropriate correlations between road noise and bird behavior cannot be made. These variables include, but are not limited to:
>
> 1) Bird species and their style of acoustic communication;
> 2) Bird species and their behavior in the presence of adverse stimuli;
> 3) Age and experience of the birds;
> 4) Hearing capabilities of a species in quiet;
> 5) Hearing capabilities of a species in noise; and
> 6) Other kinds of stimuli associated with highways that might include (among others);
>   a. Visual signals (vehicle movement);
>   b. Vehicle-produced air pollution;
>   c. Substrate vibrations resulting from the vehicles moving on the highway;
>   d. The ecosystem near the roadway including substrate, vegetation, etc.; and
>   e. Food supply near the highway.

While sandhill cranes do show some aversion to human disturbance (as described in Section 5J.D.1, *Introduction*), they are known to habituate to a certain degree to increased levels of background noise when the background noise level is relatively constant, such as roadway noise (Gary Ivey pers. comm.; Rod Drewien pers. comm.; David Brandt pers. comm.; Dwyer and Tanner 1992). However, less is known about the ability of sandhill cranes to habituate to intermittent noise such as that associated with the operation of heavy equipment at a scale construction site (e.g., pile drivers, construction cranes, compressors, heavy trucks). While the crane habitat use areas of concern in this analysis are generally in a rural setting, noises such as roadway traffic and agricultural operations can be heard within actively used areas, to which the cranes have apparently adapted.

5J.D.2 Existing Noise Environment Conditions

Primary noise sources in the project area are traffic traveling on surrounding freeways, highways, and rural roadways; agricultural operations; overhead commercial aircraft; and recreation related noise (e.g., fishing boats and waterski boats). Land uses near sandhill crane habitat are primarily rural and consist of agricultural use and low-density residential development. As such, existing noise levels are in the range of 40 to 50). Typical ambient sound levels as a function of human population density are presented in Table 5J.D-1, below.

Table 5J.D-1. Human Population Density and Associated Ambient Noise Levels

Human Population Density Type	dBA, L_{dn}
Rural	40–50
Small Town or quiet suburban residential	50
Normal suburban residential	55
Urban residential	60
Noisy urban residential	65
Very noisy urban residential	70
Downtown, major metropolis	75–80
Area adjoining freeway or near major airport	80–90

L_{dn} = Day-night sound level
Source: Hoover and Keith 2000

5J.D.3 Methods and Assumptions for Noise Impact Analysis

5J.D.3.1 Sensitivity to Noise and Thresholds for Mitigation

The general human response to changes in sound levels having similar frequency content (for example, comparing increases in continuous traffic sound levels) is summarized as follows.

- A 3 dB change in sound level is considered a barely noticeable difference.
- A 5 dB change in sound level will typically be noticeable.
- A 10 dB change in sound level is considered to be a doubling in loudness.

This may not be an appropriate metric for sandhill cranes. Because of the scarcity of data on unweighted intensities of source noise, for this analysis we assume that sandhill cranes, like most vertebrate animals, have a hearing sensitivity greater than that of humans, therefore, small changes in ambient noise (e.g., 3 dB) are assumed to be noticeable. Any errors this may introduce are compensated by use of a very conservative metric.

In this analysis we consider noise above 50 dBA to be potentially noticeable to sandhill crane, and thus to have a potential effect on foraging and roosting behavior. This very conservative approach is used in the absence of data on the effects of noise on the sandhill crane. USFWS uses 60 dBA as a significance threshold for other sensitive bird species, including least Bell's vireo and California gnatcatcher; this threshold is also supported by the California Department of Water Resources (DWR) Specification 05-16 (California Department of Water Resources 2010) that suggests the following guidelines for DWR construction projects:

> Where ambient noise levels are less than 60 dBA and it is determined that construction related noise will cause noise levels to exceed 60 dBA, or where the ambient noise levels are greater than 60 dBA and it is determined that construction related noise will cause noise levels to exceed the ambient level by 5 dBA, a temporary sound wall shall be constructed between the sensitive area and the construction related noise source. The 60 dBA limit is not a regulatory requirement. Although the 60 dBA limit is not a regulatory requirement, it has been established as a threshold for establishing noise impacts by consensus of experts, local and resource agencies, including the U.S. Fish and Wildlife Service (USFWS). It is estimated that among other things, noise levels above 60 dBA may interfere with communication among birds and other wildlife.

5J.D.3.2 Construction Equipment Noise Estimates

A wide variety of construction equipment will be used at each facility construction site and will vary throughout the construction period. Impact pile driving was analyzed separately due to the unique characteristics of noise produced from this noise source type (intermittent impact noise). Multiple source construction noise was characterized by calculating the noise levels that would be produced when the loudest six pieces of construction equipment were operating simultaneously, and noise from heavy trucks was calculated assuming three heavy trucks operating in the same general area simultaneously. Certain portions of the conveyance facility project area will have more limited construction activity and construction noise sources, including borrow areas, spoils/muck areas, and tunnel muck conveyor belt corridors. Table 5J.D-2 lists the typical noise levels from construction equipment, and Table 5J.D-3 indicates which construction activity areas are likely to have each general noise source type.

Table 5J.D-2. Commonly Used Construction Equipment Noise Emission Levels

Equipment	Typical Noise Level (dBA) 50 Feet from Source
Pile-driver (Impact)	101
Grader	85
Bulldozers	85
Heavy Truck	85
Loader	80
Air Compressor	80
Backhoe	80
Pneumatic Tool	85
Excavator	85
Auger Drill Rig (for drilled piles)	85
Crane, Derrick	88
Concrete Mixer Truck	79
Compactor (Ground)	83
Concrete mixer	85
Conveyor Belt Return/Load/Booster Drive	85
Conveyor Belt Mid-segment	75

Federal Highway Administration 2006, and conveyor belt equipment specifications.
dBA = A-weighted decibel

Table 5J.D-3. Matrix of Construction Noise Sources at Each Construction Activity Area Type (at 50 feet)

Construction Activity Areas	Noise sources for analysis			
	Pile driver	Multiple Source Construction	Conveyor Belt	Heavy Trucks
Noise level at 50 feet from Source	*101 dBA*	*96 dBA*	*85/75 dBA*	*85 dBA*
Intake	*See detail*	X		
Coffer dam	X	X		
Waterside intake feature	X	X		
Sediment basins	X	X		
Intake forebay	X	X		
Electrical substation	X	X		
Forebay	See detail	X		
Outlet structure	X	X		
Inlet structure	X	X		
Electrical substation	X	X		
Siphons	X	X		
Barge Unloading Facility	X	X		
Shaft Location	X	X	X	
Permanent Surface Impact	X	X		
Temporary Surface Impact		X		
Operable Barrier		X		
Concrete Batch Plant		X		
Tunnel Muck Area			X	X
Intake Work Area				X
Pipeline Work Area				X
Tunnel Work Area				X
Control Structure Work Area				X
Safe Haven Work Area				X
Potential Borrow Area				X
Potential Spoil Area				X
Fuel Station				X
Road Work Area				X
Temporary Access Road Work Area				X

5J.D.3.3 Construction Traffic Noise Estimates

Construction traffic will be directed to many roads throughout the Plan Area, ranging from rural agricultural access roads to highways (e.g., State Route 12) to Interstate 5. Project related construction traffic will cause the largest increases in noise levels where high volume construction traffic is directed onto roads with low current traffic loads. Conversely, it will have minimal effect on existing noise levels on roads with existing high traffic loads (e.g., State Route 12 and Interstate 5).

5J.D.3.4 Impact Assessment Methods

To assess the potential effect of noise on sandhill cranes we calculated the noise level expected in known roosting/foraging habitat (at temporary and permanent roosts), and in modeled foraging habitat. Calculations assume direct line-of-sight (no intervening barriers) with an atmospheric noise attenuation rate of approximately 6 dB with each doubling of distance plus an additional attenuation of 1.5 dB noise absorption due to propagation over soft ground (e.g., agricultural land, open natural habitat). Therefore, total noise attenuation was calculated as 7.5 dB per doubling of distance from the source. For construction noise, distance to noise level contours was calculated from the edge of each identified construction area, giving a conservative worst-case estimate of noise levels since most of the construction activity won't take place on the perimeter of each site. Distance to traffic noise level contours were calculated from the centerline of each roadway. Traffic noise contours were calculated for all roadway segments included in the Level of Service (LOS) analysis in the traffic section of the environmental impact report/environmental impact statement (EIR/EIS) for the BDCP (California Department of Water Resources et al. 2012).

Noise propagation and attenuation can be affected by a variety of other factors including air temperature, atmospheric pressure, humidity, and wind speed and direction. These factors are highly variable over space and time and therefore are not typically included in standard environmental noise calculations. Because there are many highly variable factors, the assumption of a 7.5-dB attenuation per doubling of distance is a conservative estimate.

Table 5J.D-4 lists the calculated distances to noise contour lines from each type of general construction noise source. The noise contours were then overlaid on the sandhill crane modeled foraging habitat and known temporary and permanent roost habitat to determine the potential effects of construction noise on sandhill crane habitat.

Table 5J.D-4. Calculated Distance to Noise Contours for Each Type of General Construction Noise Source

Construction Site Noise Source Type[1]	*Noise level at 50 ft*	Noise Contours (feet from source)			
		Distance to 80 dBA	*Distance to 70 dBA*	*Distance to 60 dBA*	*Distance to 50 dBA*
Impact Pile Driver	101	350	850	2,100	5,250
General Construction[2]	96	225	550	1,350	3,350
Heavy trucks[3]	90	125	300	750	1,900
Conveyor Belt Return/Load (ends of conveyor) and Boosting Drives (inline at 1.5 mile intervals)	85	80	200	500	1,200
Conveyor Belt Mid-segment (along the length of belt between ends and boosting drives)	75		80	200	500

[1] Federal Highway Administration 2006, conveyor belt equipment specifications, and calculated as below.
[2] Calculated assuming the six loudest pieces of construction equipment (except pile driver) operating simultaneously.
[3] Calculated assuming three heavy trucks operating simultaneously in same area of site.

The construction noise contours for general construction noise (all sources except pile driving) were combined with the construction traffic noise contours. Overlay of the noise contours on the modeled foraging and known roost/forage areas depicts the expected worst-case noise levels to occur in these areas during project construction based on the assumptions above. As previously mentioned, pile driving noise was analyzed and displayed separately due to the unique characteristics of this particular construction noise source (Figures 5J.D-3 and 5J.D-4 for all construction noise expect pile driving; Figures 5J.D-5 and 5J.D-6 for pile driving).

Evaluation of the general project construction noise contours (all construction types except pile driving) in relationship to the known roosting/foraging sites shows that there are nine areas where general construction noise levels are expected to exceed 50 dBA (locations G1 through G9 on Figures 5J.D-3 and 5J.D-4). Figures 5J.D-5 and 5J.D-6 show that noise levels for pile driving activities are expected to exceed 50 dBA in five areas (locations P1 through P5 on Figure 5J.D-4 and 5J.D-5). Modeled foraging habitat occurs adjacent to or in the near vicinity of much of the BDCP conveyance facility construction area. Table 5J.D-5 shows the highest expected noise level for each construction activity type at the nearest roost/forage site, and nearest modeled habitat, absent implementation of minimization measures.

The traffic noise contours shown on Figures 5J.D-3 and 5J.D-4 are based on a combination of construction and non-construction traffic. The noise contours are calculated for peak traffic loads, therefore, they represent the loudest noise levels expected, which would typically be during daytime and peak commuting hours. Based on the current project design and absent measures to minimize noise in crane habitat, 50 dBA traffic noise contour will affect the following roost sites:

- temporary roost site north of Lambert Road between Franklin Boulevard and Bruceville Road;
- permanent roost site on Hood Franklin Road just below North Stone Lake;
- several permanent roosts along Interstate 5;
- edge of the temporary and permanent roost sites along Tyler Island Road;
- permanent roost sites south of State Route 12 on Bouldin Island; and
- permanent and temporary roost sites north and south of West 8 Mile Road.

Table 5J.D-5. Construction Equipment Noise Emission Levels and Estimated Noise Levels in Foraging and Roosting Habitat

Possible Construction Equipment	Typical Noise Level[1] (dBA) at 50 ft from Source	Calculated Noise Level (dBA)	
		at Nearest Modeled Foraging Habitat (distance)	at Nearest Roost/Forage Site (distance)
Pile-driver (Impact)	101	101 (50 ft)	51 (5,000 ft)
Combined noise generation[3]	96	96 (50 ft)	48 (4,000 ft)
Heavy Trucks[4]	90	90 (50 ft)	55 (1,300 ft)
Muck Conveyor Belt Return/ Load and Boosting Drives	85	85 (50 ft)	55 (750 ft)
Conveyor Belt Mid-segment	75	75 (50 ft)	< 50 (750 ft)

[1] Federal Highway Administration 2006.
[2] Calculated based on assumed attenuation of 7.5 dB with each doubling of distance over soft ground.
[3] Calculated assuming the six loudest pieces of construction equipment (except pile driver) operating simultaneously.
[4] Calculated assuming three heavy trucks operating simultaneously in same area of site.
dBA = A-weighted decibel

To quantify the total effect of the increase in construction noise on sandhill crane habitat, we calculated the acreage of each sandhill crane habitat type occurring within each 10 decibel range interval. Table 5J.D-6 summarizes those results showing that as much as 4,466 acres of habitat (3,868 acres modeled foraging, 120 acres permanent roosting, 477 acres temporary roosting) could be affected by noise levels above 60 dBA (not including pile driving), which would be noticeably above existing baseline noise levels (40–50 dBA) in most areas. Pile driving noise is expected to affect a smaller total acreage because pile driving is expected to occur at only a few project sites (see Table 5J.D-3 and Figure 5J.D-6). However, where pile driving does occur, the higher noise levels will increase the total acreage of habitat effects.

Table 5J.D-6. Acres of Sandhill Crane Habitat Affected by Increased Noise Levels from Project Construction

Noise Level Range	Habitat Types	Pile Driver (acres)	General Construction (acres)
>80 dBA	Modeled Foraging	16	624
	Roosting-Permanent	0	2
	Roosting-Temporary	0	64
	Subtotal Habitat	16	690
80-70 dBA	Modeled Foraging	73	913
	Roosting-Permanent	0	13
	Roosting-Temporary	3	107
	Subtotal Habitat	77	1,033
70-60 dBA	Modeled Foraging	661	2,332
	Roosting-Permanent	0	105
	Roosting-Temporary	75	306
	Subtotal Habitat	736	2,743
60-50 dBA	Modeled Foraging	5,491	8,013
	Roosting-Permanent	11	548
	Roosting-Temporary	755	1,085
	Subtotal Habitat	6,257	9,646

5J.D.4 Noise Impact Conclusions

Based on the assumptions and calculations in this analysis, in the absence of avoidance and minimization measures as much as 14,112 acres of crane habitat could experience noise levels above baseline levels as a result of general construction, and as much as 7,086 acres could experience noise levels above baseline levels as a result of pile driving activity.

Note that this analysis was conducted based on the assumption that there was direct line-of-sight from sandhill crane habitat areas to the construction site, and therefore is a worst-case estimate of effects. In many areas existing levees will partially or completely block the line-of-sight and will function as effective noise barriers substantially reducing noise transmission. Additionally, as described above, in the absence of data indicating the effect that noise levels above baseline would have on greater sandhill crane, a conservative approach was used by assessing noise levels above 50 dBA even though the standard significance threshold for DWR is 60 dBA.

Sandhill cranes have been observed to habituate to increased levels of roadway noise (Gary Ivey, pers. comm.; Rod Drewien pers. comm.; David Brandt pers. comm.; Dwyer and Tanner 1992); however, little is known about their response to intermittent noise (Gary Ivey, pers. comm.; Rod Drewien pers. comm.; David Brandt pers. comm.). As stated in the Platte River Recovery Implementation Program Final Environmental Impact Statement, “At present, there is no consensus on the influence of human disturbances to potential crane habitat, or even how the concept of disturbance should be evaluated.” (U.S. Fish and Wildlife Service 2006). Therefore, it is not possible at this stage to draw definitive conclusions regarding the sandhill crane response to the increased noise environment expected to be caused by this project. We can conclude that the noise environment will be affected and noise levels will increase in sandhill crane habitat by moderate levels over larger areas (e.g., up to 20 decibel increase on approximately 17,000 acres), and by high levels over a more limited area (e.g., 20-30 decibel increase over approximately 1,000 acres).

Avoidance and minimization measures may be implemented to reduce noise related effects on cranes. Measures to reduce effects may include designing the project to avoid noise producing activities near high crane use areas, reducing noise producing activities during the winter when cranes are present, reducing night time activities in the vicinity of crane roost sites, and installing noise barriers between construction and traffic activities and crane roost sites.

5J.D.5 Nighttime Lighting Impacts on Sandhill Cranes

There has been little research into the impact of artificial lighting on roosting birds. Most discussion of birds and lighting concerns attraction, disorientation, and collisions of nocturnal migrators and/or foragers while in transit (Raine et al. 2007, Poot et al. 2008, Evans Ogden 1996, Kerlinger 2000). In addition, lighting-induced disorientation of migrating birds can make it very difficult for them to find a suitable roost location and can lead to collision and/or exhaustion (Raine et. al 2007).

Artificial lighting can have a number of potential impacts on birds that are not in migration. Nighttime lighting can affect foraging timing and efficiency and interfere with breeding and migration (Navara et. al 2007, Titulaer et. al 2012, Santos et. al 2010, Hill 1992). A number of studies show effects of artificial lighting on timing of avian life cycles, influencing breeding behavior and sleep-wake cycles in passerines (Raine et. al 2007, Dominoni et. al 2013, and Nordt and Klenke 2013). In a field study in the Netherlands, Titulaer et al. (2012) found that providing an artificial light source near nest boxes increased feeding rates of great tits (*Parus major*). This finding suggests that artificial light may affect nesting birds' energy expenditure on parental care, potentially impacting the parents' overall fitness. According to Dominoni et. al (2013), nighttime light exposure can affect a bird's metabolism by causing them to be more active during the daytime. In their study of European blackbirds (*Turdus merula*), wild-caught individuals exposed to night lighting in the lab developed their reproductive systems earlier, with earlier maturation of testes, earlier singing, and earlier molting. In a field study located in Germany, Nordt and Klenke (2013) found that urban blackbirds started singing up to 5 hours earlier than their rural counterparts.

No studies were identified that examined the effects of artificial lighting on roosting birds, including cranes. Direct light from automobile headlights has been observed to cause roosting cranes to flush and it is thought that they may avoid roosting in areas where lighting is bright (Ivey, pers comm). However, cranes exhibit high roost site fidelity and in some cases may still use artificially lit sites due to this loyalty. If the birds do use artificially lit roosting sites, they may be vulnerable to the sleep-wake cycle shifts and reproductive cycle shifts discussed above. Potential risks include a reduction in the cranes' quality of nocturnal rest, and changes to their sense of photoperiod which might cause them to shift their physiology towards earlier migration and breeding (Ivey, pers comm). Impacts such as these could prove detrimental to the cranes' overall fitness and reproductive success (which could in turn have population-level impacts). A change in photoperiod interpretation may also cause cranes to fly out earlier from roost sites to forage, and might increase their risk of power line collisions if they leave roosts before dawn (Ivey pers. comm.).

5J.D.6 Existing Artificial Lighting Conditions

Within the Plan Area, sandhill crane roosting sites are located near agricultural and rural residential land uses. Within agricultural areas in the Plan Area, artificial light is generally absent. The landscape is dark at night, except for occasional views of farmsteads dispersed through the landscape. Within rural portions of the Plan Area, lighting is related to the varied building sources (interior and exterior lighting and signage). Street lighting may be present but often is limited in extent.

5J.D.7 Proposed Project-Related Artificial Light

Construction of each intake structure would take up to 4 years to complete and would occur Monday through Friday for up to 24 hours per day. Dewatering near intakes, pumping plants, and certain pipeline construction areas and north of the intermediate forebay would take place 7 days per week and 24 hours per day. Evening and nighttime construction activities would require the use of bright lights. Nighttime construction could also result in headlights flashing into roost sites when construction vehicles are turning onto or off of construction access routes. Proposed surge towers would require the use of safety lights that would alert low-flying aircraft to the presence of these tall structures.

Completed BDCP facilities would require safety lighting. Lighting equipment associated with BDCP facilities would increase the amount of nighttime lighting in the Delta above existing ambient light levels. In particular, security lighting for the Sacramento River intakes and their associated pumping stations and facilities would create very noticeable effects relating to increased nighttime light at those locations. Lighting would be designed in accordance with guidance given by DWR's WREM No. 30a, *Architectural Motif, State Water Project* and through coordination with local agencies through an architectural review process. This guidance is set forth as follows.

> All artificial outdoor lighting is to be limited to safety and security requirements. All lighting is to provide minimum impact on the surrounding environment and is to be shielded to direct the light only towards objects requiring illumination. Lights shall be downcast, cut-off type fixtures with non-glare finishes set at a height that casts low-angle illumination to minimize incidental spillover of light onto adjacent properties, open spaces or backscatter into the nighttime sky. Lights shall provide good color rendering with natural light qualities with the minimum intensity feasible for security, safety and personnel access. All outdoor lighting will be high pressure sodium vapor with individual photocells. Lighting will be designed per the guidelines of the Illuminating Engineering Society (IES). Additionally, all lights shall be consistent with energy conservation and are to be aesthetically pleasing. Lights will have a timed on/off program or will have daylight sensors. Lights will be programmed to be on whether personnel are present or not.

Although the lighting would be designed to be shielded and oriented in such a manner minimize illumination of the immediate surroundings, these types of light generate an ambient nighttime luminescence that is visible for substantial distances from a large portion of the Delta.

Measures that may be implemented to reduce lighting effects on cranes include: limiting construction to daylight hours in the vicinity of crane roosts; locating nighttime construction lighting away from crane roost sites; avoiding nighttime construction activity in frequently used flight paths; routing truck traffic to reduce headlight impacts in roosting habitat; operating portable lights at the lowest possible wattage and height; limiting the number of nighttime lights; and installing visual barriers

5J.D.8 Human Presence/Visual Disturbance Impacts on Sandhill Cranes

It is possible that the general presence and movement of humans, vehicles, and other equipment could disturb sandhill cranes within the study area. The effect of human presence on cranes is at least somewhat confounded with that of human-caused noise and light. As mentioned above, there is conflicting information regarding the level of disturbance caused to sandhill cranes by human activities (U.S. Fish and Wildlife Service2006). The use of different types of behavioral response as measures of disturbance (including roost site selection, vigilance, and flushing) may account for some of the difference in disturbance response observed. Some studies have shown that, while sandhill cranes do show a response to human presence, it does not appear to be a substantial response in many cases (Wilkins 2012, Eldred 2009), and some degree of habituation does seem to occur over time (Norling et al. 1992).

Studies show that roost site selection is impacted by a number of human activities. In their study along the Platte River in Nebraska, Norling et al. (1992) found that human disturbance influenced selection of roost sites by cranes. The cranes were most likely to avoid areas near paved and gravel roads, bridges, and single dwellings with considerable human activity. Alternatively, roost site selection did not seem to be impacted by human activities at urban dwellings, gravel pits, private roads, railroads and powerlines.

Studies that used flushing and vigilance as measures of disturbance show less of an impact on crane behavior from human activities. Increasing numbers of visitors to a bird-watching festival at a sandhill crane staging site in Colorado did not result in increased vigilance or increased flushing on the part of the cranes (Wilkins 2012). An increase in vigilance was observed in cranes at the refuge hosting the festival when compared to cranes at an off-refuge site nearby, but this change was not attributed to the presence of the birdwatchers. Similarly, in his study of sandhill cranes nesting and staging in southern Michigan, Eldred (2009) found that increased traffic near roosting sites did not result in increased vigilance on the part of cranes. In fact, Eldred reports that “even with heavy disturbance, it appears that cranes will not increase their time in the alert investigative posture.”

However, research using vigilance to measure disturbance in red-crowned cranes does show a disturbance response, indicating that other species of crane may be more susceptible to human disturbance than sandhill cranes. A study of overwintering red-crowned cranes in China showed that increased human disturbance does significantly increase vigilance behavior, thereby decreasing time available for foraging (Wang 2011). In this study, birds’ movement to a less disturbed area did not mitigate the impacts, as many birds moved to less disturbed areas; the concentration of birds in less disturbed areas resulted in continued high levels of vigilance due to intraspecies competition and, therefore, continued lost foraging time. This lost foraging time, if experienced by a large number of individuals, has population-level implications for the cranes.

While cranes may be impacted to varying degrees by human presence, it also seems that they can habituate to disturbance to some extent. Eldred (2009) points out that while a disturbance such as a home construction site does seem to bother cranes, it appears they are capable of adapting to “low levels of human presence." In addition, Norling (1992) suggests that "some form of acclimation" occurs in sandhill cranes subject to disturbance from commercial and urban development. Therefore, it is possible that the cranes could make some degree of adaptation to the project-related increase in general human presence in the plan area.

5J.D.9 Existing Human Presence/Visual Disturbance Environment

Existing human presence in and near the crane roosting and foraging areas is generally limited to levels consistent with a rural/agricultural environment. Moderate to high traffic volume currently exist on major highways near crane roosting and foraging habitat (e.g., Interstate 5, State Route 12).

5J.D.10 Proposed Project-Related Human Presence/Visual Disturbance

The increase in human presence and visual disturbance will generally be correlated with the intensity of construction activity in the project area, and along roadways where construction-related traffic will occur. As discussed, increased noise and lighting are directly linked to these activities and therefore, it is not possible to determine if there is an additional disturbance effect from human presence above what would occur from increased noise and lighting.

5J.D.11 Proposed Human Presence Avoidance and Mitigation Measures

Since human presence within the study area is so heavily linked with noise and artificial light sources in the study area, the noise and lighting mitigation measures above would also be expected to reduce any added effect from human presence and related visual disturbance.

5J.D.12 References

5J.D.12.1 Literature Cited

Armbruster, M. J., and A. H. Farmer. 1981. Draft Sandhill Crane Habitat Suitability Model. In: J. C. Lewis (ed.). *Proceedings 1981 Crane Workshop*. Tavernier, FL: National Audubon Society Pages 136–143.

California Department of Water Resources. 2010. *Supplementary Information for EIR/EIS: Bay Delta Conservation Plan*. Sacramento, CA

California Department of Water Resources, Bureau of Reclamation, U.S. Fish and Wildlife Service, and National Marine Fisheries Service. 2012. *Environmental Impact Report/Environmental*

Impact Statement for the Bay Delta Conservation Plan. Prepared by ICF International. Sacramento, CA. February.

Caltrans. 2007. The Effects of Highway Noise on Birds. Prepared for Caltrans by Environmental BioAcoustins LLC, Rockville, MD. September 30.

Dominoni, Davide, Michael Quetting, and Jesko Partecke. 2013. Artificial Light at Night Advances Avian Reproductive Physiology. *Proceedings of the Royal Society B*. 280: 1756.

Dwyer, N. C. and Tanner, G. W. 1992. Nesting Success in Florida Sandhill Cranes. *Wilson Bulletin* 104:22–31.

Elred, Trevor. 2009. *Vigilance Behavior and Land Use by Sandhill Cranes* (Grus canadensis). Master's Theses and Doctoral Dissertations. Paper 238.

Evans Ogden, Lesley J., 1996. Collision Course: *The Hazards of Lighted Structures and Windows to Migrating Birds*. Fatal Light Awareness Program (FLAP), Paper 3.

Federal Highway Administration. 2006. *FHWA Roadway Construction Noise Model User's Guide.* Available: <http://ntl.bts.gov/lib/49000/49100/49175/rcnm.pdf>.

Hill, David. 1992. *The Impact of Noise and Artificial Light on Waterfowl Behaviour: A Review and Synthesis of Available Literature.* BTO Research Report No 61. British Trust for Ornithology, Norfolk, U.K.

Hoover & Keith, Inc.. 2000. *Noise Control for Buildings and Manufacturing Plants.* Houston, TX

Kerlinger, Paul. 2000. *Avian Mortality At Communication Towers: A Review Of Recent Literature, Research, And Methodology*. Prepared for U.S. Fish and Wildlife Service Office of Migratory Bird Management by Curry & Kerlinger LLC, Cape May Point, NJ. March.

Navara, Kristen J. and Randy J. Nelson. 2007. The Dark Side of Light at Night: Physiological, Epidemiological, Aand Ecological Consequences. *Journal of Pineal Research.*

Nordt, Anja and Reinhard Klenke. 2013. Sleepless In Town—Drivers of the Temporal Shift in Dawn Song in Urban European Blackbirds. *PLoS ONE* 8(8): e71476.

Norling, B. S., S. H. Anderson, and W. A. Hubert. 1990. *The Influence of Water Depth, Unobstructed Area, and Disturbance Features on the Selection Of Roost Sites by Sandhill Cranes Along the Platte River, Nebraska.* Wyoming Cooperative Wildlife Research Unit Project Report to Bureau of Reclamation, Grand Island, Nebraska.

Norling, B. S., S. H. Anderson, and W. A. Hubert. 1992. Nocturnal Behavior of Sandhill Cranes Roosting in the Platte River, Nebraska. *Prairie Naturalist*. 23:17–20.

Poot, H., B. J. Ens, H. de Vries, M. A. H. Donners, M. R. Wernand, and J. M. Marquenie. 2008. Green Light for Nocturnally Migrating Birds. *Ecology and Society* 13(2): 47.

Raine, Helen, John J. Borg, Andre Raine, Suzanne Bairner, and Matthew Borg Cardona. 2007. *Light Pollution and Its Effect on Yelkouan Shearwaters In Malta; Causes and Solutions.* Prepared for EU LIFE Nature Programme, Brussels.

Santos, Carlos D., Ana C. Miranda, Jose P. Granadeiro, Pedro M. Lourenco, Sara Saraiva, and Jorge M. Palmeirim. 2010. *Acta Oecologica.* 36(2): 166-172.

Titulaer, Mieke, Kamiel Spoelstra, Cynthia Y. M. J. G. Lange, and Marcel E. Visser. 2012. Activity Patterns during Food Provisioning are Affected By Artificial Light in Free Living Great Tits (*Parus major*). *PLoS ONE* 7(5): e37377.

U.S. Fish and Wildlife Service. 2006. Platte River Recovery Implementation Program—Final Programmatic Environmental Impact Statement. Sandhill Cranes Appendix, Platte River FEIS. *Sandhill Crane Spring Habitat in Nebraska, and Potential Effects to resources from Proposed Changes in River Corridor Management.* March 10.

Wang, Zhi, Zhongqiu Li, Guy Beauchamp, and Zhigang Jiang. 2011. Flock Size and Human Disturbance Affect Vigilance of Endangered Red-Crowned Cranes (*Grus japonensis*). *Biological Conservation* 144(1): 101-105.

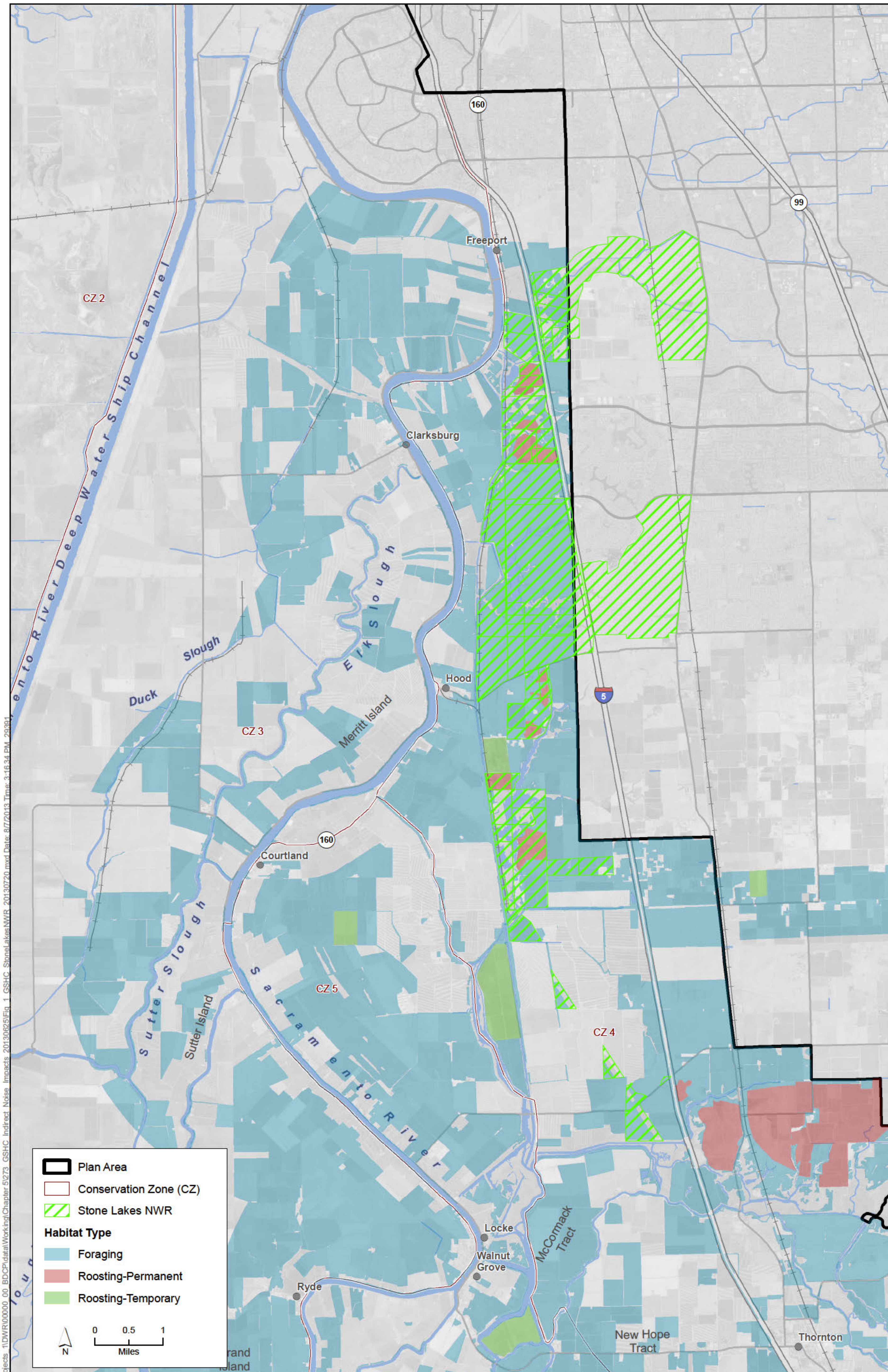
Wilkins 2012: Wilkins, K. 2012. Effects of Birdwatchers on Sandhill Crane (Grus Canadensis) Behavior at Spring Stopover Sites in the San Luis Valley, Colorado. Masters Thesis. Colorado State University, Fort Collins.

5J.D.12.2 Personal Communications

Brandt, David. Wildlife Biologist. Northern Prairie Wildlife Research Center, U.S. Geological Survey. June 20, 2013—Phone conversation with Scott Fleury, ICR, regarding sandhill crane response to noise.

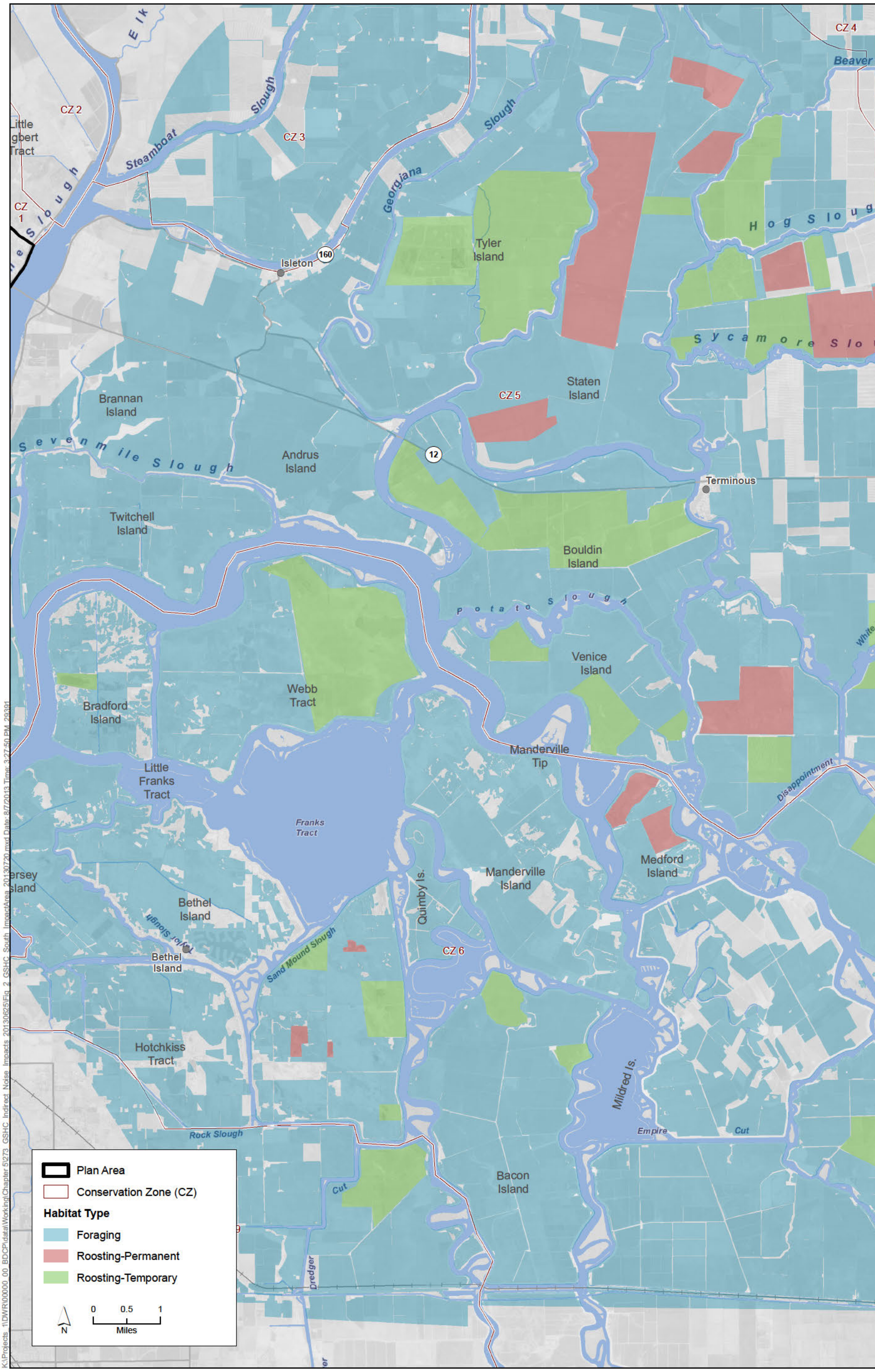
Ivey, Gary. International Crane Foundation. Bend, Oregon. August 25, 2013—Email correspondence with Heather White, ICF, regarding nighttime lighting effects on cranes.

Drewien, Rod. May 2013—Conversations with Scott Fleury, ICF< regarding sandhill crane response to noise.



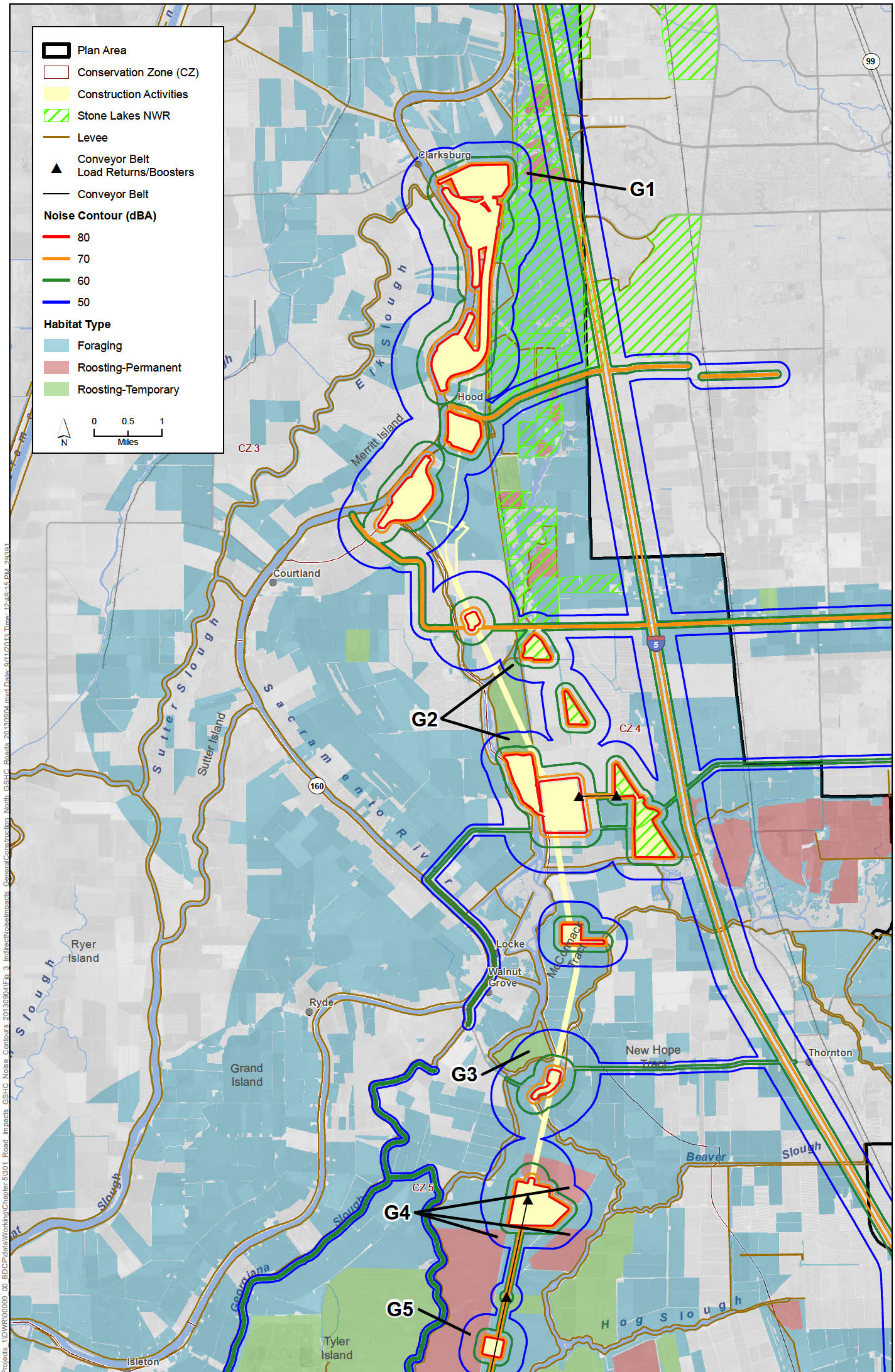
GIS Data Source: Conservation Zones, SAIC 2012; Plan Area, ICF 2012; Hydrological Subregions, ICF 2012; Restoration Opportunity Area, SAIC 2011.

Figure 1
Greater Sandhill Crane and Stone Lakes NWR



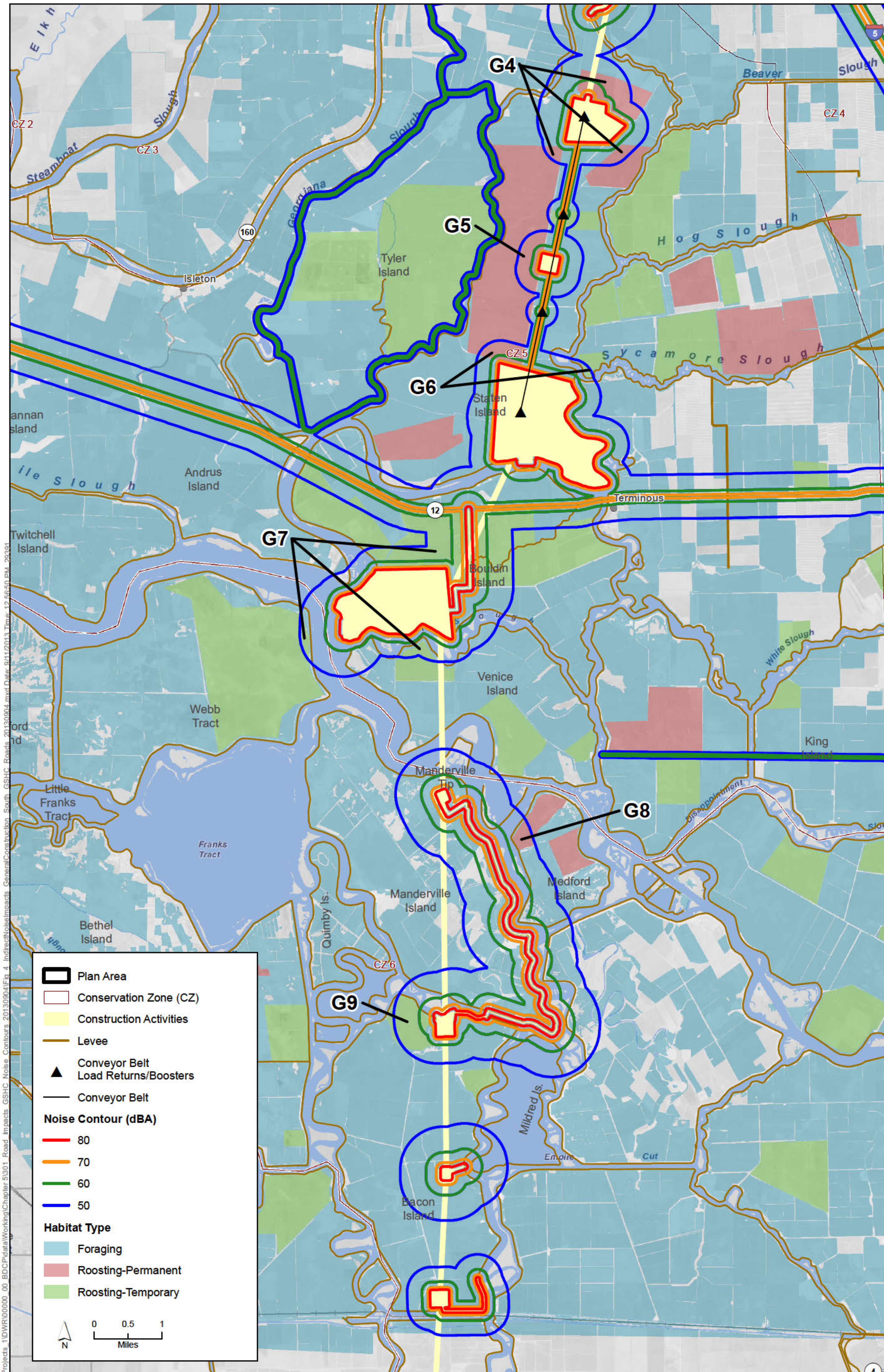
GIS Data Source: Conservation Zones, SAIC 2012; Plan Area, ICF 2012; Hydrological Subregions, ICF 2012; Restoration Opportunity Area, SAIC 2011.

Figure 2
Greater Sandhill Crane Habitat



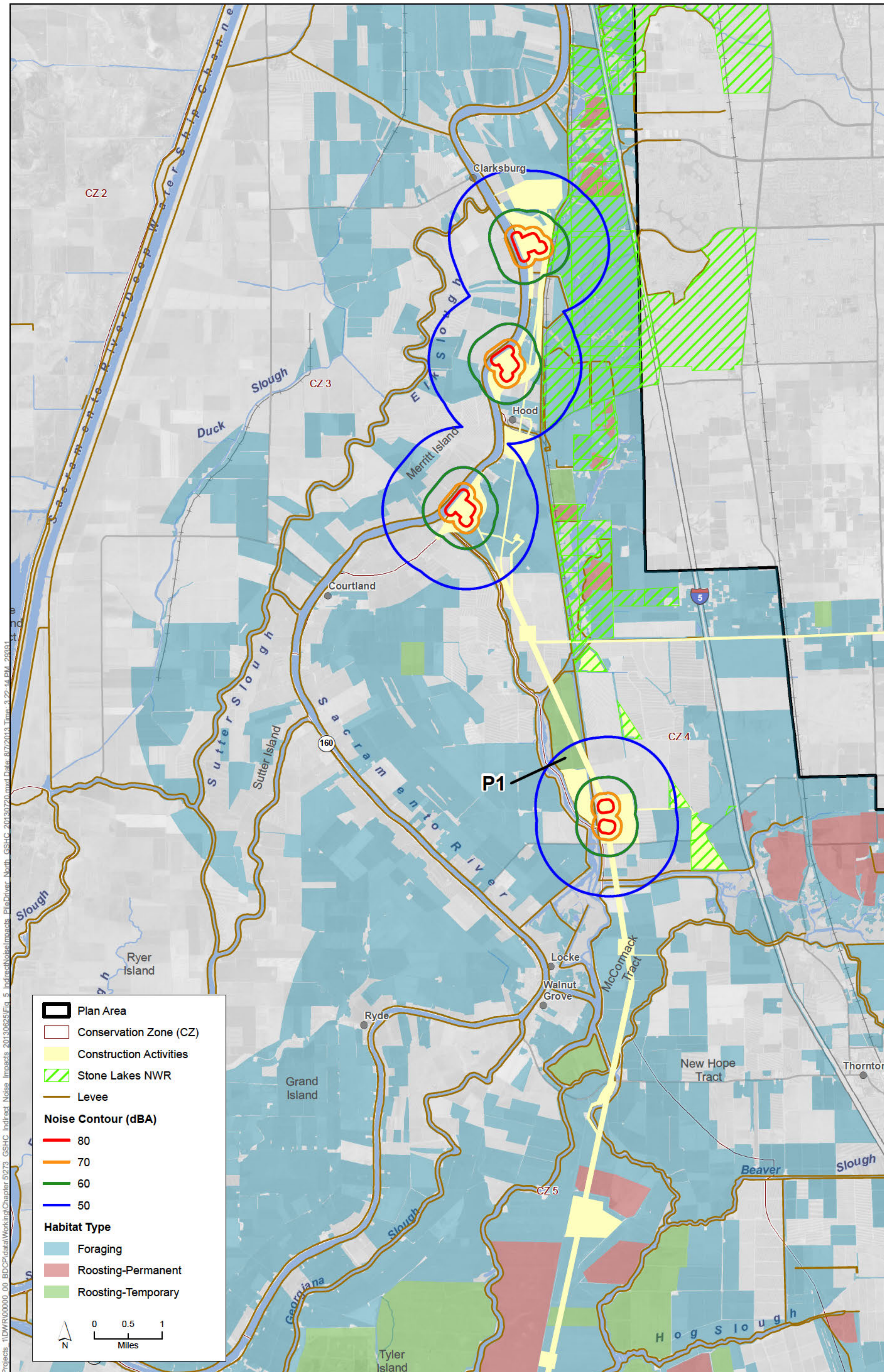
GIS Data Source:Stone Lakes NWR, Stone Lakes 2010; Construction Activities, DHCCP 2013.

Figure 3
Greater Sandhill Crane Indirect Impacts:
General Construction and Truck Traffic Noise (North)



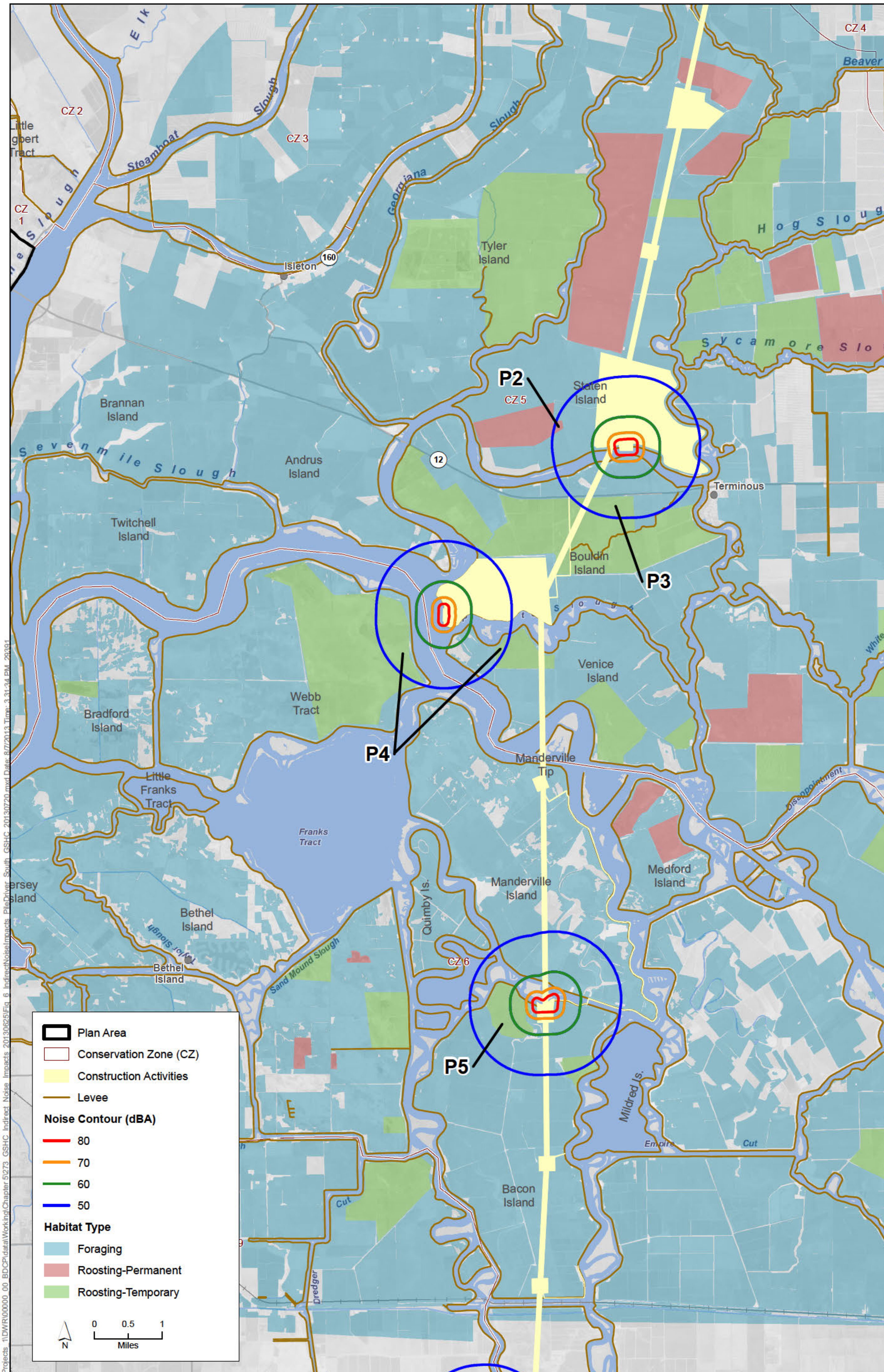
GIS Data Source: Construction Activities, DHCCP 2013.

Figure 4
Greater Sandhill Crane Indirect Impacts
General Construction and Truck Traffic (South)



GIS Data Source:Stone Lakes NWR, Stone Lakes 2010; Construction Activities, DHCCP 2013.

Figure 5
Greater Sandhill Crane Indirect Impacts:
Pile Driver Noise (North)



GIS Data Source: Construction Activities, DHCCP 2013.

Figure 6
Greater Sandhill Crane Indirect Impacts:
Pile Driver Construction (South)

Attachment 5J.E

Estimation of BDCP Impact on Giant Garter Snake Summer Foraging Habitat (Acreage of Rice) in the Yolo Bypass

Date:	June 20, 2013
To:	Laura King Moon, Project Manager, BDCP California Department of Water Resources
Cc:	Carl Wilcox California Department of Fish and Wildlife
From:	Rebecca Sloan and Ellen Berryman ICF International Neil Clipperton and Jason Roberts California Department of Fish and Wildlife
Subject:	**Estimation of BDCP Impact on Giant Garter Snake Summer Foraging Habitat (Acreage of Rice) in the Yolo Bypass**

The giant garter snake has been shown to use rice in the Yolo Bypass as aquatic foraging habitat throughout the summer. The amount of rice grown annually in the Yolo Bypass depends on a number of factors, including the degree to which late season flooding in the bypass precludes the preparation and planting of rice fields. BDCP Conservation Measure 2 (*CM2 Yolo Bypass Fisheries Enhancement*) allows for late-season inundation within the Yolo Bypass, which would potentially preclude the planting of rice in some portions of the bypass in some years. To estimate the loss of giant garter snake aquatic foraging habitat (rice) in the Yolo Bypass as a result of CM2 implementation, we used geographic information systems (GIS) to intersect spatial representations of a modeled, late-season inundation footprint associated with Fremont Weir operations under CM2 and the giant garter snake habitat model.

MIKE-21, a two-dimensional, hydrodynamic model, was used to estimate the spatial extent of inundation in the Yolo Bypass under representative flow scenarios (cbec 2010a). Two versions of the MIKE-21 model have been developed to inform Yolo Bypass effects analyses: one that includes west side tributaries as well as flows that pass over the Fremont Weir (cbec 2010b), and one that does not include the west side tributary flows (cbec 2010a). The version without west side tributary flows was chosen for use in this analysis, because it is assumed that late-season flooding under CM2 would likely result from flows entering the bypass through a modified Fremont Weir and that west side tributary flows in the late season would likely be negligible.

The hydrologic model was run for a range of flow scenarios between 1,000 and 6,000 cfs at 1,000-cubic-foot-per-second (cfs) increments. Each flow scenario produced a spatially explicit inundation footprint. The 4,000 cfs flow scenario produced the largest inundation footprint at 7,700 acres (cbec 2010a). To be conservative for the purposes of estimating habitat loss, the 4,000 cfs inundation footprint was used in the GIS intersect.

630 K Street, Suite 400 — Sacramento, CA 95814 — 916.737.3000 — 916.737.3030 fax — icfi.com

The giant garter snake habitat model uses agricultural data from the California Department of Water Resources (DWR) (2008) to model aquatic foraging habitat (rice). The 2008 DWR agricultural data is used for all agricultural-related effects analyses in the BDCP and represents a year with relatively high acreage of rice in the Yolo Bypass.

When intersected in GIS, the 7,700-acre inundation footprint overlaps with 1,662 acres of rice in the 2008 DWR agriculture dataset. The 1,662 acres of aquatic giant garter snake foraging habitat loss is assumed to be permanent; that is, the preclusion of 1,662 acres of rice is assumed to occur annually, resulting in the permanent loss of aquatic foraging habitat.

To conservatively estimate habitat loss, this analysis assumes late-season flooding occurs every year. However, the actual frequency of late-season flooding as a result of CM2 implementation is expected to be significantly less than annually. This conservative approach is considered appropriate for the purpose of setting take limits for the annual loss of aquatic, summer foraging habitat for the giant garter snake within the Yolo Bypass.

Datasets

1. 2008 Yolo County Land Use Survey Data (California Department of Water Resources 2008).
2. MIKE-21 4000 cfs flow scenario without Westside tributaries (cbec 2010a).

Steps Using GIS Tools

1. Queried out the areas attributed as rice in the 2008 Yolo County Land Use Data (California Department of Water Resources 2008).
2. Intersected the "DWR 2008 Rice" data with the "MIKE-21 4,000 cfs inundation footprint" data to create the dataset—"Rice within the 4,000 cfs Inundation Zone."
3. In the "Rice within the 4,000 cfs Inundation Zone" layer, manually digitized remaining portions of inundated rice fields to capture the total impacted acreage of agriculture.

Result

Estimated loss of rice is 1,662 acres.

References

California Department of Water Resources. 2008. 2008 Yolo County Land Use Survey Data.

cbec. 2010a. *Yolo Bypass Two-Dimensional Hydrodynamic Modeling*. Prepared for the Metropolitan Water District of Southern California. May 2010.

cbec. 2010b. *BDCP Effects Analysis: 2D Hydrodynamic Modeling of the Fremont Weir Diversion Structure*. Prepared for SAIC and the California Department of Water Resources. November 2010.