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Knightsen Wetland Restoration and Flood Protection Project - Concept Alternatives Report

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CHAPTER 1
Introduction

The Knightsen Wetland Restoration and Flood Protection Project (project), led by the East Contra Costa County Habitat Conservancy (the Conservancy), is a multi-objective effort to restore a mosaic of wetland and upland habitats for special status species, attenuate flooding in the community of Knightsen, provide water quality benefits, and explore providing opportunities for recreation and Delta access. The Project will contribute to the conservation goals of the East Contra Costa County Habitat Conservation Plan / Natural Community Conservation Plan (HCP/NCCP) as well as larger regional goals for the Delta.

The project site is a 645-acre property located in the northeastern region of the HCP/NCCCP inventory area. The Property lies in unincorporated Contra Costa County, partially in the community of Knightsen (Figure 1).

The project site consists of two legal parcels: APN 020-171-001 north of Delta Road (the North Parcel) and 020-172-004 south of Delta Road (the South Parcel). For planning purposes, the South Parcel is divided into two distinct areas (hereinafter referred to as the Central and East Sub-Parcels) by existing utility easements. Figure 2 shows the three distinct units on the project site.

The primary purpose of this report is to describe conceptual alternatives that have been developed for the project. Concept designs were developed under a multi-step process. We first articulated the multiple – sometimes competing– project objectives based on input from the Conservancy, the East Bay Regional Park District, the local community and other stakeholders. Concurrently, we performed studies to document existing conditions at the project site related to ecologic functions, groundwater and surface hydrology, utility and cultural resources constraints at the site. Next, we developed a suite of concept design elements, based on an understanding of existing conditions, projected future conditions, and opportunities and constraints of the site. We also considered input from the Knightsen Town Community Services District (CSD), and residents of the adjacent community, as solicited through two public meetings and a series of one-on-one stakeholder interviews, including meetings and solicitation of feedback from the Contra Costa County Mosquito and Vector Control District, Reclamation District 2065 (Veale Tract). Ultimately the Conservancy will select its preferred alternative to move forward toward final design and implementation.

Project goals and objectives are identified in Chapter 2. A review of the historical ecology of the site is provided in Chapter 3, existing conditions are described in Chapter 4, and site opportunities and constraints are listed in Chapter 5. Conceptual alternatives including an evaluation of the alternatives is described in Chapter 6, and next steps in development of the project are described in Chapter 7. Chapter 8 provides citations of references consulted in preparation of this report.
Figure 1
Location Map
Figure 2
Project Site Map

Knightsen Wetland Restoration and Flood Protection Project. D170045.00

SOURCE: ESRI World Topographic Map
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CHAPTER 2
Goals and Objectives

The following goals and restoration objectives were developed for the project:

2.1 Goals

The Conservancy, in conjunction with its partners, identified the following goals for the restoration project:

1. Restore a mosaic of wetland and upland habitats to support HCP/NCCP covered species;
2. Provide flood conveyance/attenuation for runoff from the adjacent community of Knightsen;
3. Provide water quality improvements for stormwater runoff from the community of Knightsen and, by extension, Delta receiving waters;
4. Protect adjacent land uses and limit the need for intensive maintenance; and
5. Preserve future opportunities for passive recreation and access to Delta waterways;

The project will also contribute to the conservation goals of the HCP/NCCP.

2.2 Restoration Objectives

In order to realize these goals, the Conservancy developed objectives for the project with input from its partners, stakeholders and the public, including:

1. Maximize areas of perennial freshwater wetland and alkali seasonal wetland complex;
2. Enhance upland habitats including oak savanna and stabilized interior dune;
3. Restore to the site habitats and conditions suitable to support special status species covered by the HCP/NCCP. These species may include giant garter snake (Thamnophis gigas), western pond turtle (Emys marmorata), tricolored blackbird (Agelaius tricolor), western burrowing owl (Athene cunicularia), Swainson’s hawk (Buteo swainsoni), golden eagle (Aquila chrysaetos), silvery legless lizard (Aniella pulchra pulchra), vernal pool fairy shrimp (Branchinecta lynchi), brittlescale (Atriplex depressa), and other locally rare plants;
4. Accept runoff from the community of Knightsen to divert flows away from areas with a history of drainage issues and flooding;
5. Direct stormwater flows to areas beneficial for target habitats;
6. Create on-site stormwater biofiltration swales and shallow wetlands to improve water quality for runoff that is ultimately discharged to the Delta;
7. Discontinue irrigated agricultural practices on site;
8. Limit the need to pump stormwater into No Name Slough;
9. Protect neighboring properties from potential overtopping or seepage effects; and
10. Preserve opportunities for future public access and recreation.
CHAPTER 3

Historical Ecology

The East Contra Costa County Historical Ecology Study, developed by the San Francisco Estuary Institute and Contra Costa County, in cooperation with the Conservancy in 2011 (SFEI 2011), mapped historical land cover in the area for the first time, and led to some surprising findings related to the project site. The maps within the study showed that the site, which is currently almost entirely cultivated land, once contained large areas of tidal and alkali wetlands, alkali meadow, oak savanna and rare interior sand dunes (Figure 3).

Along the eastern and northern half of the project site tidal marsh was historically present. The historic tidal marshes in this area are thought to have been dominated by tules (Schoenoplectus acutus) with some other species present including saltgrass (Distichlis spicata) and willows (Salix spp.) in higher elevation areas. A bank of alkali meadow occurred just to the west of the tidal marsh. Alkali meadows are characterized by fine-grained soils that have a high residual salt content supporting a distinctive, salt-tolerant plant community, including some species characteristic of salt marshes and/or vernal pools/swales. These habitats typically have high groundwater levels and are subject to temporary to seasonal flooding, with subsequent drying through the summer. Dominant plant species include saltgrass, wild barley (Hordeum spp.), saltbush (Atriplex spp.), alkali heath (Frankenia salina), and alkali weed (Cressa truxillensis) (SFEI 2011).

Oak savanna occurred along higher elevations to the south and west of the alkali meadow. Oak savannas contained widely spaced large oak trees. Oak savannas were described as park-like with single trees or groups of trees scattered around the plains. Oak savannas mostly contained blue oak (Quercus douglasii) and valley oak (Quercus lobata), but also a large amount of live oak (Quercus agrifolia) with some other species present such as buckeye (Aesculus californica) (Stanford et al. 2011).

The remnant interior dune habitat within the project site occurred within the tidal marsh in the area now within the North Parcel, and within oak savanna in a small area of the southeastern corner of the site. The most well documented plants within the interior dune habitat are silver bush lupine (Lupinus albifrons) and live oaks (Quercus agrifolia). It was described as “a patch of considerable extent of chaparral and scrub oak”. The far-flung patches of dune habitat today support herbaceous species such as California croton (Croton californicus), slender buckwheat (Eriogonum gracile), and valley lessingia (Lessingia gladulifera) (SFEI 2011).
Figure 3
Historic Habitats

Knightsen Wetland Restoration and Floodplain Protection Project. D170045.00

SOURCE: SFEI 2011
CHAPTER 4
Existing Conditions

4.1 Land Use

The project site and surrounding areas have historically been used for agricultural purposes. Most of the project site is still actively used for row crops; planted in alfalfa, field corn, and tomatoes in the recent past. The North Parcel lies fallow and has not been recently farmed. It is currently seasonally grazed by cattle.

4.2 Topography

Topography of the project site is virtually flat, sloping very slightly down from southwest to northeast, with elevations ranging from 19 feet NAVD in the southwest corner to just above sea level in the northeastern corner of the property. The topography of the site has been reconfigured to support agricultural practices (Figure 4). Numerous irrigation and drainage ditches have been cut on the site, and the site has been graded to slope away from irrigation ditches and towards drainage ditches to support flood irrigation in connection with agricultural use of the project site. The southeastern edge of the South Parcel lies adjacent to No Name Slough.

Storm water on the parcel generally flows from the southwest to the northeast until it is captured in drainage ditches and routed to the southeast where it is pumped into No Name Slough. The parcel also receives much of the runoff from the community of Knightsen, making the site a potential capture area for stormwater flow from the town of Knightsen.

4.3 Hydrology

Though considered to have a “Mediterranean” climate characterized by mild winters and hot, dry summers, Contra Costa County’s climate is distinctly varied across the landscape. Seasonally more temperate and mild temperatures occur in the western part of the county, where temperatures are moderated by the influence of the San Francisco Bay. As shown in Figures 5 and 6, in the east county areas, topography plays an important role in determining both temperatures and rainfall. Mount Diablo and the surrounding hills form a topographic barrier holding back the cooling coastal fog in the summer, and creating a rainshadow effect in the winter that results in storm clouds releasing more water on the western slopes and reduced precipitation on the leeward, eastern county areas (Contra Costa County 2003). The more extreme temperatures are seen in the eastern county areas, with winter lows in the upper 30’s and summer highs above 90 degrees Fahrenheit. Mean annual rainfall in the vicinity of the project site is approximately 10 inches per year. Upslope from the project site, mean annual rainfall increases to approximately 12.5 inches per year (Balance Hydrologics 2019).
Knightsen, Rock Slough, Delta Rd., Byron Hwy.

North Parcel
East Sub-Parcel
Central Sub-Parcel
East Sub-Parcel

Figure 4
Knightsen Wetland Restoration and Floodplain Protection Project
East Contra Costa County Habitat Conservancy
Project Topographic Map
Temperature
Though considered to have a "Mediterranean" climate with mild winters and hot dry summers, Contra Costa County's climate is distinctly varied across the landscape. Seasonally more temperate and mild temperatures occur in the western part of the county. The more extreme temperatures are seen the eastern part of the county, with winter lows in the upper 30's and summer highs above 90 degrees Fahrenheit.

The consistently cool waters of the Pacific Ocean and San Francisco Bay moderate the summer and winter temperatures in Contra Costa County, though this influence diminishes with distance. Topography also plays an important role. The hills east of Richmond and around Mount Diablo can hold back cool, coastal fog in the summer. In the winter, the hills partially block cold air and tule fog that settles in the inland valleys.

Rain
Just as seasonal temperature varies greatly across the county, so does precipitation. During the wettest months of the year, parts of the county receive up to 8 inches of rain per month, while during dryer summer months areas of the county receive little to no monthly rainfall.

The amount of rain that falls in the County depends on the season, location, and the topography. Generally, the western part of the county receives more rain than the eastern part. The East Bay Hills provide the first topographical barrier that moisture-rich clouds encounter, forcing them to release water. This phenomenon is called orographic precipitation.

Rainshadow Effect
Orographic precipitation occurs when humid air is forced to rise up the slopes of hills and mountains. As the air rises on the windward side of the mountain, it cools. If the temperature drops to its dew point, condensation occurs, and clouds form and release moisture (rain). As the rising air passes the top of the range, it begins to descend the leeward side. As it descends, the temperature rises and condensation stops, as does precipitation. This leeward side of the range is in the rain shadow of the mountain. There are consecutive rainshadow effects in the county: first as moisture encounters the East Bay Hills, and second as remaining moisture meets Mount Diablo.
Rainfall during 2018 and 2019 varied considerably. Total rainfall during water year 2018 was about 10.8 inches at the Brentwood County Corporation Yard, or about 82 percent of mean annual rainfall, and characterized as a “dry” year. Antecedent rainfall during water year 2017, was 161 percent of mean, an extremely wet year, which likely moderated the below-normal conditions of water year 2018. Subsequent rainfall during water year 2019 was above normal and included atmospheric-river storms, causing ponding and flooding on the project site, which peaked during February 2019 (Balance Hydrologics 2019).

Surface Water

The project site is located at the downstream-most portion of a broader 3.46 square-mile drainage area (ESA, 2019b). Runoff generated in the central portions of Knightsen drains toward No Name Slough and is currently pumped off the property over an existing levee into No Name Slough. Runoff generated in the northeast portion of Knightsen drains to the north toward drainage ditches along Sellers Avenue, Knightsen Avenue, and Jersey Island Road. Runoff generated in the southeast portion of Knightsen in the vicinity of Eagle Lane drains towards No Name Slough via gravity drainage through a flap gated culvert.

Historically, sheet flow and shallow swales directed runoff to wetlands that lined the fringe of the Delta. Currently, runoff flows are intercepted by private and public drainage ditches, roads, railroad embankments and levees. The flat topography combined with a variety of constructed features restricts drainage and results in relatively frequent flooding in some areas of the community. Agricultural drainage ditches and pumping operations influence the direction of flow within the project South Parcel and Veale Tract, directing the majority of runoff from the up gradient watershed to No Name Slough.

The flat topography in Knightsen is further exacerbated by the circuitous path that runoff flows through the community. The main drainage pathway in Knightsen is shown on Figure 7. Knightsen is split by the Santa Fe railroad tracks which traverse the community from the southeast to northwest. These tracks and the existing road/drainage ditch network intercept runoff flowing to the northeast and route it from its natural course to the pump station at southeast corner of the South Parcel/East Sub-Parcel. Runoff generated in the western portion of Knightsen flows northeast towards downtown Knightsen where it is captured behind the Santa Fe railroad and then flows southeast toward a culvert under the railroad. From there, runoff flows northeast towards Byron Highway, then north to Delta Road and east along Delta Road to the project South Parcel. At the South Parcel, runoff then flows south and east to the pump station at No Name Slough where it is pumped into the slough. This circuitous drainage path triples the flow length for runoff from downtown Knightsen which significantly impacts drainage in the community. The North Parcel has a somewhat natural hummocky topography, and ponds water in shallow hollows.

The existing Delta Road drainage ditch that enters the South Parcel delivers runoff from about 3.46 square miles onto the South Parcel. Hydrology modeling performed for the Knightsen CSD, indicates that runoff volumes discharged to the project site range from about 47 acre-feet in a 5-year, 24-hour storm event up to about 67 acre-feet in a 25-year, 24-hour storm event. Additionally, the Eagle Lane triangle, south of the South Parcel, generates 15 to 21 acre-feet of
Figure 7
Knightsen Surface Water Drainage
runoff from 5-year and 25-year, 24-hour storm events that is currently discharged to No Name Slough via a gravity driven, flap gated culvert. The runoff from the surrounding contributing watersheds represents an opportunity to help support wetland and other habitats at the project site.

### 4.3.1 Water Quality

The water-quality of surface waters on site was sampled on March 22, 2018, during a small late-season storm totaling one inch over three days. Surface water entering the site at the Delta Road ditch and leaving the site at the pump station to No Name Slough were sampled and analyzed for common agricultural constituents. Analysis results indicate that water leaving the site was of a lower quality than the water entering the site which suggest a flushing of minerals from on-site farm fields, which were likely retained in surface soils from slough-water irrigation during the previous dry season. Dissolved solid concentrations in the stormwater sampled at the outflow gage (pump station) were as much as 10 times or more the concentrations measured at the Inflow Gage, and exceeded maximum contaminant levels (MCLs) for drinking water. Boron, though not toxic to humans or other vertebrates, was measured on site at concentrations exceeding levels known to cause severe crop problems, and was likely introduced from irrigation with slough water. Off-site source(s) of nutrients were indicated by concentrations detected at the Inflow Gage. Chlorinated herbicides, carbamates, diquat and paraquat were not detected (Balance Hydrologics 2019).

Water quality monitoring results and more detail is provided in the *Knightsen Wetland Restoration and Flood Protection Project Baseline Soils Evaluation and Hydrologic Monitoring*(Balance Hydrologics 2019).

### 4.3.2 Groundwater

In groundwater monitoring conducted for the project, depth to groundwater across the property generally ranged from 3 to 6 feet below the ground surface with recharge peaks of a foot or more associated with rainfall in the wet season and irrigation in the dry season. Depth to groundwater in the southeastern-most portion of the property rose to within 1 foot of the ground surface several times during the February 2019 peak rains when inflows exceeded pumping of runoff to No Name Slough (Balance Hydrologics 2019).

Depth to groundwater was deepest at North Parcel, ranging between 7.5 feet and 2 feet below ground surface. Ponding at the North Parcel generally persisted while there was rain, but evaporated and percolated to groundwater relatively quickly after rain stopped. With primarily sandy loam soils underlain by dune sand, low lying areas at the North Parcel actively recharge groundwater, potentially to a broad aquifer within the dune complex, and likely connected to the sand zone identified at depth at the other well sites.

Groundwater contour maps show a 0.002 northeastward groundwater gradient (Figure 8) (Balance Hydrologics 2019). This groundwater flow gradient from southwest to northeast generally matches the larger trend in topography and indicates that groundwater flows away from the Eagle Lane triangle area and towards the project site.
Figure 20. Groundwater elevations and contours, April 3, 2019, Knightsen Wetland Restoration and Flood Protection Project, East Contra Costa County Habitat Conservancy, CA.

Groundwater gradient \( i \) = 0.0019. Bearing = NE 54°.

Contour intervals = 1 ft.


Source: Balance Hydrologics, 2019

Figure 8
Groundwater Contour Map
Groundwater monitoring results and more detail is provided in the *Knightsen Wetland Restoration and Flood Protection Project Baseline Soils Evaluation and Hydrologic Monitoring* (Balance Hydrologics 2019).

### 4.4 Soils

Site soil conditions are summarized below and described in more detail the *Knightsen Wetland Restoration and Flood Protection Project Baseline Soils Evaluation and Hydrologic Monitoring* (Balance Hydrologics 2019).

Soils on site consist of sand, loam and clay, including six soil mapping units: Delhi sand, 2 to 9% slopes (DaC), Marcuse sand (Ma), Marcuse clay (Mb), Piper loamy sand (Pe), Piper fine sandy loam (Ph), and Sacramento clay, alkali (Sb) (USDA 1977; Figure 9). The Delhi and Marcuse sands are mapped in the southern and southwestern sections of the study area. Piper sandy loam is mapped largely in the area north of Delta Road. Sacramento clay soils are mapped in the northeastern section of the study area. Piper fine sandy loam is largely restricted to the western portion of the northern Parcel. Marcuse clay makes up the majority of the soils in the study area and is mapped throughout most of the area south of Delta Road and along the southwestern edge north of Delta Road. The presence of clay, sand and sodic soils are indicative of historical habitats on the site including tidal marsh, interior sand dunes, alkali seasonal wetlands, and oak savanna (Figure 3).

### 4.5 Vegetation

HCP/NCCP land cover types observed at the project site include annual grassland, alkali grassland, ruderal, alkali wetland, seasonal wetland, permanent wetland, slough/channel, riparian, cropland, and urban (Nomad Ecology 2018). An additional land cover type was observed on site, Oakley Sand Stabilized Interior Dunes, which was not recognized at the time of HCP development. The location of the land cover types at the project site are shown in Figure 10. Each vegetation type is summarized below and described in more detail the *Biological Resources Assessment and Botanical Resources Survey Report* (Nomad Ecology 2018b).

#### 4.5.1 Grasslands

Three grassland land cover types, are present on site: alkali grassland, annual grassland, and ruderal.

Alkali grassland is characterized by a dominance of saltgrass (*Distichlis spicata*) and non-native wild barley (*Hordeum* ssp.), as well as other halophytes such as including saltbush (*Atriplex* ssp.), alkali heath (*Frankenia salina*), alkali weed (*Cressa truxillensis*), alkali mallow (*Malvella leprosa*), and common spikeweed (*Centromadia pungens* subsp. *pungens*). Within the project site, alkali grassland was observed throughout the North Parcel and in the southeast corner of Central Sub-Parcel. Characteristic species on site include saltgrass, alkali heath, alkali mallow, common spikeweed, and non-native Mediterranean barley. Small alkali scalds were also present on site.
Figure 9
Soils Map
Knightsen Wetland Restoration and Flood Protection Project. D170045.00

Figure 10
HCP/NCCP Land Cover Types

Mapped biological resources based on field work conducted in July 2015. Source: Contra Costa County. Aerials were flown in 2014. Projection: NAD 83 SP CA Zone III.
Annual grassland is characterized by grass and forb species dominating the land cover and where trees and shrubs comprise less than 5 percent canopy cover. Within the project site, annual grassland occupied the majority of the North Parcel north of Delta Road. This plant community is dominated by non-native annual grasses including ripgut brome (Bromus diandrus), slender oats (Avena barbata), Italian ryegrass (Festuca perennis), soft chess (Bromus hordeaceus), Mediterranean barley (Hordeum marinum subsp. gussoneanum), and hare barley (Hordeum murinum subsp. leporinum).

Ruderal vegetation is characterized by sparse nonnative, typically weedy vegetation, occupying vacant lots surrounded by developed areas. Within the South Parcel of the project site, ruderal vegetation is located along the irrigation ditch on the eastern edge and along the banks of the slough on the southern edge. Stands of ruderal vegetation on site are expressed as mosaics of near monocultures of invasive species including black mustard (Brassica nigra), poison hemlock (Conium maculatum), slender flowered thistle (Carduus tenuiflorus), Himalayan blackberry (Rubus armeniacus), whitetop (Lepidium draba), and broadleaf pepperweed (Lepidium latifolium).

4.5.2 Wetlands and Aquatic Habitats

Three land cover type found on site are wetlands: alkali wetland, seasonal wetland, and permanent wetland. Slough/channel is the one aquatic land cover type found on site.

Alkali wetland occurs as perennial or seasonally wet features on alkaline soils. The vegetation of alkali wetlands is composed of halophytic plant species adapted to both wetland conditions and high salinity levels. Within the North Parcel, alkali wetland occurs in low-lying level areas that are dominated by alkaline wetland species, exhibit indicators of alkaline soils, and have wetland hydrology. Species that comprise this community include saltgrass, alkali heath, silverscale (Atriplex argentea var. expansa), salt marsh sand spurrey (Spergularia marina), bush seepweed (Suaeda nigra), non-native Mediterranean barley, non-native Italian ryegrass, alkali mallow, and alkali weed (Cressa truxillensis). Within the South Parcel, alkali wetlands were present in crop fields, primarily those planted in wheat. Crop growth in these areas is usually stunted and sparse due to excessive saturation and harsh soil chemistry caused by poor drainage and alkalinity. Characteristic vegetation includes included non-native hyssop loosestrife, salt marsh sand spurrey, non-native rabbitsfoot grass (Polygogenous monspeliensis), non-native birdfoot trefoil (Lotus corniculatus), non-native swamp grass (Crypsis schoenoides), lady’s thumb (Persicaria maculosa), and non-native fat hen (Atriplex patula).

Seasonal wetlands are freshwater wetlands that support ponded or saturated soil conditions during winter and spring and are dry through the summer and fall until the first substantial rainfall. Although seasonal wetlands and vernal pools share similar hydrologic characteristics, species composition of seasonal wetlands is typically ruderal in nature. Within the project site, seasonal wetlands were present on the North Parcel. Characteristic plant species include woolly marbles (Psilocarphus brevissimus var. brevissimus), bracted popcorn flower (Plagiobothrys bracteatus), purslane speedwell (Veronica peregrina subsp. xalapensis), Jepson’s button celery (Eryngium aristulatum var. aristulatum), annual hairgrass (Deschampsia danthonioides), little mouse tail (Myosurus minimus), non-native hyssop loosestrife (Lythrum hyssopifolium), and non-native Italian ryegrass.
Permanent Wetlands are characterized by a year-round water source. Within the project site, permanent wetland is located in the manmade drainage channel along the eastern edge of the South Parcel and on the southern boundary of the project site continuous with the slough. This vegetation type consists of mixed stands of narrow-leafed cattail (*Typha angustifolia*), seacoast bulrush (*Bolboschoenus robustus*), dotted smartweed (*Persicaria punctata*), and common tule (*Schoenoplectus acutus var. occidentalis*).

Sloughs and channels are features with perennial water and artificial banks constructed of natural soil with little or no in-channel vegetation. Sloughs are tidally influenced and may contain brackish waters. Within the southern portion of project site, the area mapped as slough runs along the southern boundary of the project site near the eastern most corner. Several additional drainage channels within the South Parcel were also mapped. The slough has earthen and rip rap banks while the channels have earthen banks. Vegetation is present along the banks of these sloughs and channels and includes common tule, narrow-leaved cattail, Mexican rush (*Juncus mexicanus*), tall flatsedge (*Cyperus eragrostis*), non-native curly dock (*Rumex crispus*), and fringed willow herb (*Epilobium ciliatum* subsp. *ciliatum*). Stands of tule are present along the margin of the slough and emergent and floating plants are present in the slough including duckweed (*Lemna minor*) and non-native common water hyacinth (*Eichhornia crassipes*).

### 4.5.3 Riparian

One land cover type found on site is riparian: riparian woodland/scrub. Riparian woodland/scrub is characterized by phreatophytic woody vegetation associated with streams and permanent water sources. Within the project site, riparian woodland/scrub occurs along the drainage ditch located on the eastern edge of the South Parcel. This land cover type is characterized by an open canopy overstory of sandbar willow (*Salix exigua var. hindisana*). Other tree and shrub species present in riparian woodland/scrub within the project site include Fremont cottonwood (*Populus fremontii* subsp. *fremontii*), Gooding’s black willow (*Salix goodingii*), non-native Himalayan blackberry, and orchard waifs of northern California black walnut (*Juglans hindsii*). Understory species include non-native species such as broadleaved pepperweed, garden asparagus (*Asparagus officinalis* subsp. *officinalis*), and tall fescue (*Festuca arundinacea*).

### 4.5.4 Other

**Oakley Sand Stabilized Interior Dune**

The Oakley sand stabilized interior dune land cover type is not defined in the HCP/NCCP, however it is a very uncommon and highly threatened vegetation type in the region that should be identified during surveys. This habitat is characterized by loose to consolidated sandy soils mapped as Delhi sand, Piper sand, and Piper fine sandy loams (USDA 1977). Characteristic vegetation includes locally common natives such as California croton (*Croton californicus*), desert evening primrose (*Oenothera deltoids* subsp. *cognata*), small evening primrose (*Camissonia* spp.), slender buckwheat (*Eriogonum gracile* subsp. *graciele*), blue head gilia (*Gilia capitate* subsp. *staminea*), Kellog’s tarweed (*Deinandra kelloggii*), valley lessingia (*Lessingia glandulifera* var. *glandulifera*), coast live oak (*Quercus agrifolia* var. *agrifolia*), and silver bush lupine (*Lupinus albifrons* var. *albifrons*). Within the project site, Oakley sand stabilized interior...
dunes are aligned generally north to south and are located in the North Parcel, and in the southwest corner of the South Parcel. Beyond the project site, these dune features line up with historic dunes located along a southeast to northwest alignment along the fringe of historic tidal marsh south and west of the San Joaquin river. Species that comprise this community include California croton, blue head gilia, contorted suncup (Camissonia contorta), desert goosefoot (Chenopodium pratericola), non-native ripgut brome, non-native Italian thistle (Carduus pycnocephalus subsp. pycnocephalus), and non-native Russian thistle (Salsola tragus).

**Cropland**

Cropland are those areas that are tilled and cultivated for agricultural crops, such as corn, tomatoes, and wheat. Cropland also includes hay production in both dryland settings and irrigated areas. Some croplands become ruderal vegetation if fields are left fallow for several growing seasons. Within the project site, row crops are present in the majority of the South Parcel. During the 2017 site visits, crops observed include garlic, tomatoes, and wheat.

**Urban**

Urban sites are areas where the native vegetation has been cleared for residential, commercial, industrial, transportation, or recreational structures. Developed areas include areas that have structures, paved surfaces, horticultural plantings, and lawns smaller than 10 acres. Within the project site, the area mapped as urban includes part of the southwestern corner of the portion south of Delta Road. The single residence is characterized by plowed and cleared soil and ornamental trees, including non-native olive (Olea europaea), and non-native Eucalyptus (Eucalyptus sp.).

**4.6 Wildlife**

A total of eleven covered/no-take species were determined to have the potential to occur within the project site based on habitat suitability, the presence of essential land cover types, and the results of reconnaissance and planning surveys (Nomad Ecology 2018). The HCP/NCCP covered species that are considered to have potential to occur at the project site include the vernal pool fairy shrimp, midvalley fairy shrimp (Branchinecta mesovallensis), vernal pool tadpole shrimp (Lepidurus packardi) Northern California legless lizard (Anniella pulchra), giant garter snake, western pond turtle, western burrowing owl, Swainson’s hawk, tricolored blackbird, and golden eagle (Nomad Ecology 2018).

**4.7 Cultural**

Through background research, correspondence with potential interested parties, and a reconnaissance field survey, no archaeological resources and several architectural resources were identified at the project site (ESA 2018). Although no archaeological resources were identified, the Piper sand deposits present within the project site have been previously identified as very sensitive for containing buried prehistoric archaeological resources. It is recommended that an archaeological subsurface survey be completed to identify, to the extent possible, the presence or absence of archaeological resources in portions of the project site where ground disturbance will occur, with particular emphasis on the areas with Piper sand. If archaeological resources are
identified during the subsurface survey, it is recommended that an archaeological testing program be developed to evaluate whether the archaeological resources constitute historical resources or unique archaeological resources, pursuant to CEQA, or historic properties, pursuant to the National Historic Preservation Act (NHPA) (ESA 2018).

Finally, if the Project will directly or indirectly (i.e., visually) impact the residence at 8831 Byron Highway or irrigation canals within the project site, each resource that could be impacted would need to be evaluated for eligibility as an historical resource, pursuant to CEQA, or historic property, pursuant to the NHPA (ESA 2018).

### 4.8 Utilities

Two utility companies, Western Area Power Administration (WAPA) and PG&E maintain and operate utilities within the project site. Details are provided below for each company (ESA 2019a).

#### 4.8.1 Western Area Power Administration

The Western Area Power Administration (WAPA) operates and maintains two overhead electrical transmission lines, the Shasta-Tracy 230kV Tower Line, and the Tracy-Contra Costa 69kV Line, on behalf of the United States Department of Energy and the United States Bureau of Reclamation (referred to herein as USA). The minimum ground clearance required in rural settings for 230kV transmission lines is 30 feet and for 68kV transmission lines is 25 feet (State of California, 2015). Information on the line elevations above existing ground surface has been provided by WAPA to the project team, but is considered confidential and therefore cannot be disclosed in any public document.

The WAPA lines lie within two easements within the project area. The Shasta-Tracy easement is approximately 130-feet wide and runs in a north-south direction along the boundary between the Central and East Sub-Parcels and in a northwest-southeast direction across the eastern half of the North Parcel (shown in purple in Figures 11a and 11b, Sheets TS-2 and TS-3). The Tracy-Contra Costa easement is approximately 60-feet wide and runs in a north-south direction just west of the Shasta-Tracy easement in the Central Sub-Parcel, angles to a northwest-southeast direction across the northern quarter of the Central Sub-Parcel, and continues across the western side of the North Parcel in the same northwest-southeast direction (shown in green in Figure 11a and b, Sheets TS-2 and TS-3). The rights granted to WAPA within the easement are covered in two easement documents:

- **Tracy-Contra Costa line** – 1950 agreement referencing APN book 1663, page 564. Language from this easement was not available for review.

- **Shasta-Tracy line** – 1950 agreement between USA and multiple landowners referencing APN book 1668, page 494. This easement prohibits the land owner from the drilling of wells, building of any structure, or significant alteration of the existing topography without written consent from USA. The easement also grants ingress-egress along the southern border of the Central Parcel
Figure 11a
TS-2 Utilities

SOURCE: East Bay Regional Park District, 2017

Knightsen Wetland Restoration and Flood Protection Project, D170045.00
4.8.2 PG&E

PG&E operates and maintains two overhead electrical transmission lines, the Table Mountain-Tesla 500kV Tower Line and the Vaca-Dixon-Tesla 500 kV Tower Line, and one buried natural gas transmission line (Line 401) within its easement on the project site (shown in blue in Figure 11a and b, Sheets TS-2 and TS-3). The minimum ground clearance required for 500kV transmission lines in rural settings is 30 feet (State of California, 2015). The minimum burial depth required for the natural gas pipeline is unknown. Information on existing tower and transmission line heights above ground and the depth below ground of the natural gas pipeline was not available from PG&E (pers. comm., J. Cederquist).

The PG&E easement is 350 feet wide and runs in a north-south direction along the boundary between the Central and East Parcels and in a northwest-southeast direction across the eastern half of the North Parcel. The rights granted to PG&E within the easement are covered in two easement documents:

- **PG&E electrical easement** – 1964 agreement between PG&E and Bettencourt referencing APN book 4751, page 636. This easement reserves the right for the land owner to use the land “for purposes which will not interfere with PG&E’s full enjoyment of the rights granted”, but prohibits the drilling of wells, building of any structure or significant alteration of the existing topography without written consent from PG&E.

- **PG&E natural gas easement** – 1995 order of condemnation between PG&E and Cerri. This easement gives PG&E “the right to prohibit the erection or construction of any building or other structure, the drilling or operating of any well, or the construction of any reservoir or other obstruction within PARCEL 1, or diminish or substantially add to the ground cover over any pipelines installed therein.”
CHAPTER 5
Conceptual Planning

5.1 Project Opportunities and Constraints

The ESA team worked closely with the Conservancy and stakeholders to identify and investigate opportunities and constraints for the restoration project. Though there have been meetings with the KTCSD over the past 7 years, there were two public meetings held as part of this phase of work. These meetings occurred on May 2, 2018 and July 11, 2019. At the first meeting, the project was introduced and feedback, input and local information/knowledge of the site was solicited. At the second meeting, the results of focused studies and conceptual alternatives for project design were presented, and comments recorded to provide direction for subsequent action. The pertinent aspects of these focused studies are described in the sections below. Figure 12 depicts the main physical constraints and opportunities presented by conditions on the project site.

5.1.1 Target Species

The project site lies in Zone 6 in the HCP/NCCP. According to the HCP/NCCP, land acquisitions in Zone 6 should be focused on land suitable for restoration as habitat for tricolored blackbird, western burrowing owl, Swainson’s hawk, and giant garter snake. Other HCP/NCCP covered species identified as having potential to occur with site restoration include vernal pool fairy shrimp, midvalley fairy shrimp, vernal pool tadpole shrimp, silvery legless lizard, western pond turtle, and golden eagle. Additional species not covered in the HCP/NCCP may benefit from the project, including white-tailed kite (Elanus leucurus), northern harrier (Circus cyaneus), California black rail (Laterallus jamaicensis coturniculus), hoary bat (Lasiurus cinereus), green sturgeon (Spirischnus thaleichthys), delta smelt (Hypomesus transpacificus), steelhead (Oncorhynchus mykiss irideus), and longfin smelt (Spirischnus thaleichthys). Species descriptions below are derived from the Biological Resources Assessment and Botanical Resources Survey Report (Nomad Ecology 2018).

The opportunities and constraints for creating habitat conditions to support these species are described below. Tables A1 and A2 in Appendix A provide more detailed information about potential for HCP/NCCP covered wildlife (Table A1) and plant (Table A2) species to occur on the project site currently and with restoration.

Tricolored Blackbird

Habitat requirements for tricolored blackbird include open accessible water for drinking and bathing, a protected nesting substrate (for example flooded, thorny or spiny dense and tall vegetation), and a suitable foraging space providing adequate insect prey. Tricolored blackbird
like invasive Himalayan blackberry and thistle, but also nest in cattails and bulrush vegetation and forage in annual grassland. Ideal foraging habitat includes lightly grazed, irrigated pasturelands, annual grasslands, and grain fields. The project site presents opportunities to provide nesting habitat for tricolored blackbird and foraging habitat within uplands at the project site.

**Western Burrowing Owl**

Throughout their range, burrowing owls require habitats with three basic attributes: (1) open, well-drained terrain; (2) short, sparse vegetation generally lacking trees; and (3) underground burrows or burrow-like structures (e.g., culverts). The western burrowing owl is well adapted to open, relatively flat expanses.

Suitable habitat is present within the grassland habitat of the project site; and such habitat is likely to be enhanced with restoration. The site presents opportunities to support burrowing owl habitat with restoration of open areas within short and sparse vegetation, which could be created within oak savanna, grassland, or dune habitat. Habitat for this species could be further enhanced with installation of artificial burrows in newly graded habitat to attract and potentially establish a population of burrowing owls.

**Swainson's Hawk**

Swainson's hawks require large, open grasslands (or surrogates) with abundant prey in association with suitable nest trees. Suitable nest sites may be found in mature riparian forest, lone trees or groves of oaks, other trees in agricultural fields, and mature roadside trees. Suitable foraging areas include native grasslands or lightly grazed pastures, alfalfa and other hay crops, and certain grain and row croplands.

Suitable nesting habitat is present among large trees within and adjacent to the project site. Suitable foraging habitat is also present within the grasslands of the project site and surrounding area. The site presents opportunities for enhancement of nesting and forage habitat with restoration of oak savannah and grassland habitat. Oaks and other trees planted on the site would eventually be large enough to support nesting of this species, however such benefits would not occur for a significant number of years following restoration. It will be important to retain as many suitable nesting trees (generally located in the southwest corner and adjacent to Byron Highway on the South Parcel) on the site as possible during restoration activities.

**Giant Garter Snake**

Giant garter snakes are highly aquatic and inhabit freshwater marshes, low-gradient streams, drainage canals, and irrigation ditches. The project is located within the species’ known range, and within designated ECCC HCP “core habitat” and “movement and foraging habitat”.

Giant garter snake occupy areas with tule (*Schoenoplectus acutus*) vegetation and clay-rich, fertile, and fine-textured soil orders (alfisols, molisols, and vertisols) more than other vegetation and soil orders. These soil orders typically occur in flat areas and beneath historic tule marsh. The eastern areas of the project site were historically tule marsh. The site is flat, and the soil order is
Opportunities and Constraints

SOURCE: ESA, 2019

Figure 12

Knightsen Wetland Restoration and Flood Protection Project. D170045.00

Path: U:\GIS\GIS\Projects\17xxxx\D170045_Knightsen_Wetland_Restoration\03_MXDs_Projects\Constraints.mxd, wsm 2/27/2019
mostly vertisols (Nomad Ecology 2018, Balance Hydrologics 2018). The Marcuse clay, deep very poorly drained soils at the site will provide the correct soil type for tule vegetation to succeed after restoring the area to tidal marsh elevations.

Giant garter snakes spend the majority of their active period within or adjacent to aquatic habitats and begin seeking winter retreats in October in adjacent upland burrows and soil crevices above the flood plain. Retreats with sunny aspects along south and west facing slopes are generally preferred and are typically located within 250 meters from aquatic habitat. Basking sites consisting of protective banks and waterside vegetation, as well as abundant cover and upland refugia are key habitat elements.

The project site provides the opportunity to not only provide the necessary aquatic habitat for giant garter snake, but also protective bank, waterside vegetation, and adjacent upland habitat.

**Fairy Shrimp**

Vernal pools in Contra Costa County occupy alkaline basins, occur as small pools or as somewhat larger playas, and can occur in the saline-alkaline transition zone between vernal pools and tidal marshes. Potential habitat exists on site for vernal pool fairy shrimp and possibly midvalley fairy shrimp and vernal pool tadpole shrimp. Vernal pool fairy shrimp are more prevalent in the surrounding area and therefore are more likely to potentially be able to inoculate ponds in the future with this species than midvalley fairy shrimp and vernal pool tadpole shrimp.

There may be opportunities to enhance the existing seasonal and alkali wetlands by managing grazing, controlling invasive plant species, and planting and seeding with native plants in the North Parcel. There are also opportunities to create additional potential shrimp habitat adjacent to existing alkali wetlands and seasonal wetlands within the North Parcel. The project site has some alkaline soils with low permeability that could potentially be used to create vernal pool type seasonal wetlands that could potentially support shrimp by creating proper vernal hydrology.

**Northern California Legless Lizard**

Northern California legless lizards occur in sandy or loose loamy soils and leaf litter from Contra Costa County to northwestern Baja California. This species inhabits moist, warm, loose soil with plant cover such as in sparsely vegetated areas of beach dunes, chaparral, pine-oak woodlands, desert scrub, sandy washes, and stream terraces with sycamores, cottonwoods, or oaks. Leaf litter under trees and bushes in sunny areas and dunes stabilized with bush lupine and mock heather often indicate suitable habitat.

The dunes currently existing within the North Parcel of the project site provide potential habitat for the Northern California legless lizard. The existing habitat could be enhanced with restoration by managing invasive plant species and revegetating with proper native plants within the dune habitat.
Western Pond Turtle

Western pond turtles are habitat generalists and are frequently observed in wetlands and waters in the area surrounding the project site. They prefer aquatic habitat with refugia, such as undercut banks and submerged vegetation, and they require emergent basking sites such as mud banks, rocks, logs, root wads, or mats of submergent vegetation to thermoregulate their body temperature.

Western pond turtles use terrestrial habitat for refuge, nesting, and resting. Nest sites are most often situated on south or west-facing slopes, are sparsely vegetated with short grasses or forbs, and are scraped in sands or hard-packed, dry, silt or clay soils. Western pond turtle and giant garter snake use many of the same habitat elements including undercut banks, basking sites, upland habitat adjacent to permanent wetland habitat, and a preference for south and west-facing slopes for upland habitat.

The project has the opportunity to provide western pond turtle habitat by creating permanent wetland and slough habitat and habitat elements including undercut banks and submerged vegetation and basking sites.

Golden Eagle

Golden eagles prefer open grasslands and oak savanna habitat in central California. Golden eagles require large patches of unfragmented natural landscapes as habitat. In addition, they are relatively intolerant of human activity and other sources of anthropogenic disturbance. This species nests on cliffs and in large, predominant trees near open areas for hunting or scavenging. Golden eagles forage in open terrain including grasslands, deserts, oak savannahs and early successional stages of forest and shrub habitats.

Suitable nesting habitat is present among large trees within and adjacent to the project site. Suitable foraging habitat is present within the grasslands of the study area. The project has an opportunity to increase potential foraging and possibly breeding habitat for golden eagle.

Non-HCP/NCCP Special Status Species Opportunities

Birds

Northern harrier

Northern harriers breed and forage in a variety of open (treeless) habitats that provide adequate vegetative cover; an abundance of suitable prey (mostly small mammals); and scattered perches such as shrubs or fence posts. Harriers nest on the ground, mostly within patches of dense, often tall, vegetation in undisturbed areas. The Northern harrier would likely benefit from the restoration of tidal marsh, alkali meadow, and seasonal wetlands for both foraging and nesting.

Black rail

California black rails are not likely to nest or forage within the project site currently since it provides few locations with dense vegetation for cover or to conceal a nest. The project has an opportunity to provide nesting and foraging habitat for black rails by creating tidal wetland habitat.
Other Birds

Other non-HCP special-status birds that could benefit from restoration include Modesto song sparrow (*Melospiza melodia*), grasshopper sparrow (*Ammomanus savannarum*), California horned lark (*Eremophila alpestris actia*), and loggerhead shrike (*Lanius ludovicianus*).

Fish

If the project restores tidal sloughs it has the opportunity to provide additional habitat for fish such as green sturgeon, delta smelt, steelhead, and longfin smelt.

Bats

Planting trees to restore oak savannah could provide potential roosting habitat for many species of bats, including the hoary bat, once the trees are well established.

Rare Plants

Twenty-eight special-status plant species known from the region are considered to have the potential to be supported within the study area based on the presence of suitable habitat (i.e. alkaline soils and Delta hydrology), including eight HCP/NCCP covered/no take plant species: Contra Costa goldfields (*Lasthenia conjugens*), alkali milk vetch (*Astragalus tener var. tener*), brittlescale, round-leaved filaree (*California macrophylla*), recurved delphinium (*Delphinium recurvatum*), diamond-petaled California poppy (*Eschscholzia rhombipetala*), San Joaquin spearscale (*Extriplex joaquinana*), and caper-fruited tropidocarpum (*Tropidocarpum capparideum*).

There are several opportunities for establishing rare plant populations as a part of this effort. Deltaic rare plant species that inhabit the transition zone between tidally influence wetlands and uplands include: woolly rose-mallow (*Hibiscus lasiocarpos var. occidentalis*), Delta tule pea (*Lathyrus jepsonii var. jepsonii*), and Suisun marsh aster (*Symphyotrichum lentum*). These species have also been known to occupy riprap levees where organic material has accumulated and broken down into a thin soil layer in the spaces between the rocks. Another rare plant species that could be established, in the mudflats of restored tidal areas is Mason’s lilaeopsis (*Lilaeopsis masonii*). Where established in mudflat habitats this species is known to form large populations. Antioch dunes buckwheat (*Eriogonum nudum var. psychicola*) and Antioch dunes evening primrose (*Oenothera deltoides subsp. howellii*) could be planted in the dunes habitat.

**Locally Rare, Unusual, and Significant Plants**

A total of 23 plant species treated as locally rare by the East Bay Chapter of CNPS were observed within the project site (Nomad Ecology 2018). The presence of these species on the project site create both opportunities and constraints to restoration. The project should avoid disturbance of existing locally rare plant populations on site to the extent feasible. The fact that such species are currently supported by site conditions also indicates the opportunity to provide additional habitat for these species with restoration.

5.1.2 Target Habitats

Based on historic ecology and current site conditions, the Conservancy and its partners are interested in restoring or creating the following habitat types on site (1) seasonal alkali wetlands
and meadow (2) stabilized interior dune (3) oak savanna (4) freshwater tidal marsh. This section
describes the key components of each of these habitat types and the opportunities and constraints
of restoring these features at the project site. Habitat descriptions below are derived primarily
from the Biological Resources Assessment and Botanical Resources Survey Report (Nomad

**Alkali Seasonal Wetland Complex**

Historically, alkali seasonal wetlands occurred on the project site and the presence of seasonal
alkali vegetation adjacent to current farmed areas indicates the potential to support this habitat
following restoration. Alkali seasonal wetlands are characterized by hummocky, varied micro
topography which supports a mosaic of salt-influenced habitats including small brackish ponds/
pools, alkali flats, alkali sink-scrub and seasonally inundated alkali meadow (Stanford et al.
2011). Alkali seasonal wetlands are seasonally inundated from a couple of inches (meadow
features) to one foot or more (pond/pool features) (Stanford et al. 2011). Alkaline habitats are
characterized by having sodic soils.

Soil testing indicates moderately alkaline surface-soil conditions (pH 7 to 8.5) across the site with
generally non-sodic and non-saline soils, or possibly limited pockets of near or mildly sodic
and/or saline conditions. Strongly alkaline soil conditions (pH > 8.5) were found at depth.
Measured pH results on site are generally in line with published soil survey data going back to the
1930’s. Soils may become more saline with restoration of seasonal wetlands, as ponded water
evaporates and leaves behind salts (Balance Hydrologics 2019).

Despite the lack of sodic soils, the existence of vegetation typical of alkaline wetlands on the
project site indicates that soils are suitable to support alkali vegetation. Expected vegetation
within alkali seasonal wetlands includes salt grass (*Distichlis spicata*), alkali heath (*Frankenia
salina*), alkali weed (*Cressa truxillensis*), pickleweed (*Salicornia* sp.), rushes (*Juncus* sp.), sedge
(*Carex* sp.), alkali mallow (*Malvella leprosa*), and saltbush (*Atriplex* sp.). Several of these species
are present within the North Parcel between the dune communities and adjacent to sloughs and
ditches on the Southern Parcel.

The presence of alkali vegetation currently on the project site indicates that portions of the site
have suitable soils and hydrology to support seasonal alkali wetland features. Restoring tidal
flows to portions of the site may further support seasonal wetland development as extreme high
tides may periodically inundate topographic lows in adjacent transitional areas and create a rich
mosaic of habitats. The tidal to seasonal wetland transition zone is likely to shift landward over
time as sea level rises. Maintaining hydrological connection between seasonal wetlands and tidal
wetlands is an important aspect in making it possible for estuarine transgression to occur.

Restoration of alkali seasonal wetland and meadow habitat could support target species including
fairy shrimp, white-tailed kite, as well as other special status species such as northern harrier.

**Stabilized Interior Dune**

Historic interior dune features in this area were created as a result of windblown processes during
the Pleistocene (Stanford et. al. 2011). Two historical dune features are present in the North
Parcel and are characterized by sandy soils; and a remnant dune feature is present in the southwest corner of the Southern Parcel. Stabilized interior dune vegetation includes silver bush lupine (Lupinus albifrons), California croton (Croton californicus), slender buckwheat (Erogonum gracile), and valley lessingia (Lessingia gladulifera) (Stanford et al. 2011). California croton has been observed on site (Nomad Ecology 2018). In addition, non-native invasive grass species have extensively colonized the dunes.

The existing site topography, presence of sandy soil, and presence of target vegetation species indicates a good opportunity to restore or enhance the existing dune features. The existing native vegetation on both the dune and seasonal wetland habitats in the Northern Parcel indicates that a less intensive approach could be employed with restoration. Habitat enhancement could be accomplished using management actions to control invasive weeds, expand existing native vegetation, and introduce native interior dune plant species. Because existing desirable native vegetation is dispersed in patches across the North Parcel, it may be difficult to grade the site without impacting desirable vegetation. Alternatively, if more active manipulation of the North Parcel is deemed preferable, plant salvage may be incorporated as part of restoration activities to mitigate potential loss of existing native plant populations.

Restoration and/or enhancement of interior dune habitat presents opportunities for experimental re-introduction of rare plant species including Antioch dunes buckwheat (Eriogonum nudum var. psychicola) and Antioch dunes evening primrose (Oenothera deltoides subsp. howellii).

Target species including Northern California legless lizard and western burrowing owl could benefit from restoration of vegetated dune habitat.

**Oak Savanna**

The southwestern corner of the South Parcel was historically occupied by oak savanna habitat. Oak savanna habitat features are characterized by widely spaced blue oak (Quercus douglasii) or valley oak (Quercus lobata) trees (generally between 10-30% canopy cover), and an herbaceous understory. While site elevations are suitable to support oak savanna habitat, the poorly drained clay soils that dominate the site may be unsuitable to support blue oaks. Blue oak woodlands are typically found on shallow, low fertility, and moderately to excessively drained soils. However, there is potential to support valley oak woodland, as this oak species can tolerate seasonally saturated soils and alluvial or residual soils. One large heritage valley oak exists adjacent to the home site in the southwest corner of the South Parcel, indicating the potential to restore oak savanna habitat.

Sea level rise could pose a potential constraint to resilience of restored oak savanna habitat; as estuarine habitats shift upslope over time, the area suitable for oak savanna habitat could eventually be narrowed. This effect may be negated if PGE and/or other utilities undertake activities to raise the lands in their easements in order to facilitate access. Concentrating the oak savanna restoration effort to the highest elevation areas of the site would delay the effect of this future constraint to the extent it can be.
Restoration of oak savanna habitat could provide benefits for target species including tricolored blackbird, western burrowing owl, Swainson’s hawk, white-tailed kite, golden eagle, and for other special status species including Modesto song sparrow, grasshopper sparrow, California horned lark, and loggerhead shrike and hoary bat and other species of bats.

**Freshwater Tidal Marsh**

Historically freshwater tidal marsh occurred on the northeast portions of the site, covering approximately one-half of the project area. Key components of freshwater tidal wetlands include a complex network of channels open to tidal influence, low to high marsh vegetation, and hydric soils. Soils in this area of the site are typically high in clay content, which are typical in tidal marsh habitats.

Elevations necessary to support a variety of low to high marsh vegetation are approximately 0-6 feet NAVD. Lands of the Eastern Subunit if the South Parcel fall within this elevation range, and the southern boundary of that area is bounded by a tidal slough (No Name Slough). Elevations below MHHW over much of the Eastern Sub-Parcel and proximity to the tidal waters of No Name Slough provide opportunities to establish tidal freshwater wetlands on site without extensive site grading (as compared to many other restoration sites in the Delta). The presence of the utility easements crossing the site would impede Low gradient slopes to transitional and upland elevations also present potential transgression space for tidal wetlands to persist and move landward as sea level rises. Many existing wetland to upland transition zones have become foreshortened or disconnected with road building, development or other infrastructure. Locations than can accommodate estuarine transgression are increasingly rare and important to restore (Goals Project 1999). This site is extremely well-suited for restoring tidal marsh.

A diversity of vegetation species could be supported with restoration of tidal influence to portions of the site. Low marsh to mid marsh areas have potential to support emergent vegetation such as California bulrush (*Scirpus californicus*) cattail (*Typha spp.*), and tule (*Scirpus acutus*).

Mid to high marsh vegetation may include silverweed (*Potentilla anserine*), Western flat-topped goldenrod (*Euthamia occidentalis*), seaside arrow grass (*Triglochin maritima*), willow herb (*Epilobium ciliatum*), marsh fleabane (*Pluchea odorata*), spikerush (*Eleocharis macrostachya*), water smartweed (*Persicaria punctata*), California loosestrife (*Lythrum californicum*), bur marigold (*Bidens laevis*), panicle bulrush (*Scirpus microcarpus*), slough sedge (*Carex obnupta*) and Baltic rush (*Juncus balticus*). In small patches, woody species including dogwood (*Cornus sericeus*), arroyo willow (*Salix lasiolepis*), and cottonwood (*Populus fremontii*) could be established on high marsh to transitional areas of the site.

Tidal marsh habitat could support the following target species, including giant garter snake, western pond turtle, tricolored blackbird. Northern harrier, black rail, green sturgeon, delta smelt, steelhead, and longfin smelt could also benefit from restoration of tidal marsh habitat.

The HCP/NCCP also provides credit for preservation of alkali grassland in Zone 6 because this land cover type is rare and preservation opportunities are limited. Therefore, existing alkali grassland should be preserved to the extent feasible.
5.1.3 Hydrology and Flooding

The community of Knightsen has experienced both large flood events with widespread impacts and nuisance flooding during more frequent wet years. Knightsen’s inefficient drainage path combined with existing culverts that are undersized and/or clogged with sediment cause nuisance flooding during prolonged periods of moderate rainfall and more significant flooding following infrequent, higher return period events. In particular, Knightsen experienced significant flooding during the record setting El Nino water years of 1982 and 1998.

The South Parcel located at the eastern terminus of the Knightsen drainage network was identified in a 2002 Feasibility Report (PWA, 2002) and a 1985 Engineers Report (CCC, 1985) as an ideal location to implement stormwater quality projects including diversion channels, bioswales and treatment wetlands. The South Parcel was identified for the Conservancy by the Knightsen CSD as a possible parcel for restoration and flood conveyance & water quality improvements. In a separate independent effort, the Knightsen CSD is looking at potential stormwater improvement projects to more efficiently deliver runoff to the South Parcel.

In the vicinity of the project site, the Knightsen CSD has identified the following areas near the South Parcel that are subject to flooding and drainage issues:

- **Delta Road at Byron Highway** – existing culverts along Delta Road are undersized and clogged with sediment which causes flooding southwest of the intersection.

- **Byron Highway at Ironhorse Road** – existing culverts along Byron Highway are undersized and clogged with sediment which causes flooding southwest of the intersection. This intersection is likely also impacted by runoff backed up from the Delta Road/Byron Highway intersection.

Additionally, the community also identified the following area that is impacted by less frequent and/or less significant flooding due to poor drainage:

- **Eagle Lane** – Development in the Eagle Lane area does not have a well-defined drainage pathway for runoff that is generated both west of the Santa Fe railroad and within the Eagle Lane area creating locally poor drainage.

During and following periods of heavy or frequent rainfall, these areas experience nuisance flooding due to the poor drainage in the community. During the 2017 winter, the Knightsen CSD rented and operated a 6,000 GPM (25.6 acre-feet/day) pump station to double the pumping capacity to remove runoff from the South Parcel to limit flooding impacts to up gradient properties along Delta Road and Byron Highway and at the neighboring Veale Tract. During the 2019 winter, the Conservancy also rented and operated a second pump station to remove runoff from the South Parcel of the project site to limit flooding of the neighboring Veale Tract.

The eastern and northeastern most extents of the Knightsen community are also below the 100-year base flood elevation in the Delta at No Name Slough and Rock Slough as shown in the FEMA designated flood map for the Knightsen Area presented in Figure 13. These properties are currently protected by the existing agricultural levees along the South Parcel and at the adjacent Veale Tract. While these agricultural levees have not been constructed to current engineering standards, these
levees (particularly on the Veale Tract) are maintained to the Department of Water Resources Hazard Mitigation Program Standards (DWR HMP) set to protect agricultural parcels in the Delta from extreme water levels. Since these levees do not meet FEMA standards, FEMA neglects the potential benefit provided by these levees when designating flood extents for Flood Insurance Rate Maps (FEMA FIRM). If the existing agricultural levees were to fail, the estimated 100-year water surface would extend from the southeast to northwest inundating properties along Delta Road to just west of Byron Highway, along Byron Highway to just south of Delta Road, and along the Contra Costa Canal extending about 700 to 2400 feet south and west of the canal.

Acquisition of the project site by the Conservancy and the East Bay Regional Park District for restoration presents opportunities to include restoration elements for the conveyance of stormwater runoff across the parcel while improving water quality and providing habitat benefits for species covered under the HCP/NCCP.

Potential stormwater management benefits could include delivery of stormwater runoff from the community of Knightsen to the project site to help address flooding in the community by improving the inefficient drainage network while also providing water quality benefits and increasing groundwater recharge in areas with sandy soils. Restoration elements could be targeted to create swales and seasonal wetlands for habitat benefits and water quality treatment by incorporating design guidance for bioswales and treatment wetlands to the extent possible.

The Knightsen CSD is currently considering three potential stormwater improvement projects that would improve delivery of runoff to the South Parcel:

1. **Byron Highway Diversion and Bioswale.** The Byron Highway Diversion and Bioswale is a project that has been recommended in one form or another in several earlier studies of flooding issues in Knightsen. This particular diversion offers the greatest relief for the area in Knightsen that is most significantly and frequently impacted by flooding at the corner of Delta Road and Byron Highway. By diverting runoff away from Delta Road and directly onto the Habitat Conservancy Parcel, runoff to the Delta Road/Byron Highway intersection could be reduced by as much as 80% (ESA, 2019b).

   The Byron Highway Diversion would route runoff from the corner of Byron Highway and Ironhorse Road directly onto the South Parcel where it would be conveyed to Rock Slough in a bioswale with an infiltration basin and a series of wetland depressions. The Diversion would route about 36 to 51 acre-feet of runoff to the South Parcel in a 5- to 25-year, 24-hour rainfall event (ESA, 2019b). To meet the guidance for water quality treatment, the bioswale and wetland depressions would need to treat up to 2.3 acre-feet of runoff or a flow rate up to 9.6 cfs (ESA, 2019b).

2. **Delta Road Seasonal Treatment Wetlands or Bioswale.** Currently the majority of the runoff from Knightsen flows along Delta Road to the South Parcel where it is routed to a pump station and pumped to No Name Slough. At Byron Highway, Contra Costa County maintains a 30-inch culvert to route runoff to the east across Byron Highway. However, east (downstream) of Byron Highway most of the existing, private driveways have 12- to 18-inch diameter culverts many of which are partially clogged with sediment. These existing, undersized culverts significantly impede drainage from the south and west of the Delta Road.
and Byron Highway intersection, and contribute to some of the most significant flooding impacts in the community.

The Delta Road Seasonal Treatment Wetlands or Bioswale Project would combine improvements to the existing undersized culverts with construction of a seasonal wetland or bioswale with depressional seasonal wetland on the South Parcel. Depending on whether the Knightsen CSD implements the Byron Highway diversion, the Delta Road Seasonal Treatment Wetlands or Bioswale would need to be designed with capacity for up to 47 to 67 acre-feet of runoff (without the Byron Highway diversion) or 9.6 to 13.8 acre-feet (with the Byron Highway diversion) in a 5-year to 25-year, 24-hour rainfall event (ESA, 2019b). For water quality treatment, the seasonal wetlands or bioswale would need to be design with sufficient capacity to treat about 7.3 acre-feet of runoff or a flow rate of about 30 cfs (without the Byron Highway diversion) or up to 3.4 acre-feet of runoff or a flow rate of about 21 cfs (with the Byron Highway diversion) (ESA, 2019b).

3. **Eagle Lane Diversion and Bioswale.** Community members have noted that the Eagle Lane triangle located south of the South Parcel, experienced occasional drainage issues and elevated stormwater levels during high rainfall seasons. The Eagle Lane triangle receives runoff from south Knightsen (south of Sellers Road) via an existing culver under the Santa Fe Railroad to the west of the Eagle Lane triangle. This runoff, in addition to runoff generated locally, is currently routed to the east and is discharged through an existing culvert into No Name Slough.

The Eagle Lane Diversion and Bioswale would collect runoff from the Eagle Lane area and divert it to an infiltration basin and bioswale on the South Parcel. This approach would intercept and divert runoff to the South Parcel at relatively high elevations that would provide a more efficient drainage pathway and allow for gravity discharge across the South Parcel. The Eagle Lane Bioswale would need to have capacity for up to 15 to 21 acre-feet of runoff in a 5-year to 25-year, 24-hour rainfall event (ESA, 2019b). To meet the guidance for water quality treatment, the bioswale and wetland depressions would need to treat up to 1.5 acre-feet of runoff or a flow rate up to 6.2 cfs (ESA, 2019b).

Creation of wetland elements, seasonal ponds and/or reintroduction of tidal flows to the site, could have potential to effects to neighboring properties, particularly the Veale Tract, currently protected by an agricultural levee potentially related to increased groundwater levels. This potential risk necessitates that the restoration project incorporate elements (levees, berms, seepage walls, etc.) to limit possible negative effects associated with delivery of stormwater and/or reintroduction of tidal flows to the project site. Geotechnical investigation and analysis will be performed in subsequent phases of work on the restoration approach to better ascertain the potential for seepage to increase groundwater levels and to assess design criteria for any new levees or berms required to protect neighboring properties.

### 5.1.4 Groundwater

Properties surrounding the site that are not in agricultural use, such as the residential areas along Eagle Lane, utilize septic systems which could be sensitive to changes in groundwater elevations. As depicted in Figure 8, groundwater contour maps of the project site show a northeastward groundwater gradient, away from the Eagle Lane residential properties (Balance Hydrologics 2019).
During periods of no rainfall and no irrigation, groundwater elevations tend to be marginally higher near the slough, suggesting possible local high groundwater at the southeast-most corner of the property due to subsurface flow from the slough and/or rebounding following pumping of drainage water to the slough. The tidal cycle of the slough was also detected in the monitoring well records to a mostly a negligible degree, with the greatest tidal response of approximately 0.2 feet noted in groundwater closest to the slough. If pumping were discontinued during the dry season, it is unclear to what elevation groundwater would rise. Groundwater monitoring data and soil mottling depths suggest that the water table would likely not rise to the ground surface and may potentially be semi-confined in areas with deep clay soils (Balance Hydrologics 2019).

Further study may be needed in order to understand potential effects to groundwater elevations with restoration.

### 5.1.5 Recreation

The restoration of the site to native habitats and permanent open space presents opportunities for integration of public access and recreational amenities. Proximity to No Name Slough could potentially serve as water access for non-motorized watercraft. The water trail could potentially connect to boat launches to the north at Big Break/Dutch Slough and to the south toward other EBRPD acquisitions/Discovery Bay and planned regional trails. The property also could support trail access/connections providing expanded opportunities in this area of the County.

### 5.1.6 Utilities

Any modifications to the ground surface within the PG&E or WAPA utility corridor that would significantly raise or lower ground elevations at the existing natural gas pipeline and/or high voltage power lines will require agreement from the utility owners and modification to the existing easement language. The biggest constraint to the development of alternatives for the project is the presence of the Line 401 natural gas transmission line, also referred to as a “backbone” line for the transmission of natural gas in California. PG&E is unlikely to allow any significant modifications, including the construction of levees or the excavation of large slough channels, over the pipeline that would impact their ability to access and maintain the pipeline. However, there are a number of drainage ditches and irrigation ditches that currently cross this pipeline on the Parcel and at adjacent parcels, so construction and maintenance of shallow drainage ditches at the Parcel have not impacted operation or integrity of the pipeline. Modifications under both the PG&E and WAPA electrical transmission lines may be possible as long minimum clearances to the ground surface are maintained and maintenance access is provided.
CHAPTER 6
Concept Alternatives

Three conceptual alternatives were developed based on analysis the opportunities and constraints identified above, as well as community and stakeholder input. For each unit of the project site, different restoration approaches and elements were developed. Restoration concepts for the Central Sub-Parcel include three alternatives that focus on stormwater drainage and water quality improvements, and include three possible approaches to address capture of runoff from Delta Road, Byron Highway, and Eagle Lane using combinations of diversion locations, and bioswales and stormwater treatment wetlands designed to combine guidance for water quality best management practices (BMPs) with habitat requirements to create alkali seasonal wetland complex to benefit critical flora and fauna. Concepts for the East Sub-Parcel include two alternatives that focus on habitat restoration and include two approaches to restore tidal marsh habitat: one would reintroduce full tidal influence and one would restrict flows to create a wetland subject to muted tidal influence in summer and function as a stormwater wetland in the winter season. The North Parcel restoration concepts also include two alternatives that focus on habitat restoration with two approaches, one with active restoration through grading of dune and seasonal wetland habitats combined with enhanced existing native habitat through vegetation management and the other would enhance and expand existing habitat through vegetation management only. Further details of the conceptual alternatives developed to consider these elements and approaches in varying configurations is provided below.

6.1 Alternative 1

Alternative 1 (Figure 14) includes bioswales and stormwater wetlands on the Central Sub-Parcel to alleviate flooding and improve water quality, restoration of a fully tidal marsh with adjacent alkali meadow transition habitat and creation of a new flood control levee on the East Sub-Parcel, and restoration and enhancement of seasonal wetland and dune habitat on the North Parcel. Details of concept elements for each of these site units are provided below.

6.1.1 Central Sub-Parcel

In the Central Sub-Parcel, stormwater wetlands and bioswales would be created to address stormwater runoff at the existing Delta Road inlet and with two new diversions, one at Byron Highway and one at Eagle Lane. The Central Sub-Parcel would be connected to the East Sub-Parcel by a new water control structure installed in an enlarged existing agricultural ditch, and to the North Parcel by a new culvert under Delta Road. The water control structure would include a number of culverts with flap and slide-flap gates to manage discharge of runoff and tidal exchange with the East Sub-Parcel. During the dry season, slide-flap gates would be opened to allow muted tidal exchange from the restored tidal wetlands in the East Sub-Parcel and No Name
Slough, during the rainy season, the slide-flap gate would be closed to support stormwater detention and groundwater recharge in the winter.

The Byron Highway diversion is a concept that has been recommended in some form in studies dating back to 1985. This particular diversion offers the greatest relief for the area in Knightsen that is most significantly and frequently impacted by flooding at the corner of Delta Road and Byron Highway. By diverting runoff away from Delta Road and directly onto the Central Sub-Parcel, runoff to the Delta Road/Byron Highway intersection could be reduced by as much as 80%.

The Byron Highway diversion would divert runoff to the Central Sub-Parcel at relatively high elevations providing a more efficient drainage pathway and allow runoff to discharge to No Name Slough via gravity drainage. Water diverted from Byron Highway would first flow to an infiltration basin in an area of sandy soils at the diversion culvert outfall. This infiltration basin would support groundwater recharge at relatively high elevations to help support restoration of Oak Savanna in the southwest portion of the Central Sub-Parcel. From the infiltration basin, water would flow into a bioswale with a number of seasonal wetland depressions to provide water quality treatment while conveying runoff towards restored tidal wetlands in the East Sub-Parcel. The narrow areas of the bioswales, as seen in Figure 14 are designed to the minimum dimensions to meet water quality treatment guidance with wider areas to support seasonal wetland depressions and alkali meadow habitat. The shallow depressions (6-12 inches deep) are designed to allow for evaporative drying by spring, to minimize mosquito production potential.

The Eagle Lane diversion would help to address occasional drainage issues and elevated stormwater levels during high rainfall seasons at the Eagle Lane triangle located south of the project site. Similar to the Byron Highway bioswale, water diverted from Eagle Lane would first flow into an infiltration basin in an area of existing sandy soils and then into a bioswale with series seasonal wetland depressions. This diversion would also intercept and divert runoff at relatively high elevations that would provide a more efficient drainage pathway and allow for gravity discharge across the project site.

Currently the majority of the runoff from Knightsen flows along Delta Road to the project site. The Delta Road diversion and seasonal treatment wetlands combines improvements to the existing undersized culverts along Delta Road (performed by the Knightsen CSD/property owners) with construction of a large seasonal wetland complex on the Central Sub-Parcel to provide water quality treatment during the rainy season and muted tidal habitat in the dry season.

A Delta Road stormwater treatment wetland would take the form of an excavated marshplain and channel network to provide storage and habitat benefits specifically targeted for giant garter snake and western pond turtle. The wetlands would be graded to drain toward channels to meet mosquito abatement guidelines. Low berm and dune features would be created along the perimeter of the wetland to limit runoff from flowing towards the neighboring Veale Tract or onto Delta Road. These features would support dune grasses and alkali meadow and would be valuable wintering habitat for GGS. Additionally, basking peninsulas and islands that would support alkali meadow are located in close proximity to excavated channels to provide basking areas above summer water levels for GGS and WPT. An overflow path(s) would be created to the
Knightsen Wetland Restoration and Flood Protection Project. D170045.00

Figure 1

Concept Alternative 1

SOURCE: ESA, 2019
south to route excess runoff to the relocated pump station for discharge to No Name Slough to the south, and a second path could potentially be created to the North for runoff from Delta Road and potentially excess runoff from the Central Sub-Parcel. The wetland would function primarily as stormwater wetland in the winter and a muted tidal wetland in the summer to provide GGS and WPT habitat. Flow in and out of the wetland, to and from the East Sub-Parcel and No Name Slough would be controlled by a water control structure. Gates in the water control structure would be open in the summer to allow for muted tidal exchange (i.e. minor inflow/outflow) to support habitat benefits and closed in the winter to convert the wetland to a stormwater retention basin.

The remaining portions of the Central Sub-Parcel would be restored to grassland and oak savanna. through minor surface grading, seeding with native grasses, and plantings of native plants including valley and blue oaks, EBRPD may implement a grazing regimen in the grasslands and oak savanna to help control vegetation.

### 6.1.2 East Sub-Parcel

The East Sub-Parcel would be restored to full tidal marsh with interspersed alkali meadow islands, bordered by alkali meadow transitional habitat and a new flood control levee. The restored tidal marsh would be graded to create new tidal marshplain and would contain a tidal channel network to provide full tidal circulation and drainage from the marshplain and transitional habitats to No Name Slough. This area would be graded to elevations suitable for the establishment of emergent marsh vegetation including common tule, California bulrush, common reed, spikerush, and narrow lead cattail. The marshplain would be graded to promote positive drainage to the tidal channel network. Within the marshplain, alkali meadow islands would be located just above spring or king tides to provide basking habitat for GGS and WPT.

A branching network of tidal channels would provide tidal circulation throughout the tidal marsh areas. The design length, sinuosity, bifurcation ratios and plan form would be designed to mimic natural freshwater marshes. We anticipate that the main tidal channels would be up to a third or fourth order channel system, meaning that the main channels would branch into smaller channels up to three or four times to reach the smallest channels in the system. Channel side slopes would be constructed as steep as possible to mimic natural channel banks. The channel network would connect to No Name Slough via a single breach. The dimensions of the breaches would be informed by existing hydraulic geometry relationships for tidal marsh channels in the Delta based on the anticipated tidal prism of the restoration.

The restored marsh would be bordered by an engineered flood control levee. The levee would be designed to meet current levee standards and provide increased flood protection. The levee will include relatively flat, variable slopes ranging from 5:1 to 20:1 to provide habitat benefits, including suitable areas for burrows that could be used by burrowing owls and overwintering giant garter snakes. In addition, alkali meadow will be created along broad flat slopes between the levee and the restored marsh, providing habitat complexity and transition space for future sea level rise.

The existing pump station will also be relocated to provide a more efficient drainage pathway and better access for maintenance and operation.
6.1.3 North Parcel

The North Parcel is the least disturbed area on the project site, with minor grading of historic dunes, but forms and soils still generally in-place. The North Parcel currently supports interior dunes with some rare plants, alkali grasslands, and alkali wetlands. The restoration approach for the North Parcel is to build upon and enhance this existing habitat through vegetation management and grading to enhance seasonal wetlands and dunes. Vegetation management will entail planting rare, native dune plants and removal of non-native plants. The existing dunes will be enhanced by excavating shallow sands to expand wetland depressions and building up existing dunes to increase size and extent. Vegetation management will entail removal of non-native plants possibly including scraping of surface soils and planting rare, native dune plants.

Runoff delivery to the North Parcel could be augmented by runoff from the south side of Delta Road along the Central Sub-Parcel (east of the property boundary) via. a new culvert. Overflows from the Central Sub-Parcel could also be routed to the North Parcel, however, the existing berm that separates the North Parcel with the neighboring Veale Tract will need to be assessed and potentially improved is significant additional runoff is to be routed to the North Parcel.

6.2 Alternative 2

Alternative 2 (Figure 15) includes bioswales on the Central Sub-Parcel to alleviate flooding and improvement water quality, restoration of a muted tidal/stormwater wetland on the East Sub-Parcel, and restoration and enhancement of seasonal wetland and dune habitat on the North Parcel. Details for concept elements for each of these site units are provided below.

6.2.1 Central Sub-Parcel

In the Central Sub-Parcel, bioswales would be created to address stormwater runoff at the existing Delta Road inlet and at two new diversions, one at Byron Highway and one at Eagle Lane (similarly to Alternative 1). The Central Sub-Parcel would be connected to the East Sub-Parcel by a new water control structure installed in an enlarged existing agricultural ditch and to the North Parcel by a new culvert under Delta Road. Unlike Alternative 1, the water control structure would only allow discharge of flows from the Central Sub-Parcel to the East Sub-Parcel and would not provide a tidal connection to the Central Sub-Parcel.

The Byron Highway and Eagle Land diversions, bioswales, and seasonal wetland depressions are the same as described under Alternative 1.

Under Alternative 2, flow from Delta Road would be routed into a bioswale similar in design to the Byron Highway and Eagle Lane systems. The bioswale would be sized to meet water quality treatment guidelines while also providing wider areas to increase benefits for plants and wildlife species adapted to seasonal wetland and alkali meadow habitats. The bioswale system will include a series of shallow wetland depressions.

The remaining portions of the Central Sub-Parcel would be restored to grassland and oak savanna through minor grading, seeding and native plantings.
Figure 15
Concept Alternative 2
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6.2.2 East Sub-Parcel

In the East Sub-Parcel, a muted tidal/stormwater wetland system would be created similar to the stormwater wetland created in the Central Sub-Parcel under Alternative 1. The wetland would be graded to create new muted tidal marshplain and would contain a channel network to provide circulation and drainage from the marshplain and transitional habitats to No Name Slough. The excavated marshplain would also provide stormwater storage in the winter. Alkali meadow islands will be interspersed throughout the wetland to provide giant garter snake and western pond turtle basking habitat in proximity to the excavated channel network.

A water control structure would be installed at the connection between the seasonal / muted tidal wetland and No Name Slough. Flows would be routed by gravity and controlled by season. In the summer, gates would be open to allow muted tidal exchange to support habitat benefits. In the winter, the gates would be closed and the wetland would convert to a stormwater retention basin.

The restored marsh would be bordered by a low berm providing dune and grassland habitat. This berm would separate the wetland from the adjacent property and provide flood protection, although it would not be designed to flood control standards because water levels would be controlled via the water control structure. Similarly, to Alternative 1, alkali meadow will be created along broad flat slopes between the berm and the marsh, providing habitat complexity and transition space for future sea level rise.

The existing pump station will also be relocated to provide a more efficient drainage pathway and better access for maintenance and operation.

6.2.3 North Parcel

The North Parcel restoration is the same as described under Alternative 1 including grading, vegetation management, and potentially receiving runoff from Delta Road along the Central Parcel boundary.

6.3 Alternative 3

Alternative 3 (Figure 16) includes bioswales on the Central Sub-Parcel to alleviate flooding and improvement water quality, restoration of a muted tidal/stormwater wetland on the East Sub-Parcel, and enhancement of seasonal wetland and dune habitat on the North Parcel through vegetation management. Details of concept elements for each of these site units are provided below.

6.3.1 Central Sub-Parcel

In the Central Sub-Parcel, bioswales will be created similarly to Alternative 2, but without the new diversions at Byron Highway and Eagle Lane. Drainage in the Byron Highway and Eagle Lane areas will follow existing patterns and the bioswales will be smaller in size as compared to Alternatives 1 and 2. The existing drainage from the local site is not sufficient to support the same area of adjacent seasonal wetland and alkali meadow habitats as compared to the bioswales proposed in Alternative 1/2 and thus Alternative 3 would have lower habitat complexity and value.
At Delta Road, the inflows will be the same as under existing conditions. This will result in a considerably larger bioswale than under Alternative 2. There will also be limited flood protection improvements due to limited gravity drainage in the system because the Delta Road ditch currently enters the Central Sub-Parcel at about EL 3 ft NAVD (which is about 3 feet below MHHW). As a result, we anticipate that the existing stormwater wetland that forms in the northeast corner of the Central Sub-Parcel will persist following extreme storms and during prolonged rainy periods, but with a reduced duration and extent. It is possible that the existing ditch along the neighboring Veale Tract could be filled to provide an incrementally wider buffer between the existing low pond area and adjacent property.

The water control structure would operate as described under Alternative 2 and the remaining portions of the Central Sub-Parcel would be restored to grassland and oak savanna.

6.3.2 East Sub-Parcel

The East Sub-Parcel restoration is the same as described under Alternative 2.

6.3.3 North Parcel

Under Alternative 3, the existing habitat on the North Parcel will be enhanced through vegetation management only. Vegetation management will entail removal of invasive non-native plants planting native interior dune plants including some rare species.

Runoff delivery to the North Parcel from Delta Road and the Central Sub-Parcel are the same as described under Alternative 1.

6.4 Alternatives Evaluation

The alternatives were evaluated based upon their performance relative to project goals and objectives. In order to facilitate comparison, alternative ratings are compared side-by-side in the table below (Table 6-1). This preliminary evaluation will be used to identify areas where the alternative concepts and/or design features should be refined, and to begin the process of selecting a preferred alternative to move forward toward final design.
Knightsen Wetland Restoration and Flood Protection Project. D170045.00

Figure 16
Concept Alternative 3

SOURCE: ESA, 2019

Restored dunes and grassland

Bio swales with seasonal wetland depressions and alkali meadow

Enhance existing dunes with planting of native vegetation and management / eradication of non-natives

(E) Stormwater wetland reduced depth and duration

Restored dunes and grassland

Stormwater wetland in winter muted tidal wetland in summer

Grassland & oak savanna

Overflow path at & connects to south sluiceway

Water Control Structure

Overflow path to & connects to south sluiceway

Water Control Structure

Delta Road inlet

SOURCE: ESA, 2019

Knightsen Wetland Restoration and Flood Protection Project. D170045.00

Figure 16
Concept Alternative 3

Restored dunes and grassland

Bio swales with seasonal wetland depressions and alkali meadow

Enhance existing dunes with planting of native vegetation and management / eradication of non-natives

(E) Stormwater wetland reduced depth and duration

Restored dunes and grassland

Stormwater wetland in winter muted tidal wetland in summer

Grassland & oak savanna

Overflow path at & connects to south sluiceway

Water Control Structure

Overflow path to & connects to south sluiceway

Water Control Structure

Delta Road inlet

SOURCE: ESA, 2019
Table 6-1. Knightsen Wetland Restoration and Flood Protection Project Alternatives Evaluation

**Goals & Objectives**

<table>
<thead>
<tr>
<th>Objective</th>
<th>Alternative 1</th>
<th>Alternative 2</th>
<th>Alternative 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Goal 1</strong> Restore a mosaic of wetland and upland habitats for HCP/NCCP covered species</td>
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<tr>
<td>Objective 1</td>
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<tr>
<td>1</td>
<td>Make tidal marshes in East Sub-Parcel and restored wetland and meadow habitat adjacent to the river.</td>
<td>Make tidal marshes in East Sub-Parcel and restored wetland and meadow habitat adjacent to the river.</td>
<td>Make tidal marshes in East Sub-Parcel and restored wetland and meadow habitat adjacent to the river.</td>
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<tr>
<td>Objective 2</td>
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<tr>
<td>2</td>
<td>Enhance uplands including oak savannas and stabilized interior dunes</td>
<td>Enhance uplands including oak savannas and stabilized interior dunes</td>
<td>Enhance uplands including oak savannas and stabilized interior dunes</td>
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<tr>
<td>Objective 3</td>
<td></td>
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<tr>
<td>3</td>
<td>Restore the site habitats and special status species covered by the HCP/NCCP</td>
<td>Restore the site habitats and special status species covered by the HCP/NCCP</td>
<td>Restore the site habitats and special status species covered by the HCP/NCCP</td>
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</tbody>
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**Goal 2** Provide flood conveyance / attenuation for runoff from the adjacent community of Knightsen

<table>
<thead>
<tr>
<th>Objective</th>
<th>Alternative 1</th>
<th>Alternative 2</th>
<th>Alternative 3</th>
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<td>Objective 4</td>
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<td>Create a stormwater detention location (Alt 1); Delta Road, Byron Highway.</td>
<td>Create a stormwater detention location (Alt 1); Delta Road, Byron Highway.</td>
<td>Create a stormwater detention location (Alt 1); Delta Road, Byron Highway.</td>
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<td>Objective 5</td>
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<tr>
<td>5</td>
<td>Direct stormwater to areas where receiving such flow would be beneficial for target habitats</td>
<td>Direct stormwater to areas where receiving such flow would be beneficial for target habitats</td>
<td>Direct stormwater to areas where receiving such flow would be beneficial for target habitats</td>
</tr>
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</table>

**Goal 3** Provide water quality improvements for Knightsen stormwater runoff and Delta receiving waters

<table>
<thead>
<tr>
<th>Objective</th>
<th>Alternative 1</th>
<th>Alternative 2</th>
<th>Alternative 3</th>
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<tr>
<td>Objective 6</td>
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</tr>
<tr>
<td>6</td>
<td>Create on-stormwater biofiltering reaches and shallow wetlands to improve water quality for runoff that is ultimately discharged to the Delta.</td>
<td>Create on-stormwater biofiltering reaches and shallow wetlands to improve water quality for runoff that is ultimately discharged to the Delta.</td>
<td>Create on-stormwater biofiltering reaches and shallow wetlands to improve water quality for runoff that is ultimately discharged to the Delta.</td>
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</tbody>
</table>

**Goal 4** Protect adjacent land uses and limit the need for intensive maintenance

<table>
<thead>
<tr>
<th>Objective</th>
<th>Alternative 1</th>
<th>Alternative 2</th>
<th>Alternative 3</th>
</tr>
</thead>
<tbody>
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<td>Objective 7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Ensure stormwater retention would be discontinued upon completion of restoration construction</td>
<td>Ensure stormwater retention would be discontinued upon completion of restoration construction</td>
<td>Ensure stormwater retention would be discontinued upon completion of restoration construction</td>
</tr>
<tr>
<td>Objective 8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Enhance stormwater retention in East Sub-Parcel; no change in impact on Delta</td>
<td>Enhance stormwater retention in East Sub-Parcel; no change in impact on Delta</td>
<td>Enhance stormwater retention in East Sub-Parcel; no change in impact on Delta</td>
</tr>
</tbody>
</table>

**Goal 5** Provide opportunities for passive recreation and access to Delta waterways

<table>
<thead>
<tr>
<th>Objective</th>
<th>Alternative 1</th>
<th>Alternative 2</th>
<th>Alternative 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objective 9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Enhance stormwater retention in East Sub-Parcel; no change in impact on Delta</td>
<td>Enhance stormwater retention in East Sub-Parcel; no change in impact on Delta</td>
<td>Enhance stormwater retention in East Sub-Parcel; no change in impact on Delta</td>
</tr>
<tr>
<td>Objective 10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Provide opportunities for future public access and recreation</td>
<td>Provide opportunities for future public access and recreation</td>
<td>Provide opportunities for future public access and recreation</td>
</tr>
</tbody>
</table>
CHAPTER 7

Next Steps

In the coming months, the Conservancy and its team will work to progress the conceptual alternatives through detailed analysis and incorporation of continuing public and stakeholder input. Through this process we will refine design features and the alternatives and set criteria for final evaluation of the alternative designs to select a preferred project alternative. Once an alternative has been selected, the Conservancy team will work to complete a preliminary design for the selected alternative, complete CEQA and regulatory permitting compliance and prepare project construction documents. Descriptions of the anticipated steps to complete this work are provided below.

Selection of Preferred Alternative: The conceptual alternatives evaluation performed in this phase will be used to identify any additional needed investigations to refine design concepts and gain a better understanding of potential effects of project elements under consideration. Analyses will be performed to select a preferred alternative that balances the goals of the Conservancy for creation of special status species habitat and flood/water quality benefits with the constraints at the project site. Key considerations will include:

- Providing habitat benefits for species identified in the HCP/NCCP and other special status species
- Restoring historic ecological functions to the project site
- Providing stormwater conveyance and water quality treatment for runoff from Knightsen
- Addressing potential impacts to neighboring properties
- Managing constraints related to the existing utility easements

At this time, anticipated additional studies include:

Hydrologic and Hydraulic Modelling: Critical components of the restoration project include restoring historic wetland habitat while providing conveyance and water quality treatment for stormwater that is discharged to Delta waters through the site. To support the design, hydrologic and hydraulic modeling will be performed to:

- Determine the size of conveyance and water quality treatment elements including bioswales and wetlands to refine proposed grading to maximize potential habitat benefits (i.e. alkali wetland complex area) to refine proposed grading to maximize potential habitat benefits (i.e. alkali wetland complex area)
- Determine water levels to inform levee/berm design taking into account anticipated sea level rise as well as wave run up
- Determine the size and planform of tidal channels within tidal and/or muted tidal wetlands
- Size water control structures for muted tidal wetland areas and stormwater discharge.

**Expanded Groundwater Investigation:** The team will conduct field measurements and process the existing water level database with new survey reference points to confirm groundwater elevation data. This data will allow tracking of changed groundwater parameters relative to tides, rainfall and streamflow events. Data on the nearby domestic wells will acquired to develop an understanding of well depths and draw further conclusions about the zones from which the well draw water. From this information we will construct a conceptual geologic framework model of the aquifer from which the domestic wells draw water. This data will be used to inform refinement of potential design elements, selection of a preferred project alternative, as well as project design development and CEQA analysis.

**Geotechnical Investigation:** Restoration of tidal and/or muted tidal wetlands at the site will require construction of new levees or berms to protect neighboring properties. Levee design will be informed by geotechnical recommendations developed by a geotechnical engineer.

Geotechnical investigations will include soil borings and cone penetrometer tests along propose levee alignments and at areas where levee material could be generated (excavated channels and wetlands). Soil borings along levee alignments would be drilled through subsurface soils to assess subsurface conditions. Borings will be logged and soil samples will be tested for important geotechnical parameters. Within potential excavation areas, borings would be performed to collect subsurface samples to ascertain suitability for levee fill based on current USACE standards for levee construction.

Geotechnical analyses will examine settlement, seismic stability, and seepage based on the project design approach. Based upon the geotechnical analyses, the geotechnical engineer will provide recommendations for levee designs that meet current standards for stability and limit seepage to neighboring, down-gradient properties. Depending on the results of the initial seepage assessment, the project team will consider if a surface water-groundwater model is appropriate to analyze potential changes in seepage volumes and/or groundwater levels at adjacent properties comparing restored conditions to the current irrigated agricultural practices at the site.

**Environmental Review (CEQA):** The proposed project is intended to comply with the requirements of HCP/NCCP and associated 2006 EIS/EIR. Based upon the current understanding of the project, an Initial Study and Mitigated Negative Declaration (IS/MND) is assumed to be the appropriate CEQA compliance document.

The IS/MND would tier from the HCP/NCCP EIS/EIR including review of all potential impact categories per current CEQA Guidelines, considering near-term (construction) and long-term conditions, as well as direct, indirect, and cumulative effects. The document will focus on environmental issues considered more likely to result in significant effects and/or of particular concern to stakeholders and other interested parties including agricultural resources, biological resources, cultural resources, construction-related air quality/greenhouse gas emissions, recreation, and hydrology and water quality. The IS/MND will include CEQA compliant...
measures to mitigate potentially significant impacts. Additionally, this task includes preparation of public notices, Response to Comments, and a Mitigation, Monitoring, and Reporting Program (MMRP).

**Regulatory Permitting:** The project would be covered under existing HCP/NCCP programmatic approvals from the USACE, USFWS, and CDFW for impacts to terrestrial species. However, the project will exceed the wetland impact limitations under the existing permits, and a number of project specific permits are anticipated to be required, including:

- USACE Section 404 Permit – Nationwide Permit Program 27
- RWQCB 401 Water Quality Certification
- CDFW Streambed Alteration Agreement
- CDFW Incidental Take Permit
- Delta Plan Certification of Consistency

To support these permitting efforts, a Cultural Resources Report and a Biological Assessment/Fish Habitat Assessment will be prepared.

The **cultural resources study** will be compliant with Section 106 of the National Historic Preservation Act. The study will delineate Area of Potential Effects including historic era agricultural features in consultation with the lead federal agency. Additionally, the cultural resources study will include consultation with local Native American groups to determine if there are sacred lands or sensitive resources on the project site.

The **Biological Assessment and EFH assessment** will be developed for consultation with NMFS under Section 7 of the FESA concerning marine and anadromous aquatic species. The BA will evaluate impacts and benefits to federally listed species such as steelhead and Delta Smelt.

Following completion of these studies and assessments, required permit applications will be prepared documenting ecological functions, pre- and post-project effects related to implementation of the project including excavation and discharges into the adjacent tidal sloughs, and consistency with the Delta Plan.

**Construction Documents:** The team will prepare construction plans and technical specifications that would be combined with the Habitat Conservancy’s standard construction contract documents. Estimates of quantities, and construction costs will be updated and a proposed construction schedule will be developed.
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CHAPTER 8

References


Cederquist, Jason. Land Agent, PG&E. Email communication to Melissa Carter, ESA. November 2, 2018.


Appendix A
HCP/NCCP Species Potential to Occur Currently and with Restoration
Table A1. Potential for HCP/NCCP Covered and No Take Wildlife Species to Occur on the Project Site Currently & with Restoration

<table>
<thead>
<tr>
<th>Species Name Common Name</th>
<th>HCP/NCCP Status</th>
<th>Associated Land Cover Type</th>
<th>Typical Habitat or Physical Condition</th>
<th>Habitat Present</th>
<th>Potential for Occurrence</th>
<th>Potential for Occurrence with Restoration</th>
<th>Habitat Requirements &amp; Notes</th>
<th>Local Distribution &amp; Habitat Suitability</th>
</tr>
</thead>
</table>
| Longhorn fairy shrimp     | Covered         | Wetlands, Stream channels, Sandstone rock outcrops, Sandstone depressions | Yes | Expected | No vernal pool habitat with low alkalinity present. | No | | | The nearest reported occurrence (EONDX 412023) is located at Souza Ranch ~13.3 miles to the south (CNDDB 2017). Only reported occurrences within the county are from along the southern Contra Costa/Alameda County border. Project is not located within critical habitat. The project area does not contain sandstone outcrop vernal pools, and no such habitat is anticipated to be created with restoration.
| Vernal pool fairy shrimp  | Covered         | Aquatic (ponds, wetlands, streams, sloughs, channels, and marshes) | Yes | Possible | Possible | | | | There are 16 reported occurrences within 10 miles of the project area. The nearest occurrence (EONDX 45107) is located ~3.8 miles to the south within muddy depressions in iodine brush scrub (CNDDB 2017). Project is not located within critical habitat. Seasonal wetlands that provide vernal hydrology and could potentially support the species are present within the project area, and could be created/maintained within the restored site.
| Midvaluey fairy shrimp    | Covered         | Aquatic (ponds, wetlands, Vernal pools, Reservoirs, Vernal Pools Small Lakes) | Yes | Possible | Possible | | | | The nearest reported occurrence (EONDX 48372) is located ~4.5 miles to the southeast near Marsh Creek Road and is from an unspecified date. There are two occurrences (EONDX 48332, 68624) ~9 miles to the south near the Byron Airport from 1997 and 2006 (CNDDB 2017). Seasonal wetlands that provide vernal hydrology and could potentially support the species are present within the project area, and could be created or maintained with restoration.
| Vernal pool tadpole shrimp | Covered         | Aquatic (ponds, wetlands, streams, sloughs, channels, and marshes) | Yes | Possible | Possible | | | | The nearest reported occurrence (EONDX 852749) is located ~9.5 miles west in clay pan vernal pool with vernal pool fairy shrimp in 2003 (CNDDB 2017). The project area is not located within critical habitat. Seasonal wetlands that provide vernal hydrology and could potentially support the species are present within the project area, and could be created or maintained with restoration.
| California tiger salamander | Covered         | Wetlands, Stream channels, Sandstone rock outcrops, Sandstone depressions | Yes | Expected | Expected | | | | Annual and ruderal grasslands within the project area provide suitable aestivation habitat, but the area is surrounded by agricultural uses. The salinity levels of the wetlands on site are not currently known. There are 84 reported occurrences within a 10-mile radius of the project site (no occurrences within a 5-mile radius). The nearest reported breeding occurrence is ~6 miles to the southwest from a stock pond near Deer Valley Road in 2005 (EONDX 63055) (CNDDB 2017). The nearest "Suitable Migration and Aestivation Habitat" and "Potential Breeding Habitat" as mapped by the ECOPATH model is located ~7 miles southwest of the project area. The majority of the project area (except for the southwestern portion) was historically tidal marsh habitat. Tidal habitat that contains fluctuating salinity levels in not suitable habitat, this is thought to be why California tiger salamander occurrences have not been recorded in this northeastern section of Contra Costa County (Stanford et al. 2011). Alkali wetlands on the site and those to be created/maintained with restoration are not expected to provide suitable breeding habitat, as they do not appear to support the proper hydrology (hold water for at least three months), and salinity levels may not be suitable for the species -- no viable movement corridors exist to connect occupied habitat to the site.

Species is extremely rare and endemic to small, disjoint areas within Contra Costa, Alameda, Merced and San Luis Obispo counties. In the Livermore Vernal Pool Region of Alameda and Contra Costa counties, inhabited small, clear, sandstone outcrop vernal pools with low alkalinity (USFWS 2005a). Inhabits larger and warmer grassland pools with clear to turbid water in the San Joaquin and Carrizo Vernal Pool Regions from 75-2,887 feet (23-880 meters) (USFWS 2005a).

Inhabits clear to tea-colored freshwater vernal pools in grass or mud bottomed swales, or basalt flow depression pools in upland grasslands (59 FR 48136, Erikson and Belk 1999). 32 known populations in the Central Valley from Shasta to Tulare counties, and along the Central and South Coast Ranges from Solano to San Benito counties (59 FR 48136). Often occur in low densities and rarely co-occur with other branchiopod species (Eng et al. 1990, Simovich et al. 1992). Designated critical habitat encompasses 35 units totaling 597,821 acres in Jackson County, Oregon, and Alameda, Amador, Butte, Contra Costa, Fresno, Kings, Madera, Mariposa, Merced, Monterey, Napa, Placer, Sacramento, San Benito, San Joaquin, Alameda, Amador, Butte, Contra Costa, Fresno, Kings, Madera, Mariposa, Merced, Monterey, Napa, Placer, Sacramento, San Benito, San Joaquin counties in California (71 FR 7118).

Inhabits vernal pools and swales in the Sacramento Valley containing clear to highly turbid water; such pools are commonly found in grass bottomed swales of unplowed grasslands and are occasionally found in bog-bottomed and turf-bottomed vernal pools (59 FR 48136). Designated critical habitat encompasses 18 units totaling 228,785 acres in Alameda, Amador, Butte, Colusa, Fresno, Kings, Madera, Mariposa, Merced, Sacramento, Shasta, Solano, Stanislaus, Tehama, Tulare, Yolo, and Yuba counties (71 FR 7118).

Inhabits seasonal pools and vernal pools in the Sacramento Valley containing clear to highly turbid water; such pools are commonly found in grass bottomed swales of unplowed grasslands and are occasionally found in bog-bottomed and turf-bottomed vernal pools (59 FR 48136). Designated critical habitat encompasses 18 units totaling 228,785 acres in Alameda, Amador, Butte, Colusa, Fresno, Kings, Madera, Mariposa, Merced, Sacramento, Shasta, Solano, Stanislaus, Tehama, Tulare, Yolo, and Yuba counties (71 FR 7118).

Inhabits seasonal/semi-permanent water sources (3-4 months in duration) and adjacent upland habitats with small, fossorial mammal activity in lowland grasslands, oak savannah and mixed woodlands. Range includes the Central Valley and Central Coast ranges from Colusa County south to San Luis Obispo and Kern counties from sea level to 3,460 feet (1,046 meters) in elevation, with two disjoint populations within Solano County and Santa Barbara County. Species has been documented traveling distances up to 1 mile (1.6 km) (Austin and Shaffer 1992). Designated critical habitat encompasses 195,109 acres in 20 counties and is grouped into 4 regions: Central Valley, Southern California, Montery County, and Santa Clara County. Species has been documented traveling distances up to 3 miles to the south (CNDDB 2017). The project area is not located within critical habitat. Seasonal wetlands that provide vernal hydrology and could potentially support the species are present within the project area, and could be created or maintained with restoration.

Inhabits vernal pools and swales in grass or mud bottomed swales, such pools are commonly found in grass bottomed swales of unplowed grasslands and are occasionally found in bog-bottomed and turf-bottomed vernal pools (59 FR 48136). Designated critical habitat encompasses 18 units totaling 228,785 acres in Alameda, Amador, Butte, Colusa, Fresno, Kings, Madera, Mariposa, Merced, Sacramento, Shasta, Solano, Stanislaus, Tehama, Tulare, Yolo, and Yuba counties (71 FR 7118).

The nearest reported occurrence (EONDX 48372) is located ~4.5 miles to the southeast near Marsh Creek Road and is from an unspecified date. There are two occurrences (EONDX 48332, 68624) ~9 miles to the south near the Byron Airport from 1997 and 2006 (CNDDB 2017). Seasonal wetlands that provide vernal hydrology and could potentially support the species are present within the project area, and could be created or maintained with restoration.

The nearest reported occurrence (EONDX 852749) is located ~9.5 miles west in clay pan vernal pool with vernal pool fairy shrimp in 2003 (CNDDB 2017). The project area is not located within critical habitat. Seasonal wetlands that provide vernal hydrology and could potentially support the species are present within the project area, and could be created or maintained with restoration.

Annual and ruderal grasslands within the project area provide suitable aestivation habitat, but the area is surrounded by agricultural uses. The salinity levels of the wetlands on site are not currently known. There are 84 reported occurrences within a 10-mile radius of the project site (no occurrences within a 5-mile radius). The nearest reported breeding occurrence is ~6 miles to the southwest from a stock pond near Deer Valley Road in 2005 (EONDX 63055) (CNDDB 2017). The nearest "Suitable Migration and Aestivation Habitat" and "Potential Breeding Habitat" as mapped by the ECOPATH model is located ~7 miles southwest of the project area. The majority of the project area (except for the southwestern portion) was historically tidal marsh habitat. Tidal habitat that contains fluctuating salinity levels in not suitable habitat, this is thought to be why California tiger salamander occurrences have not been recorded in this northeastern section of Contra Costa County (Stanford et al. 2011). Alkali wetlands on the site and those to be created/maintained with restoration are not expected to provide suitable breeding habitat, as they do not appear to support the proper hydrology (hold water for at least three months), and salinity levels may not be suitable for the species -- no viable movement corridors exist to connect occupied habitat to the site.
### APPENDIX A - HCP/NCCP SPECIES WITH POTENTIAL TO OCCUR CURRENTLY AND WITH RESTORATION

#### KNIGHTSEN WETLAND RESTORATION AND FLOOD PROTECTION PROJECT

<table>
<thead>
<tr>
<th>Species Name</th>
<th>Common Name</th>
<th>HCP/NCCP Status</th>
<th>Associated Land Cover Type</th>
<th>Typical Habitat or Physical Conditions</th>
<th>Habitat Present</th>
<th>Potential for Occurrence</th>
<th>Potential for Occurrence with Restoration</th>
<th>Habitat Requirements &amp; Notes</th>
<th>Local Distribution &amp; Habitat Suitability</th>
</tr>
</thead>
<tbody>
<tr>
<td>California red-legged frog</td>
<td>Covered</td>
<td>Aquatic (ponds, wetlands, streams, sloughs, channels, and marshes)</td>
<td>Slow moving streams, ponds, and wetlands</td>
<td>Yes</td>
<td>Not Expected</td>
<td>Not Expected</td>
<td>Inhabits lowlands &amp; foothills in or near permanent sources of deep water with dense, shrubby or emergent riparian vegetation up to 4,921 feet (1,500 meters) in elevation (Jennings and Hayes 1984, Bulger et al. 2003, Stoddins 2003). Range extends from Redding to Baja California, Mexico, with hybridization occurring with the California red-legged frog from the Oregon border to Marin County. Breeding occurs between November and April in standing or slow moving water with emergent vegetation, such as cattails (Typha spp.), tules (Scirpus spp.) or overhanging willows (Salix spp.) (Hayes and Jennings 1988). Larvae undergo metamorphosis 3.5 to 7 months after hatching (Jennings and Hayes 1984, 1994). Designated critical habitat encompasses 1,636,609 acres in 20 counties and is grouped into 4 regions: Central Valley, Southern San Joaquin, East Bay and Central Coast (75 FR 12816). The East Bay Region includes Alameda County, south to San Benito and Santa Clara counties, and west to the eastern portions of San Joaquin and Merced counties (75 FR 12816). Primary habitat elements include: (1) aquatic breeding habitat; (2) non-breeding aquatic and riparian habitat; (3) upland habitats adjacent to riparian and aquatic habitat; and (4) dispersal habitat comprising accessible upland or riparian habitat within and between occupied or previously occupied sites that are located within 2 miles of each other, and that support movement between such sites (75 FR 12816).</td>
<td></td>
<td>There are 61 documented CNDDB occurrences within a 10-mile radius of the project area. The nearest occurrence (EONDX 844898) is located approximately 7.5 miles to the south, within a created pond developed to support cattle grazing (CNDDB 2017). There is suitable upland habitat within the project site, but the site is surrounded by agricultural uses. The on-site seasonal wetlands do not support the necessary hydrology for breeding habitat. The majority of the project area (excluding the southwest portion of the site) was historically tidal marsh habitat. Tidal habitat that contains fluctuating salinity levels in not suitable habitat, this is thought to be why California red-legged frog occurrences have not been recorded in this northeastern section of Contra Costa County (Stanford et al. 2011). The slough and permanent wetland habitats to be created with restoration are not likely to support breeding due to varying salinity levels and the presence of fish and other predators – no viable movement corridors exist to connect occupied habitat to the site.</td>
</tr>
<tr>
<td>Foothill yellow-legged frog</td>
<td>Covered</td>
<td>Streams</td>
<td>No</td>
<td>None</td>
<td>No</td>
<td>Inhabits rocky, cascading streams in woodland, chaparral, and coniferous forests from the Oregon border to San Luis Obispo County, and the western foothills of the Sierra Nevada below 6000 feet.</td>
<td></td>
<td>The nearest reported occurrence (EONDX 76065) is from Marsh Creek near Morgan Territory Road in 1975 (CNDDB 2017). Not located within EECCHCP designated “suitable habitat.” There is no cascading stream habitat within the project area, nor is any such habitat anticipated with restoration.</td>
<td></td>
</tr>
<tr>
<td>Northern California legless lizard</td>
<td>Covered</td>
<td>Chaparral/scrub, Oak savanna, Oak woodland, Riparian woodland</td>
<td>Sandy loam soils of stabilized dune</td>
<td>Yes</td>
<td>Possible</td>
<td>Possible</td>
<td>Inhabits sandy or loose loamy soils and leaf litter from Contra Costa County to northwestern Baja. Occurs in moist, warm, loose soil with plant cover. Occurs in sparsely vegetated areas of beach dunes, chaparral, pine-oak woodlands, desert scrub, sandy washes, and stream terraces with sycamores, cottonwoods, or oaks. Leaf litter under trees and bushes in sunny areas and dunes stabilized with bush lupine and mock heather often indicate suitable habitat (Nafis 2017).</td>
<td></td>
<td>There are 8 reported occurrences within a 10-mile radius of the project area; 3 occurrences lie “&lt;3 miles to the west” (CNDDB 2017). Dune habitat present in the North Parcel could provide suitable habitat, however, there is limited cover available, due to the lack of trees and shrubs. Project site is not located within EECCHCP designated “suitable habitat.” Lands within the known range of the species: (Nafis 2017). Stabilized interior dune habitat to be enhanced/created with restoration could provide suitable habitat for the species.</td>
</tr>
<tr>
<td>Alameda whipsnake</td>
<td>Covered</td>
<td>Chaparral/scrub, Oak savanna, Oak woodland, Riparian woodland</td>
<td>In annual grassland if adjacent to scrub habitats.</td>
<td>No</td>
<td>None</td>
<td>Not Expected</td>
<td>Inhabits the inner Coast Ranges in western and central Contra Costa and Alameda counties (Jennings 1983, McGinnis 1992, Swaim 1994). Habitat fragmentation has restricted its range into five recognized subpopulations: Tilden-Brirones population, Oakland-Las Trampas population, Hayward-Pleasanton Ridge population, Mount Diablo-Black Hills population, and Sunol-Cedar Mountain population. Designated critical habitat encompasses 154,834 acres in Alameda, Contra Costa and Santa Clara counties (71 FR 58176). Primary habitat elements include: (1) scrub/shrub communities with a mosaic of open and closed canopy; (2) woodland or annual grassland plant communities contiguous to lands containing scrub/shrub habitat; and (3) lands containing rock outcrops, talus, and small mammal burrows within or adjacent to scrub/shrub habitat or and woodland or annual grasslands adjacent to scrub/shrub habitat (71 FR 58176).</td>
<td></td>
<td>Project site is outside of species known range. The nearest occurrence (EONDX 779955) lies approximately 8.4 miles to the southwest, along Kellogg Creek 2.6 miles downstream of the Los Vaqueros Dam. Project area is approximately 8 miles east of nearest “movement habitat” as indicated by the EECCHCP. Suitable secondary habitat (grassland/riparian), is present within the study area; but no scrub/shrub habitat exists nearby. Suitable habitat is not expected to be created with restoration.</td>
</tr>
</tbody>
</table>
### APPENDIX A - HCP/NCCP SPECIES WITH POTENTIAL TO OCCUR CURRENTLY AND WITH RESTORATION

**KNIGHTSEN WETLAND RESTORATION AND FLOOD PROTECTION PROJECT**

#### LOCAL DISTRIBUTION & HABITAT SUITABILITY

<table>
<thead>
<tr>
<th>Species Name</th>
<th>Common Name</th>
<th>HCP/NCCP Status</th>
<th>Associated Land Cover Type</th>
<th>Typical Habitat or Physical Conditions</th>
<th>Habitat Requirements &amp; Notes</th>
<th>Potential for Occurrence with Restoration</th>
<th>Potential for Occurrence</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Giant garter snake</td>
<td>Covered</td>
<td>Aquatic (ponds, wetlands, streams, sloughs, channels, and marshes)</td>
<td>Aquatic habitat accessible from the San Joaquin River</td>
<td>Inhabits wetlands and waterways, including irrigation and drainage canals, sloughs, ponds, small lakes, low gradient streams, and their adjacent uplands (USFWS 2017). Typical aquatic habitats contain permanent or seasonal water, with mud substrate bottoms and vegetated dirt banks. Primary habitat elements include: 1) sufficient water during the snakes’ active season (early spring-mid fall); 2) emergent, herbaceous wetland vegetation, such as cattails (Typha spp.) and tules (Schoenoplectus spp.) with associated vegetated banks for basking and escape cover; 3) upland habitat (e.g., bankside burrows, holes, and crevices) to provide short-term refuge areas during the active season; and 4) high ground or upland hibernacula above the high-water mark (or floodplain water mark) to provide cover and refuge from flood waters during the dormant winter period (Hansen and Brode 1980). Radiotelemetry studies have shown that the home ranges of giant garter snakes vary by location, with a median home range varying between 23 acres (range 10 to 200 acres) in semi-native perennial marsh systems, and 130 acres (range 3 to 2,800 acres) in managed refuges (USFWS 1999). Overwintering typically occurs in burrows or crevices near active season forage habitats. Upon emerging from overwintering sites, adult snakes immediately disperse in search of mates and will continue breeding from March into early May. Individual snakes have been noted to use burrows as far as 50 m (160 ft) from marsh (aquatic) edges during the active season and retreating as far as 250 m (820 ft) from the edge of wetland habitats while overwintering, presumable to reach hibernacula above the annual high water mark (Hansen 1986, Wylie et al. 1997, USFWS 2017).</td>
<td>Inhabits permanent or nearly permanent water bodies and low gradient, slow moving streams below 6,000 feet elevation. Range extends from Washington to the northern Bay Area counties along the Pacific slope drainages.</td>
<td>Yes</td>
<td>Possible</td>
<td></td>
</tr>
</tbody>
</table>

The project area is identified as “core habitat” by the ECCCHCP. There are 40 reported occurrences within a 10-mile radius of the project site, which are largely concentrated to the south and southeast. 3 of these occurrences are within a 1-mile radius and the nearest reported occurrence from 2000 (EONDX 43816) is located ~0.4 miles to the north (CNWDB 2017). EBRPD personnel observed a large male near a culvert/drainage ditch on the North Parcel in March 2019 (pers.comm. Tammy Lim EBRPD). Permanent wetlands and slough provide suitable habitat within the project site, and such habitat will be enhanced/expanded with restoration. |

| Western pond turtle | Covered | Aquatic (ponds, wetlands, streams, sloughs, channels, and marshes) Riparian woodland | – | Inhabits permanent or nearly permanent water bodies and low gradient, slow moving streams below 6,000 feet elevation. Range extends from Washington to the northern Bay Area counties along the Pacific slope drainages. | Highly colonial species, most numerous in Central Valley & vicinity. Largely endemic to California. Nest in emergent vegetation within aquatic and riparian habitats. Breeds from mid-March through early August; double-brooded (Baicich & Harrison 2005, Shuford and Gardali 2008). | Yes | Possible |

The project area is identified as “Suitable Core Habitat” and as “Primary Foraging Habitat” by the ECCCHCP. There are 6 reported occurrences within a 10-mile radius of the project site, with the nearest occurrence comprised of over 1,000 tricolored blackbirds observed ~7 miles to the southwest (EONDX 7175) in March Creek Reservoir (CNWDB 2017). Nesting red-winged blackbirds were observed during the reconnaissance survey. Suitable habitat present within the permanent wetlands and slough habitat in the southeast corner of the project site, and such habitat will be enhanced/expanded with restoration. |

| Tricolored blackbird | Covered | Aquatic (ponds, wetlands, streams, sloughs, channels, and marshes) Riparian woodland | – | Inhabits permanent or nearly permanent water bodies and low gradient, slow moving streams below 6,000 feet elevation. Range extends from Washington to the northern Bay Area counties along the Pacific slope drainages. | Highly colonial species, most numerous in Central Valley & vicinity. Largely endemic to California. Nest in emergent vegetation within aquatic and riparian habitats. Breeds from mid-March through early August; double-brooded (Baicich & Harrison 2005, Shuford and Gardali 2008). | Yes | Possible |

The project area is identified as “core habitat” by the ECCCHCP. There are 40 reported occurrences within a 10-mile radius of the project site, which are largely concentrated to the south and southeast. 3 of these occurrences are within a 1-mile radius and the nearest reported occurrence from 2000 (EONDX 43816) is located ~0.4 miles to the north (CNWDB 2017). EBRPD personnel observed a large male near a culvert/drainage ditch on the North Parcel in March 2019 (pers.comm. Tammy Lim EBRPD). Permanent wetlands and slough provide suitable habitat within the project site, and such habitat will be enhanced/expanded with restoration. |
<table>
<thead>
<tr>
<th>Species Name</th>
<th>HCP/NCCP Status</th>
<th>Associated Land Cover Type</th>
<th>Potential For Occurrence</th>
<th>Potential For Occurrence With Restoration</th>
<th>Habitat Requirements &amp; Notes</th>
<th>Local Distribution &amp; Habitat Suitability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Western burrowing owl</td>
<td>Covered</td>
<td>Grassland</td>
<td>Oak savanna</td>
<td>Agriculture</td>
<td>Ruderal</td>
<td>Yes</td>
</tr>
<tr>
<td>Swainson’s hawk</td>
<td>Covered</td>
<td>Any</td>
<td>–</td>
<td>Yes</td>
<td>Possible (nesting)</td>
<td>Yes (nesting, foraging)</td>
</tr>
<tr>
<td>Golden eagle</td>
<td>Covered and No Take</td>
<td>Any</td>
<td>–</td>
<td>Yes</td>
<td>Possible (nesting and wintering)</td>
<td>Possible (nesting and wintering)</td>
</tr>
<tr>
<td>American peregrine falcon</td>
<td>No Take</td>
<td>Any</td>
<td>Cliffs</td>
<td>No</td>
<td>Not Expected</td>
<td>Not Expected</td>
</tr>
<tr>
<td>Townsend’s western big-eared bat</td>
<td>Covered</td>
<td>Rock formation with cave entrances</td>
<td>Abandoned buildings or structures outside urban areas</td>
<td>No</td>
<td>Not Expected</td>
<td>Not Expected</td>
</tr>
<tr>
<td>Species Name</td>
<td>Common Name</td>
<td>HCP/NCCP Status</td>
<td>Associated Land Cover Type</td>
<td>Typical Habitat or Physical Conditions</td>
<td>Habitat Present</td>
<td>Potential for Occurrence</td>
</tr>
<tr>
<td>--------------</td>
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<td>-----------------------------</td>
<td>----------------------------------------</td>
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<td>-------------------------</td>
</tr>
<tr>
<td>San Joaquin</td>
<td>kit fox</td>
<td>Covered</td>
<td>Grassland/cover</td>
<td>If within modeled range of species.</td>
<td>No</td>
<td>Not Expected</td>
</tr>
<tr>
<td>Ringtail</td>
<td></td>
<td>No Take</td>
<td>Woodland/canyon</td>
<td>–</td>
<td>No</td>
<td>Not Expected</td>
</tr>
<tr>
<td>Species Name</td>
<td>Common Name</td>
<td>HCP/NCCP Status</td>
<td>Associated Land Cover Type</td>
<td>Typical Habitat or Physical Conditions</td>
<td>Habitat Requirements &amp; Notes</td>
<td>Local Distribution &amp; Habitat Suitability</td>
</tr>
<tr>
<td>--------------</td>
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</tr>
<tr>
<td>Amsinckia grandiflora</td>
<td>large-flowered fiddleneck</td>
<td>No Take</td>
<td>Annual grassland</td>
<td>Generally found on clay barrens in Annual Grassland</td>
<td>No (Clay barrens are not present).</td>
<td>Occurs in seasonal habitats generally found on clay barrens in the vicinity of Black Diamond Mines. Known from Butte and Colusa counties.</td>
</tr>
<tr>
<td>Arctostaphylos duricola</td>
<td>Mt. Diablo manzanita</td>
<td>Covered</td>
<td>Chaparral and scrub</td>
<td>Elevations generally between 700 and 1,860 feet; restricted to the eastern and northern flanks of Mt. Diablo and the vicinity of Black Diamond Mines</td>
<td>No</td>
<td>Absent</td>
</tr>
<tr>
<td>Astragalus tener var. tener</td>
<td>alkil milk-vetch</td>
<td>No Take</td>
<td>Alkali wetland Annual Grassland Seasonal Wetland</td>
<td>Generally found in vernal moist habitat in soils with a slight to strongly elevated pH</td>
<td>Yes</td>
<td>Not observed. Would have been detectable during the surveys.</td>
</tr>
<tr>
<td>Astragalus depressus</td>
<td>Brittlebush</td>
<td>Covered</td>
<td>Alkali grassland Alkali wetland</td>
<td>Restricted to soils of the Pescadero or Solano soil series; generally found in southern region of HCP area</td>
<td>Yes</td>
<td>Not observed. Would have been detectable during the surveys.</td>
</tr>
<tr>
<td>Bledellia argentea</td>
<td>plumose big tarplant</td>
<td>Covered</td>
<td>Annual grassland</td>
<td>Elevations below 1,500 feet, most often on Altamont Series or Complex soils</td>
<td>No (Annual grassland is present but soils are not correct).</td>
<td>Not Expected</td>
</tr>
<tr>
<td>Calochortus pulchellus</td>
<td>Mt. Diablo fairy-lantern</td>
<td>Covered</td>
<td>Annual grassland Chaparral and scrub Oak woodland Oak savanna</td>
<td>Elevations generally between 650 and 2,600 feet</td>
<td>No (Elevations are not suitable).</td>
<td>Not Expected</td>
</tr>
<tr>
<td>Delphinium recurvatum</td>
<td>recurved larkspur</td>
<td>Covered</td>
<td>Alkali grassland</td>
<td>–</td>
<td>Yes</td>
<td>Not observed. Would have been detectable during the surveys.</td>
</tr>
</tbody>
</table>

Although suitable vegetation associations are present on the project site, the only known natural populations (either extant or extirpated) are in the vicinities of Corral Hollow and Black Diamond Mines. This species has also never been recorded in valley bottoms. The nearest CNDDB occurrence (E0104 51004, from 1887) is 11.2 miles west of the project area, at Black Diamond Regional Park. Restoration and enhancement of lowland grassland habitat could provide conditions suitable for re-introduction of this species if suitable soils are present.

The nearest CNDDB occurrence (E0104 51004, from 2006) is from 7 miles west of the project area, just outside of Brentwood in a regularly grazed field. Suitable vegetation associations and appropriate substrate and soil chemistry present. Suitable habitat anticipated to be enhanced/expanded with restoration.

The nearest CNDDB occurrence (E0104 51004, from 1978) is from 6.75 miles south-west of the project site, although the exact location of this collection is unknown. Suitable vegetation associations are present on the project site; however, this taxon prefers Altamont series soils found on the east side of the Diablo Range crest, east of the Greenville fault. Restoration and enhancement of grassland habitat not likely to provide conditions suitable for successful re-introduction of this species.

The nearest CNDDB occurrence (E0104 51004, from 2005) is from 7 miles west of the project area, in the northern Lone Tree Valley. Suitable vegetation associations and substrate are present. Suitable habitat anticipated to be enhanced/expanded with restoration.

The nearest CNDDB occurrence (E0104 51004, from 1993) is 11.4 miles west of the study area, above the southwestern section of Round Valley. Although suitable vegetation associations are present this taxon has never been recorded from the Livermore Valley. Restoration and enhancement of grassland and oak savanna habitats not likely to provide conditions suitable for successful re-introduction of this species as elevations not suitable. Soils are not suitable. Suitable habitat anticipated to be enhanced/expanded with restoration.

The nearest recorded CNDDB occurrence is a nonspecific observation 7.9 miles west of the project site near Byron (CNDDB E0104 53004, from 1887) and suitable vegetation associations or appropriate substrate types present. No suitable habitat anticipated with restoration. Suitable vegetation associations and appropriate substrate types present. No creation of suitable habitat anticipated with restoration.
<table>
<thead>
<tr>
<th>SPECIES NAME</th>
<th>COMMON NAME</th>
<th>HCP/NCCP STATUS</th>
<th>ASSOCIATED LAND COVER TYPE</th>
<th>TYPICAL HABITAT OR PHYSICAL CONDITIONS</th>
<th>HABITAT Preservation</th>
<th>POTENTIAL FOR OCCURRENCE CURRENT SITE</th>
<th>POTENTIAL FOR OCCURRENCE WITH RESTORATION</th>
<th>HABITAT REQUIREMENTS &amp; NOTES</th>
<th>LOCAL DISTRIBUTION &amp; HABITAT SUITABILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erigonum truncatum</td>
<td>Mt. Diablo buckwheat</td>
<td>No Take</td>
<td>Annual grassland, Chapparal and scrub</td>
<td>Ecotone of grassland and chapparal/scrub</td>
<td>No</td>
<td>None</td>
<td>No</td>
<td>Occurs on sandy sites in chapparal, coastal scrub, and valley and foothill grassland between 3-150 meters. Known from Alameda and Contra Costa counties. Presumed extirpated from Solano County. Rediscovered in May 2005, now known from one extant occurrence.</td>
<td>The nearest CNDDB occurrence (EONIDX 60625, from 1886) is 10 miles northwest in &quot;Antioch.&quot; Exact location is unknown. Although suitable vegetation associations are present this species prefers exposed slopes and cut banks in the vicinity of the study area. Restoration and enhancement of grassland habitat not likely to provide conditions suitable for successful re-introduction of this species.</td>
</tr>
<tr>
<td>Eucalytus rhodobiodora</td>
<td>diamond-petaled California poppy</td>
<td>No Take</td>
<td>Annual grassland</td>
<td>–</td>
<td>Yes</td>
<td>Not observed. Would have been detectable during the surveys.</td>
<td>Possible</td>
<td>Occurs on alkaline valley and foothill grassland between 0-975 meters. Known from Alameda, San Joaquin, and San Luis Obispo counties. Presumed extirpated from Contra Costa, Colusa, and Stanislaus counties.</td>
<td>The nearest CNDDB occurrence (EONIDX 31877, from 1888) is 7.75 miles south, in the hills south of Byron. Suitable vegetation associations and substrates are present and will be enhanced/expanded with restoration.</td>
</tr>
<tr>
<td>Helianthus caustaneo</td>
<td>Diablo helianthella</td>
<td>Covered</td>
<td>Alkali grassland, Alkali wetland</td>
<td>Elevation above 650 feet</td>
<td>No (Elevations are not suitable.)</td>
<td>Not Expected</td>
<td>No</td>
<td>Occurs in broadleaved upright forest, chaparral cismontane woodland, coastal scrub, riparian woodland, and valley and foothill grassland between 60-1,300. Known from Alameda, Contra Costa, San Diego, and San Mateo counties. Presumed extirpated from Marin and San Francisco counties.</td>
<td>The nearest CNDDB occurrence (EONIDX 42666, from 1998) is 10 miles west of the study area, at Roddy Ranch on the southern edge of Deer Valley. Although suitable vegetation associations substrates are present this species occurs at elevations higher than present in the study area and it is not known from valley bottoms of the Delta area. Restoration and enhancement of grassland and oak savanna habitats not likely to provide conditions suitable for successful re-introduction of this species as elevations not suitable.</td>
</tr>
<tr>
<td>Hesperolinon breweri</td>
<td>Brewer's western flax</td>
<td>Covered</td>
<td>Annual grassland, Chapparal and scrub, Oak savanna</td>
<td>Generally, restricted to grassland areas within a 500+ buffer from oak woodland and/or chapparal/scrub d</td>
<td>No</td>
<td>None</td>
<td>No</td>
<td>Occurs in cismontane woodland, alkaline playas, valley and foothill grassland, usually on serpentinite between 30 to 900 meters. Known from Contra Costa, Napa, and Solano counties.</td>
<td>Although suitable vegetation associations substrates are present this species occurs at elevations higher than present in the study area and it is not known from valley bottoms of the Delta area. Restoration and enhancement of grassland and oak savanna habitats not likely to provide conditions suitable for this species as elevations not suitable.</td>
</tr>
<tr>
<td>Lasthenia conjugens</td>
<td>Contra Costa goldfields</td>
<td>No Take</td>
<td>Alkali grassland, Annual grassland, Seasonal wetland</td>
<td>Generally found in vernal pools</td>
<td>Yes</td>
<td>Not observed. Would have been detectable during the surveys.</td>
<td>Possible</td>
<td>Occurs in cismontane woodland, alkaline playas, valley and foothill grassland, and vernal pools. Known from Alameda, Contra Costa, Monterey, Napa, San Benito, Solano, Yolo, and possibly San Luis Obispo counties. Presumed extirpated from Santa Clara, San Joaquin, and Tulare counties.</td>
<td>The nearest CNDDB occurrence (EONIDX 89952) is 2.25 miles south, at the Discovery Bay Y Mitigation site. Suitable vegetation associations and substrates are present and will be enhanced/expanded with restoration.</td>
</tr>
<tr>
<td>Madia radiata</td>
<td>showy madia</td>
<td>Covered</td>
<td>Annual grassland, Oak woodland</td>
<td>Primarily occupies open grassland or grassland on edge of oak woodland</td>
<td>No</td>
<td>Not Expected</td>
<td>No</td>
<td>Occurs in cismontane woodland and valley and foothill grassland between 25-900 meters. Known from Fresno, Kern, San Benito, San Luis Obispo, and Stanislaus counties. Presumed extirpated from Contra Costa, Kings, Monterey, Santa Barbara, and San Joaquin counties.</td>
<td>The nearest CNDDB occurrence (EONIDX 6753, from 1941) is 8 miles west of the study area, in the vicinity of Lone Tree Valley. Although suitable vegetation associations substrates are present this species occurs at elevations higher than present in the study area and it is not known from valley bottoms of the Delta area. Restoration and enhancement of grassland and oak savanna habitats not likely to provide conditions suitable for this species as elevations not suitable.</td>
</tr>
<tr>
<td>Navoreetia nigelflora subsp. nigelflora</td>
<td>Adobe navoreetia</td>
<td>Covered</td>
<td>Seasonal wetland</td>
<td>Generally found on clay barrens in Annual Grassland</td>
<td>No (Clay barrens are not present; elevation are not suitable.)</td>
<td>Not Expected</td>
<td>No</td>
<td>Occurs in vernal meic valley and foothill grasslands and vernal pools, on serpentine or clay barrens at elevations between 100-1000 meters. Known from Alameda, Butte, Contra Costa, Colusa, Fresno, Kern, Merced, Monterey, Plumas, Sutter, and Tulare counties.</td>
<td>The closest herbarium record is a Curran collection (Accession# CAS-BOT-BC23492) from Antioch. Although suitable vegetation associations substrates are present this species occurs at elevations higher than present in the study area and it is not known from valley bottoms of the Delta area. Restoration and enhancement of grassland and oak savanna habitats not likely to provide conditions suitable for this species as elevations not suitable.</td>
</tr>
<tr>
<td>Tropidocarpum caperifolium</td>
<td>caper-fruited Tropidocarpum</td>
<td>No Take</td>
<td>Alkali grassland</td>
<td>–</td>
<td>Yes</td>
<td>Not observed. Would have been detectable during the surveys.</td>
<td>Possible</td>
<td>Occurs in valley and foothill grassland, often alkaline hills, between 1 to 455 meters. Known from Fresno, Monterey, and San Luis Obispo counties. Presumed extirpated from Alameda, Contra Costa, Glenn, San Joaquin, and San Luis Obispo counties. Rediscovered in 2000 on Ft. Hunter Liggett.</td>
<td>Nearest recorded CNDDB occurrence is 5.3 miles to the southeast and is an extirpated occurrence along Highway 4 at Old River (CNDDB EONIDX #20439). A second historic occurrence is near Byron, 6.3 miles south of the study area (CNDDB EONIDX #21437). Suitable vegetation associations and alkaline soil chemistry are present and will be enhanced/expanded with restoration.</td>
</tr>
</tbody>
</table>

**APPENDIX A - HCP/NCCP SPECIES WITH POTENTIAL TO OCCUR CURRENTLY AND WITH RESTORATION** KNIGHTEN WETLAND RESTORATION AND FLOOD PROTECTION PROJECT