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**Figure 3.4-2**
**Temporary Effects on Suitable Giant Garter Snake Upland Habitat**

active period for giant garter snakes (May 1–October 1) to reduce the potential for injury and mortality during this activity.

- The construction specifications will require that RD 108 or its contractor retain a qualified biologist to identify the suitable giant garter snake aquatic and upland habitat that are to be avoided during construction. Sensitive habitat areas adjacent to the construction area, including staging and access, will be fenced off to avoid inadvertent disturbance in these areas. Before construction, the contractor will work with the qualified biologist to identify the locations for the barrier fencing and will place flags or flagging around the areas to be protected to indicate the locations of the barrier fences. The location of the barrier fencing and sensitive habitat areas will be clearly identified on the construction drawings. The fencing will be installed the maximum distance practicable from the aquatic habitat areas and will be in place before construction activities (including vegetation removal, grading, or equipment staging) are initiated.
- The exclusion fencing will consist of 3-foot-tall silt fencing buried 4–6 inches below ground level. The exclusion fencing will ensure that giant garter snakes are excluded from the construction area and that suitable upland and aquatic habitat is protected throughout construction. The construction barrier fencing will be commercial-quality, woven polypropylene, orange in color, and 4 feet high (Tensor Polygrid or equivalent). The fencing will be tightly strung on posts with a maximum of 10-foot spacing. The construction barrier fencing can be attached to the exclusion fencing or the exclusion fencing can double as construction barrier fencing if it is orange in color and is a minimum of 4 feet tall.
- Barrier and/or exclusion fences will be inspected weekly by a USFWS-approved biological monitor during ground-disturbing activities occurring in the giant garter snake active period, and exclusion fencing will be inspected daily during ground-disturbing activities in the giant garter snake dormant period until construction is complete or until the fences are removed, as approved by the biological monitor. The biological monitor will be responsible for ensuring that the contractor maintains the protective fencing around giant garter snake habitat throughout construction. Weekly monitoring logs will be provided to RD 108 and USFWS, as necessary.

#### Mitigation Measure BIO-MM-5: Conduct Construction Activities during the Active Period for Giant Garter Snake

To the maximum extent possible, all construction activity within suitable giant garter snake aquatic and upland habitat (undeveloped areas within 200 feet of aquatic habitat) will be conducted during the snake's active period (May 1 through October 1). During this timeframe, potential for injury and mortality are lessened because snakes are actively moving and avoiding danger. Water barrier installation and dewatering, and erosion repairs will occur during this timeframe. Construction is scheduled from September 1 to October 15 to take advantage of the low-flow period in order to minimize in-water work, as well as to fit the approval timeline for associated permits. Because construction of the fish barrier cannot occur during the high flows caused by runoff from the agricultural fields upstream of the existing KLOG structure, the fish barrier construction must be conducted after October 1. Additional protective measures will be implemented for this construction and associated staging areas (see Mitigation Measure BIO-MM-7).

**Mitigation Measure BIO-MM-6: Minimize Potential Effects on Giant Garter Snake Habitat**

RD 108 will implement the following measures to minimize potential effects on giant garter snake habitat.

- Staging areas will be located more than 200 feet from suitable giant garter snake aquatic habitat or will be fenced with exclusion fencing prior to the start of construction and between May 1 and October 1.
- Any dewatered habitat will be sufficiently dry (no standing water) prior to excavating or filling of the dewatered habitat.
- Vegetation clearing within 200 feet of the banks of suitable giant garter snake aquatic habitat will be limited to the minimum area necessary.
- The movement of heavy equipment within 200 feet of the banks of suitable giant garter snake aquatic habitat will be confined to designated haul routes to minimize habitat disturbance.

**Mitigation Measure BIO-MM-7: Implement Additional Protective Measures for Work that Would Occur in Suitable Habitat and during the Giant Garter Snake Dormant Period**

RD 108 will implement additional protective measures during time periods when work must occur during the giant garter snake dormant period (October 2 through April 30), when snakes are more vulnerable to injury and mortality.

- A full-time USFWS-approved biological monitor will be onsite for the duration of construction activities after October 1.
- All vegetation within 200 feet of aquatic habitat will be cleared prior to the giant garter snake hibernation period (i.e., vegetation clearing must be completed by October 1 for following winter work).
- No new excavation will be conducted within suitable upland habitat for giant garter snakes between October 2 and April 30.
- Piles of side-cast soil or debris will be removed from the construction area prior to October 1 to avoid attracting snakes to the construction area.
- Exclusion fencing will be installed around the perimeter of the work area where construction activities associated with fish barrier installation activities would take place. The fencing will enclose the work area to the maximum extent possible to prevent giant garter snakes from entering the work area. Fencing will be installed during the active period for giant garter snakes (May 1 through October 1) to reduce the potential for injury and mortality during fence installation. The USFWS-approved biological monitor will work with the contractor to determine where fencing should be placed and will monitor fence installation. The exclusion fencing will consist of 3-foot-tall erosion fencing buried 4–6 inches below ground level. The exclusion fencing will minimize opportunities for giant garter snake hibernation in the adjacent upland area (Sycamore Slough and associated uplands, and between the CBD and associated uplands).

**Effect BIO-3: Disturbance of Special-Status Fish Species and Their Habitat (less than significant with mitigation)**

The displacement of fish from the placement of riprap and the temporary water barrier (to allow dewatering of the construction area) could result in localized, temporary disturbance of aquatic habitat that may alter natural behavior patterns of adult and juvenile fish and potentially result in physical injury and death of individuals. Potential behavioral effects include displacement and temporary disruption of feeding, migration, and other essential behaviors from noise, suspended sediment, turbidity, and sediment deposition generated during in-water construction activities. These effects could extend beyond the action area because noise and sediment may be propagated downstream of the construction area while construction is taking place.

The extent of construction-related effects depends on the timing, duration, and in-water extent of these activities; the timing of fish presence in the action area; and their ability to successfully avoid the affected areas. Construction activities, including potential in-water activities, are scheduled for a 2-month period, starting as early as September 1 and lasting through the end of October. This construction timing would avoid the primary adult and juvenile migration periods of winter-run Chinook salmon, spring-run Chinook salmon, green sturgeon, and splittail. Although historical records indicate that steelhead and fall/late-fall adults may migrate past the construction site as early as August, adult salmonids in general are not expected to be adversely affected by proposed in-water construction activities because of their large size, rapid migration rates, and mobility, which allows them to readily avoid in-water disturbances.

Upstream migrating adult winter-run Chinook salmon occur in the action area primarily from November through July (Yoshiyama et al. 1998; Moyle 2002), and downstream migrating juveniles occur primarily from November through February, judging from rotary screw trap catches at Knights Landing (California Department of Fish and Wildlife unpublished data 1999–2011). Spring-run Chinook salmon adults generally occur in the action area from January through August, with peak migration from March through July (Yoshiyama et al. 1998; Moyle 2002), and juveniles occur primarily from November through May (Snider and Titus 2000). The numbers of juvenile winter- and spring-run Chinook salmon that may occur in the action area and the timing of their movements are highly variable, but peak numbers generally occur following the onset of major fall or winter storm events and resulting high flows and turbidity (Williams 2006). Adult fall-run Chinook salmon migrate through the Delta and into Central Valley rivers from June through December and spawn from September through December. Peak spawning activity usually occurs in October and November. The life history characteristics of late fall–run Chinook salmon are not well understood. Adult late fall–run Chinook salmon migrate through the Delta and into the Sacramento River from October through April and may wait 1–3 months before spawning from December through April. Peak spawning activity occurs in February and March. Most fall-run Chinook salmon fry rear in fresh water from December through June, with smolt emigration occurring primarily from April through June. Late fall fry rear in fresh water from April through the following April and emigrate as smolts from October through February (Snider and Titus 2000).

Historical records indicate that California Central Valley steelhead adults migrate into the Sacramento River from June through March with a peak in August through October (Hallock 1957). Rotary screw trap catches of juvenile steelhead in the Sacramento River at Knights Landing indicate that juveniles generally migrate downstream from November through June, with a peak in January and February (CDFW unpublished data 1999–2011).

Upstream migrating adult green sturgeon may occur in the action area from February through April, although some adults may migrate as late as June or July (Heublein et al. 2009). Some post-spawning adults may be present during outmigration, which has been observed during summer (June through August) and late fall or winter (November through December) coincident with increases in flow from the first significant rain events (Heublein et al. 2009). Juvenile green sturgeon appear to rear for 1–2 months in the Sacramento River before entering the Delta and estuary (California Department of Fish and Game 2002) and therefore may be present in the action area from May through August based on spawning time.

Adult splittail migrate up the Sacramento River primarily in April through June to spawn in backwaters and adjacent sloughs to the Sacramento River (Feyrer 2005). Young-of-the-year splittail could drift downstream as larvae or rear upstream for 30–60 days before emigrating downstream. This would exclude both adult and juvenile splittail from the action area during the construction period.

Adult river lamprey and juvenile and adult hardhead may be present in the action area during the proposed construction period but are not likely to be adversely affected by construction activities because of their large size, preference for deeper water, and ability to readily avoid areas of disturbance.

In addition to construction-related habitat disturbances, operation and maintenance of the picket weirs could result in direct effects on special-status fish. Potential exists for adult and juvenile salmonids and green sturgeon to enter the area behind the picket weir and become trapped once the picket weirs are raised, although the probability is very low because the weirs would be raised only when river stage and flows through the gates are starting to reach levels that are known to attract salmon. Juvenile fish may move back and forth through the picket weir at will, so raising the weir would not change the existing condition. The possibility of take during operation exists, although it is considered very low and the operation of the picket weirs would result in a net benefit, as fewer salmon and sturgeon would be lost from production when compared to the existing conditions.

The general maintenance requirements of the picket weir structure will require in-water activities that may disturb fish and move fish away from the immediate area around the structure. This would be short term, and the habitat would become available immediately after maintenance activities have been performed, thus there would be no permanent loss of habitat related to operation and maintenance of the picket weirs.

As there is potential for special-status fish species to be in the action area during construction, operation, and maintenance, this effect would be significant. Implementation of Mitigation Measures BIO-MM-2, BIO-MM-8, WQ-MM-2, described in Section 3.3, *Hydrology and Water Quality*, and the Protection of Fish in Dewatered Construction Zone Environmental Commitment, described in Chapter 2, *Alternatives*, would reduce this effect to a less-than-significant level.

#### Mitigation Measure BIO-MM-8: Minimize Effects on ESA Listed Fish Species during Operation and Maintenance

To minimize direct effects on special-status fish species during operation and maintenance, the USACE, in coordination with RD 108 and DWR, will:

- Develop a protocol for operating and maintaining the picket weirs to minimize incidental take;

- Develop a protocol for monitoring and/or rescuing incidental take of special-status fish species associated with the operation and maintenance of picket weirs;
- Submit to NMFS an annual report for the incidental take resulting from the operation and maintenance of the picket weirs to document the effects of the operation and maintenance on ESA listed fish species. Reports shall be filed not later than October 1 of each year, starting 2017, covering the time period from September 1 of the preceding year to August 31 of the following year.
- Submit to NMFS, no later than February 1, 2016, a protocol for operating and maintaining the picket weirs. The picket weirs shall be operated and maintained by following the specific criteria and guidelines for picket barriers described in the NMFS Anadromous Salmonid Passage Facility Design document (National Marine Fisheries Service 2008).
- Submit to NMFS, not later than February 1, 2016, a protocol for monitoring, rescuing, and reporting incidental take of ESA listed fish species.
- In the case that the take exceeds the identified incidental take level, ESA Section 7 consultation shall be reinitiated immediately.

**Effect BIO-4: Exposure of Aquatic Organisms to Contaminants (less than significant with mitigation)**

Potential contamination could occur from leakage or accidental spills of petroleum products or contact of uncured concrete with flowing water. Toxic substances such as gasoline, lubricants, and other petroleum-based products can kill salmonids and other aquatic organisms through exposure to lethal concentrations or exposure to nonlethal levels that cause physiological stress and increased susceptibility to other sources of mortality. Exposure of uncured concrete to surface water can cause localized increases in pH that can cause physiological stress in fish and other aquatic organisms. This effect would be potentially significant. Implementation of Mitigation Measure WQ-MM-1, described in Section 3.3, *Hydrology and Water Quality*, would ensure that the risk of exposing aquatic organisms to accidental spills would be minimized and that this effect would be less-than-significant.

**Effect BIO-5: Loss of Riparian Habitat (less than significant with mitigation)**

Construction activities for the rock slope protection would cause the permanent loss of up to 0.01 acre of Great Valley valley oak riparian habitat on the southwest bank of the CBD. Proposed action construction would require access to the southwest bank for placement of rock slope protection. Equipment access to the southwest bank erosion site would require the removal of riparian vegetation, specifically one Oregon ash tree with two trunks (diameter at breast height [dbh] of 12 inches and 8 inches) and associated understory vegetation. One cottonwood tree (dbh 36 inches) would require trimming for access. Because the levees are federally regulated, tree replacement on the levee would not be permitted without a variance for the USACE's standard levee vegetation guidelines (U.S. Army Corps of Engineers 2014). Therefore, the loss of riparian habitat at the access location on the southwest bank would be permanent. If the long-reach excavator is used to install the rock slope protection, this effect would be avoided.

Additional temporary effects on adjacent riparian habitat could occur during construction. Movement of construction equipment through the riparian vegetation from the access point to the erosion control site could cause damage to riparian trees and understory vegetation.

Riparian habitat is regulated by CDFW, and Great Valley valley oak riparian forest is considered a sensitive natural community and is tracked in the CNDDB. The permanent loss of riparian habitat would be considered significant because the removal of mature woody vegetation would adversely affect the small amount of existing riparian habitat in this area. The temporary effects would be considered significant because of the potential for additional loss of the riparian habitat. The loss of riparian habitat would also affect special-status fish species, as the tree removal (if necessary) would reduce the riparian habitat function for juvenile salmonids and other fishes. Implementation of Mitigation Measures BIO-MM-2, BIO-MM-3, BIO-MM-4, and BIO-MM-9 would reduce the permanent and temporary effects on riparian habitat to less-than-significant levels. Mitigation Measure BIO-MM-8 would not be implemented if the long-reach excavator is used to install rock slope protection and the loss of riparian habitat is avoided.

**Mitigation Measure BIO-MM-9: Compensate for Loss of Riparian Habitat**

RD 108 will compensate for the permanent loss of up to 0.01 acre of riparian habitat by purchasing credits at an approved mitigation bank. For the mitigation bank option, mitigation will be at a minimum ratio of 2:1 (2 acres of mitigation for each acre of riparian habitat removed) if credits are for preservation of riparian habitat, or at a ratio of 1:1 (1 acre of mitigation for each acre of riparian habitat removed) if credits are for creation of riparian habitat. The final compensation ratio will be approved by CDFW in order to result in no net loss of riparian habitat. The riparian habitat to be removed provides riparian habitat functions, such as shading of riverine habitat and nesting and roosting sites. RD 108 will compensate for the loss of riparian habitat by purchasing riparian habitat credits from an approved mitigation bank near the proposed action, such as Wildlands' Sacramento River Ranch Mitigation Bank.

**Effect BIO-6: Loss of Waters of the United States (less than significant with mitigation)**

Filling of the CBD, which is a perennial drainage and water of the United States, would occur as a result of the barrier construction and erosion repairs.

*Barrier Construction*

Barrier construction would include the installation of five new wing walls, each with a footprint of approximately 32.5 square feet for a total of 162.7 square feet (0.005 acre) of fill. Because this fill would be placed on top of existing permitted fill, which is a concrete apron on the downstream side of the KLOG, installation of the wing walls would not result in the loss of additional waters of the United States, and no compensatory mitigation would be required. However, the construction would be regulated under Section 404 of the CWA and would require a permit, most likely Nationwide Permit #'s 3 and 13 (for modifications to outfall structures and for bank stabilization). In addition, construction would require Section 401 water quality certification from the Central Valley Water Board, and the CDFW could impose additional requirements as part of the streambed alteration agreement under Section 1602 of the CFGC.

A temporary water barrier would be installed on the downstream edge of the concrete apron in order to dewater the construction site and would temporarily affect 0.007 acre of perennial drainage in the CBD. Because the water barrier would be entirely on top of the concrete, which is previously permitted fill, it would not be considered a temporary loss of waters of the United States. However, the temporary placement of additional fill would be included in the CWA Section 404 NWP.

*Erosion Repairs*

Direct effects would occur as a result of the erosion repairs on the southwest bank of the CBD, which would involve placement of rock slope protection by crane. All of the rock slope protection would be placed below the OHWM of the CBD. The extent of the rock slope protection would be 100 linear feet of the channel and a total area of up to 0.07 acre (3,000 square feet) within the OHWM of the CBD. Because the affected bank and channel bed in this area is currently native soil, the rock slope protection would be considered fill in a non-wetland water of the United States. The placement of rock slope protection would be included in the CWA Section 404 NWP and Section 401 water quality certification, and in the CFGC Section 1602 streambed alteration agreement. The loss of perennial drainage as a result of rock slope protection placement would also be considered a long-term degradation of critical habitat for special-status fish species.

Temporary effects on the surrounding channel bank could occur as a result of construction access to the erosion repair site, and would affect up to 0.19 acre. However, the crane used to place the rock slope protection would be on a platform outside of the OHWM of the CBD, and no additional areas of the CBD outside of the erosion repair site would be affected during construction.

Indirect effects on the part of the perennial drainage outside of the rock slope protection area could occur as a result of disturbing sediment on the channel bed and bank during placement of the rock slope protection. This effect would be avoided by the installation of silt fencing/curtains around the extent of the in-water work area to prevent any sediment that may be disturbed and suspended during construction from increasing turbidity in the CBD. Effects on water quality and mitigation measures are described further in Section 3.3, *Hydrology*.

Direct, temporary, and indirect effects on the CBD as a result of barrier construction and erosion repair would be considered significant because these activities would place permanent and temporary fill in a federally protected water of the United States and could indirectly affect water quality in the CBD. Implementation of Mitigation Measures BIO-MM-2, BIO-MM-10, and WQ-MM-1 (described in Section 3.3, *Hydrology and Water Quality*) and the Turbidity Monitoring Environmental Commitment (described in Chapter 2, *Alternatives*) would reduce this effect to a less-than-significant level. Mitigation would include avoidance and minimization to the extent feasible and compensation for the erosion repair site only if required by USACE.

**Mitigation Measure BIO-MM-10: Minimize Loss of Perennial Drainage**

Placement of rock slope protection in the CBD will be limited to the smallest area necessary to prevent additional erosion of the levee bank. Due to the minor extent of fill in a perennial drainage, no compensatory mitigation is likely to be required. However, if USACE requires compensatory mitigation for the loss of up to 0.07 acre of perennial drainage at the erosion repair site, RD 108 will either purchase mitigation bank credits at an accredited bank, such as Wildlands' Fremont Landing conservation bank, or pay into the National Fish and Wildlife Foundation Sacramento District in-lieu fee program. The mitigation ratio would be a minimum of 1:1 (1 acre mitigation for each acre of loss), or as determined by USACE during the permitting process.

# 3.5 Air Quality

## 3.5.1 Introduction

This section analyzes the proposed action's potential effects related to air quality. It describes existing air quality conditions in the action area, identifies sensitive land uses, and summarizes the overall regulatory framework for air quality management in California and the region. Air-quality–related environmental effects also are discussed and applicable mitigation proposed. Please refer to Section 3.6, *Climate Change*, for a discussion of greenhouse gas (GHG) emission and climate change.

## 3.5.2 Existing Conditions

The primary factors that determine air quality are the locations of air pollutant sources and the amount of pollutants emitted from those sources. Meteorological and topographical conditions are also important factors. Atmospheric conditions, such as wind speed, wind direction, and air temperature gradients interact with the physical features of the landscape to determine the movement and dispersal of air pollutants. Air quality is indicated by ambient concentrations of criteria pollutants: ozone, carbon monoxide (CO), nitrogen dioxide ($NO_2$), sulfur dioxide ($SO_2$), lead, and particulate matter (PM), which consists of PM less than or equal to 10 microns in diameter (PM10) and PM less than or equal to 2.5 microns in diameter (PM2.5).

### 3.5.2.1 Climate and Topography

The action area is in Yolo County, which is located in the Sacramento Valley Air Basin (SVAB). The SVAB has a Mediterranean climate characterized by hot, dry summers and cool, rainy winters. During the year, the temperature may range from 20 to 115°F, with summer highs usually in the 90s and winter lows occasionally below freezing. Average annual rainfall is about 20 inches, with about 75% of the total falling during the rainy season (generally from November through March). The prevailing winds are moderate in strength and vary from moist, clean breezes from the south to dry land flows from the north.

The mountains surrounding the SVAB create a barrier to airflow, which can trap air pollutants under certain meteorological conditions. The highest frequency of air stagnation occurs in autumn and early winter when large high-pressure cells lie over the Sacramento Valley. The lack of surface wind during these periods and the reduced vertical flow caused by less surface heating reduce the influx of outside air and allow air pollutants to become concentrated in a stable volume of air. The surface concentrations of pollutants are highest when these conditions are combined with smoke or when temperature inversions trap cool air, fog, and pollutants near the ground.

The ozone season (May through October) in the Sacramento Valley is characterized by stagnant morning air or light winds with the Delta sea breeze arriving in the afternoon out of the southwest. Usually, the evening breeze transports the airborne pollutants to the north out of the Sacramento Valley. During about half of the days from July to September, however, a phenomenon called the Schultz Eddy prevents this from occurring. Instead of allowing the prevailing wind patterns to move north carrying the pollutants out, the Schultz Eddy causes the wind pattern to circle back south. Essentially, this phenomenon causes the air pollutants to be blown south toward the Sacramento area. This phenomenon exacerbates the pollution levels in the area and increases the likelihood of violating federal or state standards. The eddy normally dissipates around noon, when the Delta sea breeze arrives. (Yolo-Solano Air Quality Management District 2007)

### 3.5.2.2 Existing Air Quality Conditions

Existing air quality conditions in the action area can be characterized in terms of the Federal and state air quality standards by monitoring data collected in the region. The EPA and California Air Resources Board (ARB) maintain an extensive network of monitoring stations throughout California. Table 3.5-1 presents pollutant concentrations measured at the Woodland Gibson Road monitoring station for which complete data are available (2011–2013). The Woodland Gibson Road monitoring station is located approximately 11 miles south of the proposed action.

As shown in Table 3.5-1, the monitoring station has experienced exceedances of the state and Federal 8-hour ozone standards and the state PM10 standard.

**Table 3.5-1. Pollutant Concentrations Measured at the Woodland Gibson Road Monitoring Station**

| Pollutant | 2011 | 2012 | 2013 |
|---|---|---|---|
| **1-Hour Ozone** | | | |
| Maximum 1-hour concentration (ppm) | 0.088 | 0.101 | 0.080 |
| 1-hour California designation value (ppm) | 0.09 | 0.09 | 0.09 |
| 1-hour expected peak day concentration (ppm) | 0.090 | 0.087 | 0.086 |
| Number of days standard exceeded[a] | | | |
| CAAQS 1-hour (>0.09 ppm) | 0 | 1 | 0 |
| **8-Hour Ozone** | | | |
| National maximum 8-hour concentration (ppm) | 0.072 | 0.080 | 0.067 |
| National second-highest 8-hour concentration (ppm) | 0.070 | 0.076 | 0.066 |
| State maximum 8-hour concentration (ppm) | 0.073 | 0.080 | 0.067 |
| State second-highest 8-hour concentration (ppm) | 0.071 | 0.076 | 0.067 |
| 8-hour national designation value (ppm) | 0.069 | 0.069 | 0.069 |
| 8-hour California designation value (ppm) | 0.082 | 0.080 | 0.080 |
| 8-hour expected peak day concentration (ppm) | 0.083 | 0.081 | 0.080 |
| Number of days standard exceeded[a] | | | |
| NAAQS 8-hour (>0.075 ppm) | 0 | 2 | 0 |
| CAAQS 8-hour (>0.070 ppm) | 2 | 9 | 0 |
| **Carbon Monoxide** | | | |
| No stations monitor CO in Yolo County. | | | |
| **PM10[b]** | | | |
| National maximum 24-hour concentration ($\mu g/m^3$)[c] | 53.2 | 56.4 | 60.3 |
| National second-highest 24-hour concentration ($\mu g/m^3$)[c] | 47.4 | 42.7 | 59.2 |
| California maximum 24-hour concentration ($\mu g/m^3$)[d] | 56.6 | 56.8 | 61.5 |
| California second-highest 24-hour concentration ($\mu g/m^3$)[d] | 48.8 | 42.9 | 61.1 |
| California annual average concentration ($\mu g/m^3$)[e] | 19.1 | 18.1 | 22.9 |
| Number of days standard exceeded[a] | | | |
| NAAQS 24-hour (>150 $\mu g/m^3$)[f] | 0 | 0 | 0 |

| Pollutant | 2011 | 2012 | 2013 |
|---|---|---|---|
| CAAQS 24-hour (>50 μg/m³)[f] | 7 | 6 | 23 |
| **PM2.5** | | | |
| National maximum 24-hour concentration (μg/m³)[c] | 39.4 | 14.6 | 22.0 |
| National second-highest 24-hour concentration (μg/m³)[c] | 25.8 | 14.2 | 22.0 |
| California maximum 24-hour concentration (μg/m³)[d] | 39.4 | 14.6 | 22.0 |
| California second-highest 24-hour concentration (μg/m³)[d] | 25.8 | 14.2 | 22.0 |
| National annual designation value (μg/m³) | - | - | - |
| National annual average concentration (μg/m³) | - | 6.4 | 7.4 |
| California annual designation value (μg/m³) | 6 | 6 | 6 |
| California annual average concentration (μg/m³)[e] | - | 6.4 | - |
| Number of days standard exceeded[a] | | | |
| NAAQS 24-hour (>35 μg/m³)[f] | – | 0 | 0 |

Source: California Air Resources Board 2015.

a An exceedance is not necessarily a violation.

b Usually, measurements are collected every 6 days.

c National statistics are based on standard conditions data. In addition, national statistics are based on samplers using federal reference or equivalent methods.

d State statistics are based on local conditions data. In addition, state statistics are based on California-approved samplers.

e State criteria for ensuring that data are sufficiently complete for calculating valid annual averages are more stringent than the national criteria.

f Mathematical estimate of how many days' concentrations would have been measured as higher than the level of the standard had each day been monitored. Values have been truncated.

CAAQS = California ambient air quality standards; NAAQS = national ambient air quality standards; ppm = parts per million; μg/m³ = micrograms per cubic meter; – = insufficient data available to determine the value.

### 3.5.2.3 Attainment Status

Local monitoring data (Table 3.5-1) are used to designate areas as nonattainment, maintenance, attainment, or unclassified for the national ambient air quality standards (NAAQS) and California ambient air quality standards (CAAQS) (discussed in Section 3.5.3.1). The four designations are further defined as follows.

- **Nonattainment**—Assigned to areas where monitored pollutant concentrations consistently violate the standard in question.
- **Maintenance**—Assigned to areas where monitored pollutant concentrations exceeded the standard in question in the past but are no longer in violation of that standard.
- **Attainment**—Assigned to areas where pollutant concentrations meet the standard in question over a designated period of time.
- **Unclassified**—Assigned to areas were data are insufficient to determine whether a pollutant is violating the standard in question.

Table 3.5-2 summarizes the attainment status of the action area with regard to the NAAQS and CAAQS.

**Table 3.5-2. Federal and State Attainment Status of Action Area within Yolo County**

| Pollutant | National Ambient Air Quality Standards | California Ambient Air Quality Standards |
|---|---|---|
| 8-hour ozone | Severe nonattainment | Nonattainment |
| CO | Attainment[a] | Attainment |
| PM2.5 | Nonattainment | Attainment |
| PM10 | Attainment | Nonattainment |

Sources: California Air Resources Board 2014; U.S. Environmental Protection Agency 2015.
CO = carbon monoxide; PM2.5 = particulate matter less than or equal to 2.5 microns; PM10 = particulate matter less than or equal to 10 microns;
[a] The City of West Sacramento is considered maintenance for the CO NAAQS, but the action area and Knights Landing is attainment.

### 3.5.2.4 Sensitive Receptors

Sensitive land uses are defined as locations where human populations, especially children, seniors, and sick persons, are located and where there is reasonable expectation of continuous human exposure according to the averaging period for the air quality standards (i.e., 24-hour, 8-hour, and 1-hour). Typical sensitive receptors are residences, hospitals, and schools. The nearest sensitive receptors are residential land uses on Reed Street (130 feet east of the riverbank). Knights Landing United Methodist Church is approximately 1,375 feet east of the construction site.

## 3.5.3 Regulatory Setting

This section summarizes Federal, state, and local regulations that apply to air quality. The air quality management agencies of direct importance in the action area are EPA, ARB, and Yolo-Solano Air Quality Management District (YSAQMD). EPA has established Federal air quality standards for which ARB and YSAQMD have primary implementation responsibility. ARB and YSAQMD are also responsible for ensuring that state air quality standards are met.

### 3.5.3.1 Federal

#### Clean Air Act

The CAA was first enacted in 1963 and has been amended numerous times in subsequent years (1965, 1967, 1970, 1977, and 1990). The CAA establishes federal air quality standards, known as NAAQS, and specifies future dates for achieving compliance. The CAA also mandates that the state submit and implement a State Implementation Plan (SIP) for local areas not meeting those standards. The plans must include pollution control measures that demonstrate how the standards will be met.

The 1990 amendments to the CAA identify specific emission-reduction goals for areas not meeting the NAAQS. These amendments require both a demonstration of reasonable further progress toward attainment and incorporation of additional sanctions for failure to attain or meet interim milestones. Table 3.5-3 shows the NAAQS currently in effect for each criteria pollutant, as well as the California ambient air quality standards (CAAQS).

**Table 3.5-3. National and State Ambient Air Quality Standards**

| Criteria Pollutant | Average Time | California Standards | National Standards[a] | |
|---|---|---|---|---|
| | | | Primary | Secondary |
| Ozone | 1-hour | 0.09 ppm | None | None |
| | 8–hour | 0.070 ppm | 0.075 ppm | 0.075 ppm |
| Particulate matter (PM10) | 24-hour | 50 μg/m$^3$ | 150 μg/m$^3$ | 150 μg/m$^3$ |
| | Annual mean | 20 μg/m$^3$ | None | None |
| Fine particulate matter (PM2.5) | 24-hour | None | 35 μg/m$^3$ | 35 μg/m$^3$ |
| | Annual mean | 12 μg/m$^3$ | 12.0 μg/m$^3$ | 15 μg/m$^3$ |
| Carbon monoxide | 8-hour | 9.0 ppm | 9 ppm | None |
| | 1-hour | 20 ppm | 35 ppm | None |
| Nitrogen dioxide | Annual mean | 0.030 ppm | 0.053 ppm | 0.053 ppm |
| | 1-hour | 0.18 ppm | 0.100 ppm | None |
| Sulfur dioxide[b] | Annual mean | None | 0.030 ppm | None |
| | 24-hour | 0.04 ppm | 0.014 ppm | None |
| | 3-hour | None | None | 0.5 ppm |
| | 1-hour | 0.25 ppm | 0.075 ppm | None |
| Lead | 30-day average | 1.5 μg/m$^3$ | None | None |
| | Calendar quarter | None | 1.5 μg/m$^3$ | 1.5 μg/m$^3$ |
| | 3-month average | None | 0.15 μg/m$^3$ | 0.15 μg/m$^3$ |
| Sulfates | 24-hour | 25 μg/m$^3$ | None | None |
| Hydrogen sulfide | 1-hour | 0.03 ppm | None | None |
| Vinyl chloride | 24-hour | 0.01 ppm | None | None |

Source: California Air Resources Board 2013.

[a] National standards are divided into primary and secondary standards. Primary standards are intended to protect public health, whereas secondary standards are intended to protect public welfare and the environment.

[b] The final 1-hour sulfur dioxide rule was signed June 2, 2010. The annual and 24-hour standards were revoked in that same rulemaking. However, these standards remain in effect until 1 year after an area is designated for the 2010 standard, except in areas designated nonattainment for the 1971 standards, where the 1971 standards remain in effect until implementation plans to attain or maintain the 2010 standard are approved.

μg/m$^3$ = micrograms per cubic meter; ppm = parts per million.

### 3.5.3.2 General Conformity

EPA enacted the Federal General Conformity regulation (40 CFR Parts 5, 51, and 93) in 1993. The purpose of the General Conformity rule is to ensure that Federal actions do not generate emissions that interfere with state and local agencies' SIPs and emission-reduction strategies to ensure attainment of the NAAQS.

The General Conformity rule applies to all Federal actions located in nonattainment and maintenance areas, unless one or more of the following criteria are satisfied.

- The action is exempt from General Conformity (i.e., the action is covered by Transportation Conformity or is listed in the General Conformity rule).

- The action is covered by a Presumed-to-Conform approved list.[1]
- The action does not have *de minimis* emissions.

If none of the above criteria applies, the project is subject to the General Conformity rule and the Federal lead agency must perform a conformity determination. The determination is made only for direct and indirect emissions associated with the Federal action that are subject to the New Source Review (NSR) (i.e., the rule does not apply to stationary industrial sources that require air quality permits from local air pollution control agencies); that a Federal permitting agency has directly caused or initiated; or over which the Federal permitting agency has continued program responsibility or can practically control.

### 3.5.3.3 State

#### California Clean Air Act

At the state level, the California CAA establishes a statewide air pollution control program. The California CAA requires all air districts in the state to endeavor to meet the CAAQS by the earliest practical date. Unlike the CAA, the California CAA does not set precise attainment deadlines. Instead, the California CAA establishes increasingly stringent requirements for areas that will require more time to achieve the standards. CAAQS are generally more stringent than the NAAQS and incorporate additional standards for sulfates, hydrogen sulfide, visibility-reducing particles, and vinyl chloride. The CAAQS are summarized in Table 3.5-3.

### 3.5.3.4 Local

#### Yolo-Solano Air Quality Management District Attainment Plans

YSAQMD has local jurisdiction over air quality in Yolo County. Under the California CAA, YSAQMD is required to develop an air quality plan for nonattainment criteria pollutants in the air district. The *1994 Sacramento Area Regional Ozone Attainment Plan* was prepared to address reactive organic gases (ROG) and nitrogen oxides ($NO_X$) emissions following the region's serious nonattainment designation for the 1-hour ozone NAAQS in November 1991. The *Sacramento Regional 8-Hour Attainment and Reasonable Further Progress Plan* has also been adopted to address the region's nonattainment status for the 8-hour ozone NAAQS. Air districts within the Sacramento Federal Nonattainment Area (SFNA) have submitted the ozone plan to EPA and are currently waiting for the agency to approve the document. Counties in the SFNA (Sacramento, Yolo, Placer, El Dorado, Solano, Sutter, and Butte) have also adopted the *2012 Northern Sacramento Valley Planning Area 2009 Triennial Air Quality Attainment Plan* (2012 Plan). This plan outlines strategies to achieve the health-based ozone standard. The Sacramento region is also in the process of developing a plan to address PM.

All activities located in Yolo County are subject to the YSAQMD regulations in effect at the time of construction. The following YSAQMD rules may apply to the proposed action. This list of rules may not be all encompassing as additional YSAQMD rules may apply to the alternatives as specific components are identified.

[1] Category of activities designated by a Federal agency as having emissions below *de minimis* levels or that otherwise do not interfere with the applicable SIP or the attainment and maintenance of the NAAQS.

- Rule 2.5 (Nuisance). This rule prevents dust emissions from creating a nuisance to surrounding properties.
- Rule 2.11 (Particulate Matter Concentration). This rule restricts emissions of PM greater than 0.1 grain per cubic foot of gas at dry standard conditions.
- Rule 2.32 (Stationary Internal Combustion Engines). This rule requires portable equipment greater than 50 horsepower, other than vehicles, to be registered with either ARB Portable Equipment Registration Program or with YSAQMD.

## 3.5.4 Significance Criteria

The following significance criteria are based on NEPA standards and standards of professional practice. For this analysis, an environmental effect related to air quality was considered to be significant if the proposed action would result in any of the effects listed below.

- Conflict with or obstruct implementation of the applicable air quality plan.
- Violate any air quality standard or contribute substantially to an existing or projected air quality violation.
- Result in a cumulatively considerable net increase of any criteria pollutant for which the region is a nonattainment area for an applicable federal or state ambient air quality standard (including releasing emissions that exceed quantitative thresholds for ozone precursors).
- Expose sensitive receptors to substantial pollutant concentrations.
- Create objectionable odors affecting a substantial number of people.

The action area is in federally classified nonattainment area for ozone and PM2.5 (see Table 3.5-2). Consequently, to fulfill general conformity requirements, a General Conformity evaluation must be undertaken to identify whether the total ozone and PM2.5 emissions for the proposed action are subject to the General Conformity rule. The General Conformity evaluation must consider both direct and indirect sources of emissions for all nonattainment and/or maintenance pollutants, which include regulated precursor emissions. Regulated precursor emissions for ozone include ROG and $NO_X$. Regulated precursor emissions for PM2.5 include $SO_2$, $NO_X$, and ROG. Therefore, the General Conformity analysis evaluates each of these direct and indirect (precursor) emissions.

The General Conformity evaluation is made by comparing all emission sources (e.g., haul trucks, offroad equipment) to the applicable General Conformity *de minimis* thresholds. Table 3.5-4 summarizes the *de minimis* thresholds applicable to the action area.

**Table 3.5-4. Federal *de minimis* Thresholds for the Action Area (tons per year)**

| Pollutant | Threshold |
|---|---|
| $NO_X$ | 25 |
| ROG | 25 |
| PM2.5 | 100 |
| $SO_2$ | 100 |

As discussed in Section 3.5.3.1, the purpose of the General Conformity rule is to ensure that Federal actions do not generate emissions that interfere with state and local agencies' SIPs and emission-reduction strategies to ensure attainment of the NAAQS. Accordingly, the general conformity evaluation addresses the first three State CEQA Guidelines Appendix G criteria (see above); emissions in excess of the federal *de minimis* threshold could conflict with applicable air quality plans, violate existing or projected air quality standards, or contribute to a cumulative air quality effect.

With respect to potential health effects from project-generated emissions, the analysis focuses on those pollutants with the greatest potential to result in a significant, material impact on human health, which are (1) diesel particulate matter (DPM) and (2) locally concentrated CO (i.e., CO hotspots). Since the EPA has not adopted quantitative thresholds to assess potential health risks, the following criteria published by the YSAQMD (2007) were used to determine whether project generated emissions would result in a significant impact to sensitive receptors.

- Result in exposure to DPM resulting in a maximum incremental cancer risk greater than 10 in 1 million, or a health hazard index greater than 1.
- Creates CO hotspots near sensitive receptors (i.e., degrade intersections to level of service [LOS] E or worse) that exceed the CAAQS.

## 3.5.5 Environmental Consequences

### 3.5.5.1 No Action

Federal approvals are not required for the No Action Alternative because neither construction nor changes to existing flood gate operation would occur. Therefore, the No Action Alternative is not subject to General Conformity. There would be no change or improvement in operational conditions at the facility. Accordingly, there would be no construction or operational emission effect, including exposure of sensitive receptors to increased pollutant concentrations or odors. Since existing flood gate operation has already been factored into the applicable air quality plans, there would be no conflict with or obstruction of implementation of any such plans.

### 3.5.5.2 Proposed Action

**Effect AQ-1: Be in conflict with applicable air quality plans, violation of existing or projected air quality standards, or a contributor to a cumulative air quality effect (no effect)**

As discussed in Section 3.5.3.1, EPA enacted the General Conformity rule to ensure that Federal actions do not generate emissions that interfere with state and local agencies' SIPs and emission-reduction strategies to ensure attainment of the NAAQS. The Federal *de minimis* thresholds summarized in Table 3.5-4 identify maximum annual emissions that may be generated by the proposed action; actions with emissions in excess of these thresholds could conflict with the 2012 Plan and other Federal and state emissions reduction strategies.

Construction of the proposed action has the potential to directly affect ambient air quality through the use of heavy-duty construction equipment, construction worker vehicle trips, and truck hauling trips. Criteria pollutant emissions generated by these sources were quantified using information provided by the project proponent and emission factors from the CalEEMod (version 2013.2.2) and EMFAC2014 emissions models. It was assumed that construction would require three phases between September and October 2015.

Operation of the proposed action would require routine inspections. These inspections would occur annually over a period of one day and require one crane and six truck trips. Emissions generated by these sources were quantified using emission factors from the CalEEMod (version 2013.2.2) and EMFAC2014 emissions models.

Annual criteria pollutant emissions resulting from construction and operation of the proposed action are shown in Table 3.5-5. Please refer to Appendix D for modeling assumptions and calculations.

**Table 3.5-5. Annual Criteria Pollutant Emissions (tons per year)**

| Activity/Year | ROG | $NO_X$ | CO | PM10 | PM2.5 | $SO_2$ |
|---|---|---|---|---|---|---|
| **Project Construction** | | | | | | |
| 2015 | 0.01 | 0.10 | 0.06 | 0.02 | 0.01 | <0.01 |
| **Long-Term Operation** | | | | | | |
| 2016 onward | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| *De minimis* Level | 25 | 25 | -[a] | -[a] | 100 | 100 |

[a] The proposed action is located in an attainment area for CO and PM10 and is therefore not subject to a General Conformity evaluation for these pollutants.

As shown in Table 3.5-5, annual criteria pollutant emissions would not exceed the federal *de minimis* thresholds. There would be no direct or indirect air quality effect.

### Effect AQ-2: Exposure of sensitive receptors to substantial pollutant concentrations (no effect)

*Diesel Particulate Matter*

Diesel-fueled engines used during construction could expose adjacent residential receptors to DPM, which is considered carcinogen. However, DPM generated during construction is expected to be minor and would not exceed 0.02 ton (see Table 3.5-5). These emissions would dissipate as a function of distance and would be lower at the nearest sensitive receptor (130 feet east of the construction site). Moreover, emissions would only occur for 2 months, which is significantly lower than the 70-year exposure period typically associated with chronic cancer health risks. Similarly, while a diesel-powered crane and haul trucks would be required during operational inspections, emissions would only occur 1 day per year. Consequently, neither construction- nor operational-related DPM is expected to expose sensitive populations to substantial pollutant concentrations or exceed YSAQMD thresholds. There would be no direct or indirect air quality effect.

*Localized Carbon Monoxide*

Implementation of the proposed action would not alter or worsen the current congestion (i.e., no changes in LOS) on any streets in the project vicinity. Likewise, the proposed action would not alter the design of any roadways or generate a significant number of new vehicles trips. Temporary construction vehicles would not reduce the LOS at affected intersections to unacceptable levels. Accordingly, the proposed action would not exceed YSAQMD's (2007) screening criteria, where a less-than-significant impact to localized CO concentrations would occur for traffic volumes that do not negatively affect or degrade intersections to unacceptable LOS. Thus, the proposed action would not contribute to or worsen localized CO concentrations within the study area from construction traffic. There would be no direct or indirect air quality effect.

**Effect AQ-3: Creation of objectionable odors affecting a substantial number of people (no effect)**

While offensive odors rarely cause any physical harm, they can be unpleasant, leading to considerable distress among the public and often generating citizen complaints to local governments and air districts. Odor emissions related to the proposed action would primarily occur during the construction period, when emissions from equipment may be evident in the immediately surrounding area. These activities would be short term and are not likely to result in nuisance odors that would violate YSAQMD nuisance standards. Similarly, the limited diesel-powered equipment required for the once yearly operational inspection would not result in substantial odor emissions. There would be no direct or indirect air quality effect.

# 3.6 Climate Change

## 3.6.1 Introduction

This section provides an analysis of climate change effects resulting from the proposed action. It describes commonly generated GHG emissions and summarizes the current federal regulatory framework related to GHG emissions and climate change. Environmental effects related to climate change also are discussed. Please refer to Section 3.5, *Air Quality*, for an analysis of criteria pollutants and air quality effects.

## 3.6.2 Existing Conditions

Rising atmospheric concentrations of GHGs in excess of natural levels result in increasing global surface temperatures and shifts in the global climate. Assembly Bill (AB) 32 identifies the following compounds as the major GHGs: carbon dioxide ($CO_2$), methane ($CH_4$), nitrous oxide ($N_2O$), perfluorinated carbons (PFCs), sulfur hexafluoride ($SF_6$), and hydrofluorocarbons (HFCs). The primary sources of GHGs are vehicles (including planes and trains), energy generation plants, and industrial and agricultural operations (such as dairies and hog farms). Because construction equipment and heavy duty trucks generate primarily GHG emissions consisting of $CO_2$, $CH_4$, and $N_2O$, the following discussion focuses on these pollutants.

$CO_2$ is the most important anthropogenic GHG, followed by $CH_4$ and $N_2O$. It is estimated that $CO_2$ accounts for more than 75% of all anthropogenic GHG emissions. Three quarters of anthropogenic $CO_2$ emissions are the result of fossil fuel burning (and to a very small extent, cement production), and approximately 25% of emissions are the result of land use change (Intergovernmental Panel on Climate Change 2007). $CH_4$ is the second largest contributor of anthropogenic GHG emissions and is the result of growing rice, raising cattle, fuel combustion, and mining coal (National Oceanic and Atmospheric Administration 2005). $N_2O$, while not as abundant as $CO_2$ or $CH_4$, is a powerful GHG. Sources of $N_2O$ include agricultural processes, nylon production, fuel-fired power plants, nitric acid production, and fuel combustion.

In order to simplify reporting and analysis, methods have been set forth to describe emissions of GHGs in terms of a single gas. The most commonly accepted method to compare GHG emissions is the global warming potential (GWP) method defined in the Intergovernmental Panel on Climate Change (IPCC) reference documents. The IPCC defines the GWP of various GHG emissions on a normalized scale that recasts all GHG emissions in terms of $CO_2$ equivalents ($CO_2e$), which compares the gas in question to that of the same mass of $CO_2$ ($CO_2$ has a GWP of 1 by definition). Table 3.6-1 lists the GWP of $CO_2$, $CH_4$, and $N_2O$; their lifetimes; and abundances in the atmosphere in parts per million (ppm).

**Table 3.6-1. Lifetimes and Global Warming Potentials of Principal Greenhouse Gases**

| Greenhouse Gas | Global Warming Potential (100 years) | Lifetime (years) | 2014 Atmospheric Abundance |
|---|---|---|---|
| Carbon dioxide | 1 | 50–200 | 402 |
| Methane | 28 | 9–15 | 1,893 |
| Nitrous oxide | 265 | 120 | 326 |

Sources: Myhre et al. 2013, Blasing 2014; National Oceanic and Atmospheric Administration 2015.

# 3.6.3 Regulatory Setting

## 3.6.3.1 Federal

Climate change only recently has been widely recognized as an imminent threat to the global climate, economy, and population. Thus, the climate change regulatory setting is complex and evolving. The following section identifies key federal legislation relevant to the environmental assessment of proposed action GHG emissions.

### Endangerment and Cause or Contribute Findings (2009)

On December 7, 2009, the EPA signed the Endangerment and Cause or Contribute Findings for Greenhouse Gases under Section 202(a) of the Federal CAA. Under the Endangerment Finding, EPA finds that the current and projected concentrations of the six key well-mixed GHGs—$CO_2$, $CH_4$, $N_2O$, $SF_6$, PFCs, and HFCs—in the atmosphere threaten the public health and welfare of current and future generations. Under the Cause or Contribute Finding, EPA finds that the combined emissions of these well-mixed GHGs from new motor vehicles and new motor vehicle engines contribute to the GHG pollution that threatens public health and welfare.

These findings do not themselves impose any requirements on industry or other entities. However, this action was a prerequisite to finalizing EPA's proposed new corporate average fuel economy standards for light-duty vehicles, which EPA proposed in conjunction with the U.S. Department of Transportation.

### Regulation of GHG Emissions under the Clean Air Act (ongoing)

Under the authority of the Federal CAA, EPA is beginning to regulate GHG emissions, starting with large stationary sources. In 2010, EPA set GHG thresholds to define when permits under the New Source Review Prevention of Significant Deterioration and Title V Operating Permit programs are required for new and existing industrial facilities. In 2012, EPA proposed a carbon pollution standard for new power plants.

### Council on Environmental Quality GHG Guidance (ongoing)

On February 19, 2010, the Council on Environmental Quality (CEQ) issued draft NEPA guidance on the consideration of the effects of climate change and GHG emissions. This guidance advises Federal agencies that they should consider opportunities to reduce GHG emissions caused by Federal actions, adapt their actions to climate change effects throughout the NEPA process, and address these issues in their agency NEPA procedures. Where applicable, the scope of the NEPA analysis should cover the GHG emissions effects of a proposed action and alternative actions, as well as the relationship of climate change effects on a proposed action or alternatives (Council on Environmental Quality 2010).

The draft guidance was updated in 2014 to further refine the scope of NEPA analyses. The 2014 guidance recommends that analyses should include the potential effects of a proposed action on climate change as indicated by its GHG emissions, as well as the implication of climate change for the environmental effects of the proposed action (Council on Environmental Quality 2014). The GHG analysis should be proportionate to the effects of the proposed action. The guidance also includes a 25,000 metric ton reference point that can be used to determine whether a quantitative analysis should be undertaken. The 2014 CEQ guidance is still considered draft as of the writing of this document and is not an official CEQ policy document.

### 3.6.3.2 State

California has adopted legislation, and regulatory agencies have enacted policies, addressing various aspects of climate change and GHG emissions mitigation. Much of this legislation and policy activity is not directed at citizens or jurisdictions but rather establishes a broad framework for the state's long-term GHG mitigation and climate change adaptation program. The following key legislation is applicable to CVFPB and RD 108's implementation, construction, operation, and maintenance of the proposed action.

#### Assembly Bill 32, Global Warming Solutions Act (2006)

AB 32 codified the state's GHG emissions target by requiring that the state's global warming emissions be reduced to 1990 levels by 2020. Since being adopted, the CARB, California Energy Commission, California Public Utilities Commission, and the Building Standards Commission have been developing regulations that will help meet the goals of AB 32. The Scoping Plan for AB 32 identifies specific measures to reduce GHG emissions to 1990 levels by 2020, and requires ARB and other state agencies to develop and enforce regulations and other initiatives for reducing GHGs. Specifically, the Scoping Plan articulates a key role for local governments, recommending they establish GHG reduction goals for both their municipal operations and the community consistent with those of the state.

On December 11, 2008, pursuant to AB 32, ARB adopted the AB 32 Scoping Plan. This plan outlines how emissions reductions from significant sources of GHGs will be achieved via regulations, market mechanisms, and other actions. The Scoping Plan also describes recommended measures that were developed to reduce GHG emissions from key sources and activities while improving public health, promoting a cleaner environment, preserving our natural resources, and ensuring that the impacts of the reductions are equitable and do not disproportionately affect low-income and minority communities. The first update to the Scoping Plan was released in 2014.

### 3.6.3.3 Local

The following local regulations related to climate change may apply to CVFPB and RD 108's implementation, construction, operation, and maintenance of the proposed action.

### Yolo-Solano Air Quality Management District

The Yolo-Solano Air Quality Management District (YSAQMD), along with and a committee of air districts in the Sacramento Region,[1] have developed draft thresholds for evaluating GHG emissions from new stationary source and land development projects. While the Sacramento Metropolitan Air Quality Management District formally adopted the GHG thresholds in October 2014, they are still considered draft in YSAQMD.[2] The GHG thresholds include project categories and emission levels. Construction activities would result in a significant and unavoidable effect if emissions exceed 1,100 metric tons $CO_2e$ per year. Projects with operational emissions in excess of the threshold must mitigate to 1,100 metric tons $CO_2e$ or demonstrate a 21.7% reduction from a projected no action taken scenario to show consistency with AB 32 reduction goals.

### Yolo County

Yolo County adopted a climate action plan (CAP) in 2011. The plan outlines a variety of strategies to reduce GHG emissions generated by community activities by 80% by 2050.

## 3.6.4 Significance Criteria

The following significance criteria are based on NEPA standards and standards of professional practice. For this analysis, an environmental effect related to climate change was considered significant if the proposed action would result in any of the effects listed below.

- Generate a significant amount of GHG emissions, either directly or indirectly.
- Conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing the emissions of GHGs.

Direct and indirect GHG emissions from the proposed action are discussed with respect to the draft YSAQMD and CEQ GHG thresholds (1,100 and 25,000 metric ton $CO_2e$, respectively). Since there are no federal GHG reduction plans applicable to the project, consistency with AB 32 and the Yolo County's CAP is also assessed.

The draft CEQ guidance recommends lead agencies consider implication of climate change for the environmental effects of a proposed action. Accordingly, a qualitative discussion of potential climate change effects on the proposed action has been provided below using the following criterion.

- Place people or structures at substantial risk of harm as a result of predicted climate change effects.

[1] Air districts in the region include YSAQMD, Sacramento Metropolitan Air Quality Management District, El Dorado County Air Quality Management District, Feather River Air Quality Management District, and the Placer County Air Pollution Control District.

[2] The YSAQMD current CEQA Guidelines recommend that lead agencies include at least a qualitative discussion of potential climate change impacts in the air quality analyses of sizable projects. YSAQMD further advises that the lead agency can require mitigation measures such as building code restrictions, increased public transportation, alternative fuels, or other actions that reduce $CO_2$ (Yolo Solano Air Quality Management District 2007).

## 3.6.5 Environmental Consequences

### 3.6.5.1 No Action

Neither construction nor changes to existing flood gate operation would occur under the No Action Alternative. Accordingly, there would be no construction or operational emission effect. Since existing flood gate operation has already been factored into the applicable GHG reduction plans, there would be no conflict with or obstruction of implementation of any such plans.

### 3.6.5.2 Proposed Action

**Effect CC-1: Generate a significant amount of GHG emissions, either directly or indirectly (no effect)**

Construction of the proposed action would generate direct emissions of $CO_2$, $CH_4$, and $N_2O$ from mobile and stationary construction equipment exhaust and employee and haul truck vehicle exhaust. Indirect emissions would also be generated by electricity consumption and concrete batching. Emissions from equipment and vehicles were quantified using information provided by the project proponent and emission factors from the CalEEMod (version 2013.2.2) and EMFAC2014 emissions models. Electricity-related emissions were quantified using emission factors published by Pacific Gas & Electric (2013) and EPA (2014); $CO_2$ emissions generated during concrete batching were estimated using emission factors from Nisbet et al. (2002).

Operation of the proposed action would require routine inspections. These inspections would occur annually over a period of one day and require one crane and six truck trips. Operation of the flood gates would also consume approximately 600 kilowatt-hours of electricity per year. Emissions generated by equipment and vehicles were quantified using emission factors from the CalEEMod (version 2013.2.2) and EMFAC2014 emissions models. Electricity-related emissions were quantified using emission factors published by Pacific Gas & Electric (2013) and EPA (2014).

Annual GHG emissions resulting from construction and operation of the proposed action are shown in Table 3.6-2. Please refer to Appendix D for modeling assumptions and calculations.

**Table 3.6-2. Estimated Annual Greenhouse Gas Emissions of the Proposed Action (metric tons per year)**

| Activity/Year | $CO_2$ | $CH_4$ | $N_2O$ | Other[a] | $CO_2e$[b] |
|---|---|---|---|---|---|
| Construction (2015) | 43 | <0.01 | <0.01 | 0.26 | 44 |
| Operation (2016 onward) | 1 | <0.01 | <0.01 | 0.01 | 1 |
| YSAQMD draft threshold | - | - | - | - | 1,100 |
| CEQ draft reference point | - | - | - | - | 25,000 |

[a] From construction worker commutes (mix of fuels). Other GHGs include $CH_4$, $N_2O$, and HFCs, which represent 5% of total GHG emissions from on-road sources (calculated by diving $CO_2$ emissions by 0.95 and multiplying the resulting number by 0.05).

[b] Refers to carbon dioxide equivalent, which includes the relative warming capacity (i.e., GWP) of each GHG.

As shown in Table 3.6-2, neither construction nor operation of the proposed action would generate emission in excess of YSAQMD draft threshold and CEQ's draft reference point. There would be no direct or indirect GHG effect.

### Effect CC-2: Conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing the emissions of greenhouse gases (no effect)

As discussed above, there are no federal GHG reduction plans applicable to the project. Accordingly, consistency with AB 32 and the Yolo County's CAP is assessed in this impact.

AB 32 codified the state's GHG emissions target by requiring that the state's global warming emissions be reduced to 1990 levels by 2020. ARB adopted the AB 32 Scoping Plan as a framework for achieving AB 32 goals. The Scoping Plan outlines a series of technologically feasible and cost-effective measures to reduce statewide GHG emissions. Similarly, the Yolo County CAP identifies several implementation actions to guide the County in reducing communitywide GHG emissions.

Both the AB 32 Scoping Plan and Yolo County CAP target sources with the greatest GHG emissions potential, including transportation, building energy consumption, and waste generation. Neither construction nor operational activities associated with the proposed action are considered by either plan as significant emissions sources, and as such, none of the measures outlined in the AB 32 Scoping Plan or Yolo CAP is directly applicable to the proposed action. Accordingly, implementation of the project would not conflict with adopted plans for reducing GHG emissions. There would be no direct or indirect GHG effect.

### Effect CC-3: Place people or structures at substantial risk of harm as a result of predicted climate change effects (no effect)

Unavoidable climate change may result in a range of potential effects on the proposed action and adjacent areas. The extent of these effects is still being defined as climate modeling tools become more refined. Regardless of the uncertainty in precise predictions, it is widely understood that substantial climate change is expected to occur in the future. Potential climate change effects in California and the Sacramento Valley could include extreme heat events, increased energy consumption, increase in infectious diseases and respiratory illnesses, reduced snowpack and water supplies, increased water consumption, and potential increase in wildfires.

While the Knights Landing area may experience unavoidable climate shifts, the proposed action does not involve construction of any residential or commercial structures that would attract or otherwise house people. The new flood gates would be constructed of concrete and capable of withstanding seasonal changes in temperatures, which fluctuate by more than the estimated 4–6 degree increase in annual average temperatures for Knights Landing (California Energy Commission 2015). Increased wildfire risk for the action area is also classified as low. Therefore, the proposed action is not anticipated to place people or structures at substantial risk of harm as a result of predicted climate change effects. There would be no direct or indirect effect.

# 3.7 Noise

This section analyzes the proposed action's potential effects related to noise. It describes existing noise and vibration conditions in the action area in a regional and site-specific context and summarized the overall regulatory framework for noise management in the region. Noise- and vibration-related environmental effects on the proposed action also are discussed, and applicable mitigation is proposed.

## 3.7.1 Introduction

### 3.7.1.1 Noise Terminology

The following are brief definitions of noise terminology used in this evaluation.

- **Sound.** A vibratory disturbance transmitted by pressure waves through a medium such as air and capable of being detected by a receiving mechanism, such as the human ear or a microphone.
- **Noise.** Sound that is loud, unpleasant, unexpected, or otherwise undesirable.
- **Decibel (dB)**. A measure of sound based on a logarithmic scale that indicates the squared ratio of actual sound pressure level to a reference sound pressure level (20 micropascals).
- **A-Weighted Decibel (dBA).** A measure of sound that is weighted to take into account the varying sensitivity of the human ear to different frequencies of sound. The dBA scale is the most widely used for environmental noise assessments. Typical A-weighted noise levels for various types of sound sources are summarized in Table 1.
- **Equivalent Sound Level ($L_{eq}$)**. $L_{eq}$ represents an average of the sound energy occurring over a specified period. In effect, $L_{eq}$ is the steady-state sound level that would contain the same acoustical energy as the time-varying sound that actually occurs during the monitoring period. The 1-hour A-weighted equivalent sound level ($L_{eq}$ 1h) is the energy average of A-weighted sound levels occurring during a 1-hour period.
- **Maximum Sound Levels ($L_{max}$).** The maximum ($L_{max}$) sound levels measured during a monitoring period.
- **Day-Night Level ($L_{dn}$).** The energy average of the A-weighted sound levels occurring during a 24-hour period, with 10 dB added to the A-weighted sound levels occurring between 10 p.m. and 7 a.m.
- **Percentile-Exceeded Sound Level ($L_{xx}$).** The sound level exceeded some percentage of the time during a monitoring period. For example $L_{50}$ is the sound level exceeded 50% of the time, and $L_{10}$ is the sound level exceeded 10% of the time.
- **Community noise equivalent level (CNEL).** The energy average of the A-weighted sound levels occurring during a 24-hour period with 5 dB added to the A-weighted sound levels occurring during the period from 7:00 p.m. to 10:00 p.m. and 10 dB added to the A-weighted sound levels occurring during the period from 10:00 p.m. to 7:00 a.m.

**Table 3.7-1. Typical A-Weighted Sound Levels**

| Common Outdoor Activities | Sound Level (dBA) | Common Indoor Activities |
|---|---|---|
| | 110 | Rock band |
| Jet flyover at 1,000 feet | | |
| | 100 | |
| Gas lawnmower at 3 feet | | |
| | 90 | |
| Diesel truck at 50 mph at 50 feet | | Food blender at 3 feet |
| | 80 | Garbage disposal at 3 feet |
| Noisy urban area, daytime | | |
| Gas lawnmower at 100 feet | 70 | Vacuum cleaner at 3 feet |
| Commercial area | | Normal speech at 3 feet |
| Heavy traffic at 300 feet | 60 | |
| | | Large business office |
| Quiet urban area, daytime | 50 | Dishwasher in next room |
| Quiet urban area, nighttime | 40 | Theater, large conference room (background) |
| Quiet suburban area, nighttime | | |
| | 30 | Library |
| Quiet rural area, nighttime | | Bedroom at night, concert hall (background) |
| | 20 | |
| | | Broadcast/recording studio |
| Rustling of leaves | 10 | |
| | 0 | |

Source: California Department of Transportation 2013.

Sound from multiple sources operating in the same area such a multiple pieces of construction equipment will result in a combined sound level that is greater than any individual source. The individual sound levels for different noise sources cannot be added directly to give the sound level for the combined noise sources. Rather, the combined noise level produced by multiple noise sources is calculated using logarithmic summation. For example, if one bulldozer produces a noise level of 80 dBA, then two bulldozers operating side by side would generate a combined noise level of 83 dBA (only 3 dBA louder than the single bulldozer).

Human sound perception, in general, is such that a change in sound level of 3 dB is just noticeable; a change of 5 dB is clearly noticeable; and a change of 10 dB is perceived as doubling or halving the sound level. A doubling of actual sound energy is required to result in a 3 dB (i.e., barely noticeable) increase in noise; in practice, for example, this means that the volume of traffic on a roadway typically needs to double to result in a noticeable increase in noise.

When distance is the only factor considered, sound levels from isolated point sources of noise typically decrease by about 6 dB for every doubling of distance from the noise source. When the noise source is a continuous line, such as vehicle traffic on a highway, sound levels decrease by about 3 dB for every doubling of distance. Noise levels can also be affected by several factors other than the distance from the noise source. Topographic features and structural barriers that absorb, reflect, or scatter sound waves can affect the reduction of noise levels over distance. Atmospheric conditions (wind speed and direction, humidity levels, and temperatures) and the presence of dense vegetation can also affect the degree of sound attenuation.

## 3.7.2 Existing Conditions

The action area is located in the census-designated place of Knights Landing, California, in Yolo County. The area is surrounded by the Sacramento River on the north, agricultural areas to the west, and a residential neighborhood on the east. The nearest residence is located 130 feet from the construction site. The majority of noise in the action area comes from motor vehicle traffic, residential noise, and the existing KLOG facility. Given the rural nature of the action area, ambient noise levels are expected to be in the range of 40 to 50 dBA $L_{dn}$.

## 3.7.3 Regulatory Setting

### 3.7.3.1 Federal

There are no federal noise regulations that are applicable to the proposed action.

### 3.7.3.2 State

There are no state noise regulations that are applicable to the proposed action.

### 3.7.3.3 Local

The following local regulations related to noise may apply to CVFPB and RD 108's implementation, construction, operation, and maintenance of the proposed action.

#### Yolo County Noise Ordinance

Yolo County does not have an adopted noise ordinance.

#### County of Yolo General Plan

The noise section of the Health and Safety Element of the *County of Yolo General Plan* (County of Yolo 2009) establishes interior and exterior noise level standards for planning purposes to ensure land use compatibility for new developments as it relates to noise exposure. Sound levels in the range of 60 to 65 $L_{dn}$ are identified as being "normally acceptable" for residential uses.

#### Knights Landing Comprehensive General Plan

The statements of goals and policies which follow supplement those of the Noise Element of the *County of Yolo General Plan*. The goals of the Noise Element of the general plan are to protect citizens from the harmful effects of exposure to excessive noise and to protect the economic base of the town by preventing the encroachment of incompatible land uses near noise-producing roadways, industries, and other sources. For example, exterior noise levels in the range of 50–60 dB CNEL are generally considered to be acceptable for residential land uses, allowing normal indoor and outdoor residential activities to occur without interruption. In contrast, industrial activities relatively insensitive to noise may be located in a noise environment up to 75 dB CNEL without adverse effects. The following policies reflect the commitment of Yolo County to the above noise-related goals.

1. Areas within the Town shall be designated as noise-impacted if exposed to existing or projected future noise levels exterior to buildings exceeding 60 dB CNEL or the performance standards described in Table Vl-1.
2. New development of residential or other noise· sensitive land uses will not be permitted in noise impacted areas unless effective mitigation measures are incorporated into project designs to reduce noise levels to the following levels:
   a. For noise sources preempted from local control, such as street and highway traffic: 60 dB CNEL or less in outdoor activity areas; 45 dB CNEL within interior living spaces or other noise-sensitive interior spaces. Where it is not possible to achieve reductions of exterior noise to 60 dB CNEL or less by using the best available and practical noise reduction technology, an exterior noise level up to 65 dB CNEL will be allowed. Under no circumstances will interior noise levels be allowed to exceed 45 dB CNEL with windows and doors closed.
   b. For noise from other sources, such as local industries: 60 dB CNEL or less in outdoor activity areas; 45 dB CNEL or less within interior living spaces, plus the performance standards contained in Table Vl-1.
3. New development of industrial, commercial or other noise generating land uses will not be permitted if resulting noise levels will exceed 60 dB CNEL in areas containing residential or other noise-sensitive land uses. Additionally, new noise generating land uses which are not preempted from local noise regulation will not be permitted if resulting noise levels will exceed the performance standards contained in Table Vl-1 in areas containing residential or other noise-sensitive land uses.
4. Noise level criteria applied to land uses other than residential or other noise-sensitive uses shall be consistent with the recommendations of the California Office of Noise Control.
5. New equipment and vehicles purchased by the County, Community Services District and School District for use in Knights Landing shall comply with noise level performance standards consistent with the best available noise reduction technology.

**Table 3.7-2. Exterior Noise Level Performance Standards[a]**

| Decibels | Minutes in any 1-Hr. Time Period | Daytime 7:00 a.m.–10:00 p.m. | Nighttime 10:00 p.m.–7:00 a.m. |
|---|---|---|---|
| 45 | 1 | 30 | 55 |
| 50 | 2 | 15 | 60 |
| 55 | 3 | 5 | 55 |
| 60 | 4 | 1 | 70 |
| 65 | 5 | 0 | 75 |

[a] Each of the noise level standards specified in this table shall be reduced by five (5) dBA for pure tone noises, noise consisting primarily of speech or music, or for recurring impulsive noises. The standards should be applied at a residential or other noise-sensitive land use and not on the property of a noise-generating land use.

### 2005 Yolo County Central Landfill Permit Revision EIR

The YCCL Permit Revision Project provides guidance in terms of noise levels that the county considers to be acceptable.

The YCCL Permit Revision Project proposed a variety of changes to the design and operation of the YCCL, including the purchase of additional land for the development of a soil borrow site. The noise section of the EIR analyzed the potential noise and vibration impacts that could result from the exposure of sensitive receptors to noise generated by activities at a soil borrow site. The following mitigation measures were identified to reduce the potential impacts to a less-than-significant level.

> Mitigation Measure 3.7.2a: As stated in the siting criteria for the soil borrow operation in Chapter 2, Project Description, "Soil-borrow" activities shall be located in areas with a buffer zone of 2,000 feet to the nearest sensitive receptors.
>
> Mitigation Measure 3.7.2b: Soil borrow activities will be limited to achieve an hourly average noise level that does not exceed 65 dBA at the nearest sensitive receptor.
>
> Mitigation Measure 3.7.2c: If haul routes pass sensitive noise receptors that are within approximately 50 feet of the roadway, hourly heavy truck trips should be limited to no more than 25 passbys of the sensitive receptor per hour.
>
> Mitigation Measure 3.7.2d: To avoid noise effects of nighttime operations, haul trips leaving the soil-borrow area shall be limited to 7 a.m. to 5 p.m.

## 3.7.4 Significance Criteria

The following significance criteria are based on NEPA standards and standards of professional practice. For this analysis, an environmental effect related to noise is considered to be significant if the proposed action would result in any of the effects listed below.

- Expose persons to or generate noise levels in excess of standards established in a local general plan or noise ordinance or applicable standards of other agencies.
- Expose persons to or generate excessive groundborne vibration or groundborne noise levels.
- Result in a substantial temporary or periodic increase in ambient noise levels in the vicinity of the action area above levels existing without the proposed action.

## 3.7.5 Environmental Consequences

### 3.7.5.1 No Action

Federal approvals are not required for the No Action Alternative because neither construction nor changes to existing flood gate operation would occur. No change or improvement in operational conditions at the facility would occur. Accordingly, there would be no construction or operational noise effects, including exposure of sensitive receptors to increased noise levels.

### 3.7.5.2 Proposed Action

**Effect NOI-1: Exposure of persons to or generation of noise levels in excess of standards established in a local general plan or noise ordinance or applicable standards of other agencies (less than significant with mitigation)**

#### Construction

As stated in Chapter 2, *Alternatives*, construction staff is expected to work from 7 a.m. to 7 p.m., 5 days per week. Construction of the proposed new concrete wing walls, installation of a metal picket weir, installation of rock slope protection, and the removal of vegetation for construction purposes is anticipated to begin in September of 2015 and continue for approximately 2 months. Construction of these elements of the proposed action would temporarily increase the noise levels at the construction site for the entirety of the construction period.

Table 3.7-3 lists equipment that is expected to be used along with typical noise levels reported in the Federal Highway Administration's Roadway Construction Noise Model (Federal Highway Administration 2006). $L_{max}$ sound levels at 50 feet are shown along with the typical acoustical use factors. The acoustical use factor is the percentage of time each piece of construction equipment is assumed to be operating at full power (i.e., its noisiest condition) during construction and is used to estimate $L_{eq}$ values from $L_{max}$ values. For example, the $L_{eq}$ value for a piece of equipment that operates at full power 50% of the time (acoustical use factor of 50) is 3 dB less than the $L_{max}$ value for that piece of equipment.

**Table 3.7-3. Typical Construction Noise Emission Levels**

| Equipment | Typical $L_{max}$ Noise Level (dBA) at 50 feet | Acoustical Use Factor (%) | $L_{eq}$ Noise Level at 50 feet (dBA) |
|---|---|---|---|
| Crane | 81 | 16 | 73 |
| Pump | 81 | 50 | 78 |
| Tractor | 84 | 40 | 80 |
| Jackhammer | 89 | 20 | 82 |
| Long reach excavator | 81 | 40 | 77 |

Source: Federal Highway Administration 2006.
dBA= A-weighted decibel
$L_{eq}$ = equivalent sound level
$L_{max}$ = maximum sound levels

A reasonable worst-case construction noise level scenario assumes that the three loudest pieces of equipment operate concurrently (tractor, jackhammer, and pump). The combined $L_{max}$ level for these three pieces of equipment is 91 dBA at 50 feet and the $L_{eq}$ level is 85 dBA at 50 feet. The nearest residence is located approximately 130 feet from the construction site. At this distance, this construction noise level would reduce to about 80 dBA $L_{max}$ and 75 dBA $L_{eq}$. Construction noise at the nearest noise sensitive use is assessed using the sound level threshold of 65 dBA (one-hour Leq) as described above in the 2005 YCCL Permit Revision EIR, Mitigation Measure 3.7.2b. Because the predicted $L_{eq}$ noise level is more than 65 dBA, the exposure of existing residents to construction noise would be a significant effect. Mitigation Measure NOI-MM-1 would reduce noise associated with this effect to below the 65 dBA threshold.

As described in Chapter 2, *Alternatives*, during construction there would be increased traffic on SR 45 to reach Road 108 for access to the left bank, and SR 45 to reach the levee-top road on the right bank as a result of material delivery and worker trips. A staging area would be established on top of the right bank, as well as in an empty lot adjacent to a residential area (Figure 2-1). However, this increased traffic would be a small percentage of the existing traffic volume on the local roadways and is expected to result in an increase in noise that is less than 3 dB (i.e., less than perceptible).

**Mitigation Measure NOI-MM-1: Minimize noises from construction**

The County will implement construction practices to limit construction noise to 65 dBA (1-hour $L_{eq}$) at nearby residences. Measures to be employed may include the following.

- Limit onsite truck speed to 5 mph to reduce truck-generated noise.
- Comply with manufacturers' muffler requirements on all construction equipment engines.
- Turn off construction equipment when not in use, where applicable.
- Locate stationary equipment as far as practical from receiving properties.
- Use temporary sound barriers or sound curtain around loud stationary equipment if the other noise reduction methods are not effective or possible.
- Provide advance written notification of construction activities to residences around the construction site.

### Operation

Operation of the proposed action would generate similar levels of noise as the existing KLOG facility. Therefore, there would be no effect related to an increase in noise associated with operation of the proposed action.

**Effect NOI-2: Generation of Excessive Groundborne Vibration or Groundborne Noise Levels (less than significant)**

Typical outdoor sources of perceptible groundborne vibration and noise are construction equipment, steel-wheeled trains, and heavy vehicles over bumps. If the roadways in use are smooth, the groundborne vibration and noise from traffic is rarely perceptible.

The operation of heavy construction equipment can generate localized groundborne vibration at buildings adjacent to the construction site, especially during the operation of high-impact equipment, such as pile drivers. Vibration from nonimpact construction activity and truck traffic is typically below the threshold of residential annoyance when the activity is more than about 50 feet from the noise-sensitive land uses (Federal Transit Administration 2006). The nearest residential uses are located more than 130 feet from the construction site. Additionally, construction of the proposed action would not involve high-impact equipment, such as a pile driver. Therefore, groundborne vibration and noise effects associated with construction of the proposed action would be less than significant.

**Effect NOI-3: A Substantial Temporary Increase in Ambient Noise Levels (less than significant with mitigation)**

As discussed under Effect NOI-1, construction noise could be as high as about 77 dBA $L_{max}$ and 72 dBA $L_{eq}$ at the nearest residences. This would cause an increase in noise above existing conditions. This increase is predicted to cause noise that would exceed the applicable standard of 65 dBA $L_{eq}$ and, therefore, would be significant. Implementation of Mitigation Measure NOI-MM-1 would decrease the effect of temporary noise associated with construction to a less-than-significant level.

# 3.8 Cultural Resources

## 3.8.1 Introduction

This section analyzes the proposed action's potential adverse effects related to cultural resources. It describes existing cultural resources in the study area and summarizes the overall federal, state, and local regulatory framework for cultural resources. Cultural resources-related adverse effects are also discussed along with applicable mitigation. Cultural resources include historic architectural resources (i.e., buildings, structures, or landscapes) and, archaeological resources such as sites, objects, and traditional cultural properties. A more detailed definition of these terms is provided in Section 3.8.3, *Regulatory Setting*.

## 3.8.2 Existing Conditions

This setting section for cultural resources provides an overview of the prehistory and history for the KLOG study area. The following text is from the *Knights Landing Outfall Gate Rehabilitation Project Archaeological Survey Report, Yolo County, California*, prepared by Rebecca H. Gilbert, California Department of Water Resources (Gilbert 2011: 4-7).

### 3.8.1.1 Prehistory

Very little archaeological work has been conducted in the vicinity of the study area. As a result, a reconstruction of the prehistory must rely on work that has taken place around the city of Sacramento to the south and near the town of Colusa to the north. Although there are suggestions of at least 10,000 years of occupation in Central California, there is no evidence to indicate habitation of the Sacramento Valley before about 3,500 years ago. This is likely due to rapid sedimentation of the valley from flood events

Investigations of the Sacramento Valley sites began during the 1930s when Sacramento Junior College and the University of California, Berkeley worked together on archaeological projects. At that time a number of sites were excavated along the Cosumnes River in the northern Delta and in Colusa County. As a result of those efforts and subsequent studies in the region, a tripartite cultural sequence was established. Three horizons were delineated: Early, Middle, and Late, with respective initial dates of 2,500 B.C., 1,500 B.C., and 500 A.D.

Additional research over the years has led to a refinement of dates and the realization that basic socioeconomic and technical trends or patterns were found over a broad region, but that these patterns could last for different lengths of time in localized areas and were reflected by various expressions of material culture. The revised cultural chronology, with rough dates associated with the study area vicinity, is identified by the Windmiller Pattern, the Berkeley Pattern, and the Augustine Pattern.

The Windmiller Pattern dominated the region from approximately 5,000 to 2,500 years before present (B.P.). Relative to subsequent periods, Windmiller subsistence appears to have focused largely on hunting, as evidenced by large quantities of faunal remains and projectile points in the archaeological record. However, there is also evidence of fishing and seed procurement. With regard to tool technology, both flaked stone and ground stone industries are well represented. Acquisition of raw materials for tool and ornament production was facilitated by a vast trade network, in which obsidian was obtained from North Coast Range and eastern Sierran sources, shell beads from the coast, and quartz and alabaster from the Sierra foothills. The Windmiller Pattern is also characterized by distinctive burial patterns, with bodies typically buried fully extended, face down, with the head oriented toward the west, and the placement of funerary objects in the grave.

The Berkeley Pattern was present in the Central Valley from approximately 3,600 to 1,000 years B.P. This pattern is represented by an apparent increase in the use of pestles and mortars, which is thought indicative of an intensified reliance on acorns as a principal dietary staple. In addition, the Berkeley Pattern exemplifies a well-developed bone industry, distinctive diagonal flaking of large concave-base points, and marked forms of shell beads and ornaments. In contrast to the Windmiller pattern, Berkeley burials are found in a flexed position with variable orientation and fewer funerary artifacts.

The Augustine Pattern occurred in the Central Valley from approximately 2,000 to 250 years B.P. This pattern is distinguished by large populations with complex social systems that depended heavily upon fishing, hunting, and gathering. Tool technology is represented by shaped pestles and mortars, bone awls, the bow and arrow, and in some cases pottery. There was considerable variation in mortuary practices, including flexed burials, cremation, and funerary object differentiation.

### 3.8.1.2 Ethnography

The study area is in a region historically occupied by the Valley Patwin. The Patwin held lands throughout the Sacramento Valley from Suisun and San Pablo Bays in the south to Princeton in the north, including the west bank of the Sacramento River just south of Knights Landing and extending further north. They also held lands in the lower Napa Valley. The Patwin they were closely related linguistically to the Nomlaki and culturally to the Wintu, both of whom resided directly to the north. They were closer still to their Hill Patwin kindred who lived in the Coast Range Mountains to the east.

The Patwin people inhabited large villages, predominately along the Sacramento River. The largest political entity was the tribelet, which consisted of one primary and several satellite villages, each of which was headed by a chief.

### 3.8.1.3 History

The Sacramento Valley in the study area vicinity was visited by the Spanish in the early 1800s. Gabriel Moraga was the first to explore up the Sacramento River in 1808. He was later followed by the companies led by Luis Arguello in 1817 and again in 1821. Euro-American trappers explored the valley during the 1820s and 1830s, which caused diseases to spread to indigenous villages and decimate the native populations.

The Mexican government continued the earlier Spanish practice of granting large land tracts, or rancheros, to loyal Californios. The first ranchos in Yolo County were established in the early 1840s. These included the Rancho Rio de Jesus Maria, which occupied 27,000 acres from Cache Creek to the north and the Sacramento River to the east in the study area, including land directly opposite the confluence of the Feather and Sacramento Rivers. This rancho was granted to Thomas Hardy in 1843. A portion of the rancho was purchased by James Harbin who established the first town, Fremont, in Yolo County in 1849. Fremont was located at the confluence of the Sacramento and

Feather Rivers and became the first county seat in 1850. However, as the result of flood damage, the town was virtually abandoned in less than a decade.

Although the region was prone to flooding and often swampy, agriculture was, and continues to be, the primary economic base for the area. The ability to successfully grow crops in the rich soil was enhanced in the early 1900s as hundreds of miles of levees were constructed to control flooding in the Sacramento Valley. Numerous public works, such as the Knights Landing Ridge Cut, the Fremont and Sacramento Weirs, and the Yolo Bypass, were built as the result of the SRFCP.

The KLOG is located on the western border of the town of Knights Landing within the CBD. The CBD provides drainage for flood water and agricultural runoff and is also a water supply for irrigation. The KLOG also prevents Sacramento River floodwater from flooding the CBD when water levels are high. The KLOG structure was originally built by local interests sometime during either 1914 or 1915. It consisted of a concrete slab floor 84 feet wide with abutments at either side, 30 feet high. Two gate leaves constructed of timber and held together with straps and bolts closed the space between the abutments. During 1929 and 1930 the timber gate leaves were replaced with a permanent concrete buttress to support new steel flap gates. New control gates replaced the steel flap gates in 1949. In 1985 the manual gates were replaced with automated actuators to maintain a set water surface elevation on the upstream side of the structure.

# 3.8.3 Regulatory Setting

## 3.8.3.1 Federal

### National Environmental Policy Act

As amended, NEPA (42 USC Sections 4321–4347) establishes a federal policy of protecting important historic, cultural, and natural aspects of our national heritage during federal project planning. All federal or federally assisted projects requiring action pursuant to Section 102 of NEPA must take into account the effects on cultural resources. The President's Council on Environmental Quality (CEQ) has adopted regulations and other guidance that provide detailed procedures that federal agencies must follow to implement NEPA. However, the CEQ has not adopted regulations or other guidance that establish procedures for addressing cultural resources, specifically. In 2013, CEQ and the Advisory Council on Historic Preservation (ACHP) issued guidance on integrating NEPA and Section 106 of the NHPA. This guidance reflects a long-standing practice of incorporating the Section 106 technical findings into NEPA to address project impacts on historic and cultural resources, and provides options for coordinating or, if planned in advance, substituting Section 106 and NEPA reviews.

### Section 106 of the National Historic Preservation Act

Section 106 of the NHPA (54 USC §306108) requires that effects to historic properties be taken into consideration in any federal undertaking. "Historic property means any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places (NRHP) maintained by the Secretary of the Interior. This term includes artifacts, records, and remains that are related to and located within such properties. The term includes properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization that meet the NRHP criteria" [36 CFR Part 800.16(l)]. Implementing regulations at 36 CFR Part 800 outline the process whereby federal agencies, in consultation with the State Historic Preservation Officer (SHPO) and other consulting parties, identify historic properties within the Area of Potential Effects (APE) of the proposed action and make a finding of effect. If the proposed action is determined to have an adverse effect on historic properties, the federal agency is required to consult further with SHPO and the Advisory Council on Historic Preservation to develop methods to resolve the adverse effects. The Section 106 process has six basic steps.

1. Initiate the Section 106 process, including the identification of consulting parties, such as Native American tribes.
2. Identify the APE, in consultation with the SHPO and other consulting parties.
3. Identify if any historic properties are located in the APE.
4. Assess the effects of the undertaking on historic properties within the APE.
5. If historic properties may be subject to an adverse effect, the federal agency, the SHPO, and any other consulting parties (including Native American tribes and the ACHP) continue consultation to seek ways to avoid, minimize, or mitigate the adverse effect. A Memorandum of Agreement (MOA) is usually developed to document the measures agreed upon to resolve adverse effects. Alternatively, the federal agency may prepare and execute a Programmatic Agreement (PA) with the aforementioned parties to comply with 36 CFR Part 800, particularly in the context of complex undertakings that entail years of implementation actions or where the undertaking's effects on historic properties cannot be well characterized during the planning phase.
6. Proceed in accordance with the terms of the MOA or PA.

## Criteria for Eligibility for the National Register of Historic Places

Cultural resources are eligible for the NRHP if they have integrity and significance as defined in the regulations for the NRHP. Four primary criteria define significance; a property may be significant if it meets one or more of the following characteristics:

A. It is associated with events that have made a significant contribution to the broad pattern of our history; or

B. It is associated with the lives of people significant in our past; or

C. It embodies the distinct characteristics of a type, period, or method of construction, or that represents the work of a master, or that possesses high artistic values, or it represents a significant and distinguishable entity whose components may lack individual distinction; or

D. It has yielded, or is likely to yield, information important in prehistory or history (36 CFR 60.4).

Some types of cultural resources are not typically eligible for the NRHP. These resources consist of cemeteries, birthplaces, graves of historical figures, properties owned by religious institutions or used for religious purposes, structures that have been moved from their original locations, reconstructed historic buildings, properties primarily commemorative in nature, and properties that have achieved significance within the past 50 years. These property types may be eligible for the NRHP, however, if they are integral parts of eligible districts of resources or meet the criteria considerations described in 36 CFR 60.4.

In addition to possessing significance, a property must also have integrity to be eligible for listing in the NRHP. The principle of integrity has seven aspects: location, design, setting, materials, workmanship, feeling, and association (36 CFR 60.4). To retain historic integrity, a property will always possess several, and usually most, of the qualities of integrity (U.S. Department of the Interior 1995:44).

### 3.8.3.2 State

The following state regulations related to cultural resources apply to CVFPB and RD 108's implementation, construction, operation, and maintenance of the proposed action.

#### California Environment Quality Act

CEQA requires that public agencies that finance or approve public or private projects must assess the effects of the project on cultural resources. CEQA requires that projects resulting in significant effects to significant cultural resources consider alternative plans or mitigation measures. A project that causes a substantial adverse change in the significance of an historical resource is a project that may have significant impact under CEQA (State CEQA Guidelines Section 15064.5[b]). A substantial adverse change in the significance of an historical resource means physical demolition, destruction, relocation, or alteration of the resource or its immediate surroundings such that the significance of an historical resource would be materially impaired. The significance of an historical resource is materially impaired if the project demolishes or materially alters any qualities as follows.

- Qualities that justify the inclusion or eligibility for inclusion of a resource on the CRHR (State CEQA Guidelines Section 15064.5[b][2][A],[C]).
- Qualities that justify the inclusion of the resource on a local register (State CEQA Guidelines Section 15064.5[b][2][B]).

Two categories of cultural resources are specifically called out in the State CEQA Guidelines. The categories are historical resources (State CEQA Guidelines Section 15064.5[b]) and unique archaeological sites (State CEQA Guidelines 15064.5[c]; California Public Resources Code [PRC] Section 21083.2). In most situations, resources that meet the definition of a *unique archaeological resource* also meet the definition of a *historical resource*. As a result, it is current professional practice to evaluate cultural resources for significance based on their eligibility for listing in the California Register of Historical Resources (CRHR).

*Historical resources* are those meeting the following requirements.

- Resources listed in or determined eligible for listing in the CRHR (State CEQA Guidelines Section 15064.5[a][1]).
- Resources included in a local register as defined in PRC Section 5020.1(k), "unless the preponderance of evidence demonstrates" that the resource "is not historically or culturally significant" (State CEQA Guidelines Section 15064.5[a][2]).
- Resources that are identified as significant in surveys that meet the standards provided in PRC Section 5024.1[g] (State CEQA Guidelines Section 15064.5[a][3]).
- Resources that the lead agency determines are significant, based on substantial evidence (State CEQA Guidelines Section 15064.5[a][3]).

*Unique archaeological resources*, on the other hand, are defined in PRC Section 21083.2 as a resource that meets at least one of the following criteria.

- Contains information needed to answer important scientific research questions and there is a demonstrable public interest in that information.
- Has a special and particular quality such as being the oldest of its type or the best available example of its type.
- Is directly associated with a scientifically recognized important prehistoric or historic event or person. (PRC Section 21083.2[g])

The process for identifying historical resources is typically accomplished by applying the criteria for listing in the CRHR (14 CCR Section 4852). This section states that a historical resource must be significant at the local, state, or national level under one or more of the following four criteria.

1. It is associated with events that have made a significant contribution to the broad patterns of California's history and cultural heritage.
2. It is associated with the lives of persons important in our past.
3. It embodies the distinctive characteristics of a type, period, region, or method of construction, or represents the work of a master or possesses high artistic values.
4. It has yielded, or may be likely to yield, information important in prehistory or history.

To be considered a historical resource for the purpose of CEQA, the resource must also have *integrity*. Integrity is the authenticity of a resource's physical identity, evidenced by the survival of characteristics that existed during the resource's period of significance. Resources, therefore, must retain enough of their historic character or appearance to be recognizable as historical resources and to convey the reasons for their significance. Integrity is evaluated with regard to the retention of location, design, setting, materials, workmanship, feeling and association. It must also be judged with reference to the particular criteria under which a resource is eligible for listing in the CRHR (14 CCR 14 Section 4852[c]). Integrity assessments made for CEQA purposes typically follow the National Park Service guidance used for integrity assessments for National Register of Historic Places (NRHP) purposes.

Even if a resource is not listed or eligible for listing in the CRHR, in a local register of historical resources, or identified in an historical resource survey, a lead agency may still determine that the resource is an historical resource as defined in PRC Section 5020.1j or 5024.1 (State CEQA Guidelines Section 15064.5[a][4]).

## State Law Governing Human Remains

California law sets forth special rules that apply where human remains are encountered during proposed action construction. As set forth in State CEQA Guidelines Section 15064.5[e], in the event of the accidental discovery or recognition of any human remains in any location other than a dedicated cemetery, no further excavation or disturbance of the site or any nearby area suspected of overlying adjacent human remains should take place until the following measures are implemented.

1. The coroner of the county in which the remains are discovered is contacted to determine that no investigation of the cause of death is required (as required under California Health and Safety Code [CHSC] Section 7050.5).
2. If the coroner determines the remains to be Native American:

a. The coroner will contact the Native American Heritage Commission (NAHC) within 24 hours.

b. The NAHC will identify the person or persons it believes to be the most likely descended from the deceased Native American.

c. The most likely descendent may make recommendations to the landowner or the person responsible for the excavation work, for means of treating or disposing of, with appropriate dignity, the human remains and any associated grave goods (as provided in PRC Section 5097.98).

d. Where the following conditions occur, the landowner or his authorized representative will rebury the Native American human remains and associated grave goods with appropriate dignity on the property in a location not subject to further subsurface disturbance.

   1) The NAHC is unable to identify a most likely descendent or the most likely descendent failed to make a recommendation within 24 hours after being notified by the commission.

   2) The descendant identified fails to make a recommendation.

   3) The landowner or his authorized representative rejects the recommendation of the descendant, and the mediation by the NAHC.

### 3.8.3.3 Local

The regulatory context for local conditions is summarized from the 2009 County of Yolo *2030 Countywide General Plan* and provides the regulatory context for local conditions, which applies to CVFPB and RD 108's implementation, construction, operation, and maintenance of the proposed action.. The 2030 Countywide General Plan includes an Open Space Element that incorporates background information, a policy framework, and an implementation program for Cultural Resources. According to the plan, Yolo County cultural resources include archaeological, paleontological and historic resources, including cemeteries and burials outside of cemeteries. Yolo County has examples of all of these, including prehistoric Native American sites, fossilized dinosaur remains, and historical man-made artifacts, buildings, sites and landmarks. The policy framework includes policies for the identification of important cultural resources, encouragement of preservation of cultural and historic resources on private property, promotion of historic preservation and heritage tourism, consultation with culturally affiliated tribes to address tribal resources during development projects, and to ensure compatibility of permitted land use activities across planning documents.

## 3.8.4 Methods

### 3.8.4.1 Records Search

A California Historical Resources Information System records search was conducted at the Northwest Information Center, Sonoma State University, Rohnert Park, on April 30, 2015. The records search compiled bibliographic references, previous survey reports, historic maps, and archaeological site records pertinent to the proposed action in order to identify prior archaeological studies and known cultural resources within 0.25 mile of the study area.

Thirteen previous cultural resources studies have covered portions of the study area and vicinity. The majority of these studies focused on the Sacramento River, CBD, SR 45, County Road 16, and SR 113.

The records search identified no previously recorded archaeological resources within the study area. Segments of the CBD canal (P-57-000705/CA-YOL-240H) and the Knights Landing Ridge Cut (P-57-00706/CA-YOLO-241H), within the records search buffer (outside of the APE) have been previously recorded and evaluated as ineligible for listing in the NRHP. The KLOG crosses over the associated CBD canal/levee. The KLOG structure, and a small portion of the CBD canal/levee (P-57-000705/CA-YOL-240H) are located in the study for this project, and were formally evaluated as part of the technical study prepared as part of this project.

#### 3.8.4.2 Additional Background Research

RD 108 and DWR provided property-specific information, including historic era photographs and as-built plans of the KLOG structure.

#### 3.8.4.3 Field Survey

A field survey of the study area was conducted by an ICF archaeologist and historian on May 13, 2015. The only historic era resources identified in the study area were the KLOG structure and a portion of the CBD canal/levee. As part of the field survey process, an ICF historian visually inspected, photographed, and took notes on this structure.

Although the location has been highly affected by travel, farming, construction (levee, gates, and canal), and recreation (fishing), a prehistoric archaeological site (ICF-01) was identified during the survey. Cultural materials observed at the site include dietary whole half shell and fragmented freshwater mussel shell, fire affected rock, obsidian flakes, and shell beads.

#### 3.8.4.4 Consultation with Native Americans and Other Interested Parties

On April 29, 2015, ICF sent a letter to NAHC requesting that it consult its sacred lands file and send a list of individuals and organizations that may have knowledge of properties of cultural or religious importance to Native Americans in the area of potential effects and vicinity. A follow-up email to the April 29 fax request was sent to the NAHC on May 4, 2015. As of August 20, 2015, a response had not yet been received. On May 19, 2015, individual consultation letters regarding the proposed action were mailed with certified response preferences to a list of Native American individuals and organizations who may have interest in the proposed action. USACE staff sent letters to these contacts again on July 17, 2015, and will coordinate as necessary with interested parties.

On May 6, 2015, ICF sent contact letters to the Yolo County Historical Society, Yolo County Historical Museum, and the California Institute for Rural Studies. The letters briefly described the proposed action and requested information about cultural resources near the proposed study area. As of August 20, 2015, ICF had not received any responses.

### 3.8.5 Findings for Cultural Resources

ICF has prepared a detailed cultural resources technical report that can be made available upon request (ICF International 2015). Sensitive information on archaeological resources located within the vicinity of the study area will not be included in the copy of the technical report made available for the public. Below is a summary of findings for cultural resources located in the KLOG study area.

#### 3.8.5.1 Archaeological Resources in the Study Area

ICF-01 is a prehistoric archaeological site identified during the May 13, 2015 pedestrian survey. The site consists of dietary remains including freshwater mussel and clam shell, fire cracked rock, obsidian flake debitage, and shell bead jewelry. The current site size is approximately 0.5 acre; it is approximately 80 feet wide, east to west, and approximately 340 feet long northeast to southwest. The proposed action APE has been adjusted to exclude the recorded location of the site.

#### 3.8.5.2 Historic Architectural Resources in the Study Area

Two historic era structures, the KLOG structure and a small portion of the CBD canal/levee (P-57-000705/CA-YOL-240H), are more than 50 years old and initially required evaluation under NRHP criteria as part of this study. These resources were found to be ineligible for listing in the NRHP. As such, the resources are therefore not considered historic properties for purposes of NEPA. Consequently, the proposed action would have no effect on historic architectural cultural resources. Below are summaries of the NRHP evaluations. Detailed records and NRHP evaluation can be found in the ICF cultural resources technical report as noted above and can be made available upon request (ICF International 2015).

##### Knights Landing Outfall Gate

The KLOG structure is an 84-foot-wide concrete slab apron with a 6-foot-high wing wall on each side. The structure has a concrete buttress with eight 66-inch and two 42-inch screw-operated slide gates on the Colusa Drain side, and eight 66-inch and two 42-inch combination flap and slide gates on the Sacramento River side. Constructed in 1915, the KLOG structure has an association with the construction of the CBD (1911), and the Knight Landing Ridge Cut (1915), which were important regional flood control projects. The KLOG was first constructed to serve three essential purposes: 1) prevent water from the Sacramento River from flowing into the Colusa Basin; 2) direct all drainage from the Colusa Basin into the Yolo Bypass through the Knights Landing Ridge Cut: and 3) provide a bridge to cross the nearby slough. Consequently, the KLOG could be considered significant under NRHP criterion A for its association with the construction and implementation of the CBD (1911), and the Knight Landing Ridge Cut (1915).

The KLOG structure does not appear to be eligible for listing under NRHP criterion B. It is a component of a larger flood control and irrigation system and represents the collective efforts of many individuals, rather than the work of any single individual. Thus, the KLOG structure is not directly associated with individuals' important achievements in local, state, or national history.

Regarding NRHP Criterion C, the structure is not innovative in its design, form, or function. Gate structures and components of larger flood control and irrigation systems are common throughout California. As a component of such a system, the KLOG structure represents an undistinguished example of a gate control structure constructed in 1913 and does not appear to be important for its design or construction value. Therefore, the subject property does not appear to meet NRHP Criterion C. Furthermore, the subject property does not appear to have the potential to yield more information about flood control technology during the early twentieth century. Therefore, the subject property does not appear to be eligible under NRHP Criterion D.

Lastly, the KLOG structure has been reconstructed since it was originally constructed in 1915. Specifically, the modifications between 1929 and 1986, when the gates were reconstructed have resulted in major alterations. Overall, the resource has been modified to the extent that it appears to be a structure built in the latter half of the twentieth century, not 1915 when it was originally constructed. These significant alterations have diminished its ability to convey its historical significance as a component of the Knights Landing Ridge Cut project. Despite its association with Knights Landing Ridge Cut project (under NRHP Criterion A), the significant loss of historic integrity precludes it from listing as an individual or contributing resource under any NRHP criteria. The KLOG is therefore not considered a historic property for purposes of NEPA.

### CBD canal/levee (P-57-000705/CA-YOL-240H)

The CBD is located in Knights Landing along the western boundary of the town. The CBD canal is earthen and flanked by east and west levee structures. The canal/levee runs in a northeast direction. Both levees are earthen and from crown to crown are 314 feet apart. County Road 108, which is paved, runs along the west levee crown.

Under NRHP Criterion A, the west levee structure, which has been incorporated as part of the overall CBD system, is likely associated with early reclamation and flood control efforts initiated in the 1870s. The canal was likely initially constructed as part of the Knights Landing Ridge Cut in 1913 and utilized as part of the dredge cut work for that project. The east levee was likely completed by the USACE in by the mid to late 1950s as a result of construction related to the Sacramento River Flood Control Project. Overall, the components that comprise the CBD system are essentially infrastructure representative of several efforts to provide and enhance flood control and water conveyance in the Knights Landing region starting in the 1870s and though the 1950s. As such, the CBD system might be considered significant under NRHP Criterion A for its association with trends and/or events that have made a significant contribution to the broad patterns of our history, particularly in regional flood control, reclamation, and development of water conveyance.

While these systems may have influenced the growth of local economies and agricultural ventures, this is too common an association to merit a conclusion of historical significance under NRHP Criterion A. At some point in the past, all forms of historic-era infrastructure were associated locally or regionally with growth and/or development, actual or intended. It is often exceedingly difficult to prove whether historic-era infrastructure associated with recognizable growth actually caused the growth or accommodated the growth. Consequently, CBD canal/levee does not appear eligible under NRHP Criterion A.

To be found eligible under NRHP Criterion B, the property has to be directly tied to an important person and the place where that individual conducted or produced the work for which he or she is known. The CBD canal and levee are components of a flood control and water conveyance system. The combined structures represent the collective efforts of several individuals and organizations rather than the work of any single individual. Consequently, the CBD canal/levee is not directly associated with individuals' important achievements in local, state, or national history. Therefore, it does appear to be eligible for listing under NRHP Criterion B.

Regarding NRHP Criterion C, the structure is not innovative in its design, form, or function. Components of flood control and irrigation systems are commonly found throughout California's agricultural regions where flood control systems have been established and subsequently expanded. Components of these systems featured standardized designs and were built using a similar method of construction. As a component of such a system, the subject property represents an undistinguished example of earthen levees and canal structures initiated in the late 1800s with expansion and improvements made through the mid twentieth century. The CBD canal/levee does not appear to be significant for its design and does not appear to meet NRHP Criterion C. Moreover, the subject property does not appear to have the potential to yield more information about the design of earthen levees or canals. Therefore, CBD canal/levee the subject property does not appear to be eligible under NRHP Criterion D.

Finally, the components that comprise the CBD Canal/levee have been modified to the extent that they no longer retain historic integrity. The structure as it currently exists and functions is representative of a conglomeration of flood control projects that began in the 1870s and continued though at least the 1950s. The significant loss of historic integrity precludes it from listing as an individual or contributing resource under any NRHP criteria. Ultimately, lacking historical and engineering significance, as well as integrity, the CBD canal/levee does not appear to meet the NRHP criteria. The CBD canal/levee is therefore not considered a historic property for purposes of NEPA.

## 3.8.6 Significance Criteria

For this analysis, an effect pertaining to cultural resources was analyzed under NEPA if it would result in any of the following environmental effects, which are based on NEPA standards and standards of professional practice.

### Federal Criteria

According to 36 CFR 800.5, an undertaking would have an adverse effect on historic properties if the effect alters the characteristics that make a property eligible for inclusion in the NRHP. Such effects also would be considered adverse under NEPA. Adverse effects can occur when prehistoric or historic archaeological sites, structures, or objects listed in or eligible for listing in the NRHP are subjected to the following:

- physical destruction of or damage to all or part of the property.

## 3.8.7 Environmental Consequences

### 3.8.7.1 No Action

Under the No Action Alternative, it is presumed that no ground-disturbing activities associated with the construction of a positive fish barrier would take place on the downstream side of the existing KLOG in the CBD would occur and there would be no resulting effect on cultural resources. A small amount of riprap will be placed on the right bank of the CBD immediately downstream of the KLOG (proposed action)

### 3.8.7.2 Proposed Action

No historic architectural cultural resources that qualify as NRHP historic properties are located in or near the study area. Therefore, there would be no effect on historic architectural cultural resources.

**Impact CUL-1: Change in the Significance of an Archaeological Historic Property**

An archaeological inventory identified one prehistoric archaeological site, ICF-01, in the study area vicinity. The possibility exists that buried archaeological resources that may meet the definition of archaeological historic properties are also present in the study area. If ICF-01 is damaged during construction or if any buried resources are encountered and damaged during construction, the destruction of the archaeological resources would be a potentially significant impact. Implementation of Mitigation Measures CUL-MM-1, CUL-MM-2, and CUL-MM-3 would reduce this impact.

**Mitigation Measure CUL-MM-1a: Implement Measures to Protect Known Archaeological Resources**

- No proposed action related work, including staging or any ground-disturbing activities, shall take place in or within 50-feet of archaeological site ICF-01. Road 108 may be used for access. All potential proposed action-related traffic will be confined to the pavement.
- ESA fencing shall be installed with a 50-foot buffer around the known boundaries of archaeological site ICF-01. Installation shall take place under direct supervision of a qualified archaeologist.
- A qualified archaeologist will intermittently inspect the archaeological site and the integrity of the fence throughout the duration of the proposed action.

**Mitigation Measure CUL-MM-1b: Conduct Mandatory Cultural Resources Awareness Training for All Construction Personnel**

Before any ground-disturbing work (including vegetation clearing, grading, and equipment staging) commences, a qualified archaeologist will conduct a mandatory cultural resources awareness training for all construction personnel. The training will cover the cultural history of the area, characteristics of archaeological sites, applicable laws, and the avoidance and minimization measures to be implemented. Proof of personnel attendance will be provided to overseeing agencies as appropriate. If new construction personnel are added to the proposed action, the contractor will ensure that the new personnel receive the mandatory training before starting work.

**Mitigation Measure CUL-MM-1c: Implement Measures to Protect Previously Unidentified Archaeological Resources**

Construction shall stop if potential archaeological resources are encountered. It is possible that previous activities have obscured surface evidence of archaeological resources. If signs of an archeological site, such as any unusual amounts of stone, bone, or shell, are uncovered during grading or other construction activities, work will be halted within 100 feet of the find and the lead federal agency professionally qualified staff and Yolo County Public Works Department will be notified. A qualified archeologist will be consulted for an onsite evaluation. If the site is or appears to be eligible for listing on the NRHP, additional mitigation, such as further testing for evaluation or data recovery, may be necessary.

In the event resources are discovered, RD 108 will retain a qualified archaeologist to assess the find and to determine whether the resource requires further study. Any previously undiscovered resources found during construction will be recorded on appropriate California Department of Parks and Recreation 523 forms and evaluated for significance under all applicable regulatory criteria.

All work will stop in the immediate vicinity of the find. If the find is determined to be an important cultural resource, RD 108 will make available contingency funding and a time allotment sufficient to allow recovery of an archaeological sample or to implement an avoidance measure. Construction work can continue on other parts of the proposed action while archaeological mitigation takes place.

### Impact CUL-2: Disturbance of Human Remains

There are no known formal cemeteries within the study area, and neither the results of the records search nor the pedestrian survey indicate that human remains are present in the study area. However, there is always the possibility that ground-disturbing activities during construction may uncover previously unknown buried human remains, which would be a potentially significant impact. Implementation of Mitigation Measure CUL-MM-4 would reduce this impact.

#### Mitigation Measure CUL-MM-2: Implement Measures if Construction Activities Inadvertently Discover or Disturb Human Remains

If human remains are discovered during any phase of construction, including disarticulated or cremated remains, the construction contractor will immediately cease all ground-disturbing activities within 100 feet of the remains and notify RD 108.

In accordance with CHSC Section 7050.5, no further disturbance will occur until the following steps have been completed.

- The Yolo County Coroner has made the necessary findings as to origin and disposition pursuant to PRC Section 5097.98.
- If the remains are determined by the County Coroner to be Native American, the Coroner shall notify NAHC within 24 hours.

A professional archaeologist with Native American burial experience will conduct a field investigation of the specific site and consult with the Most Likely Descendant (MLD), if any, identified by NAHC. As necessary and appropriate, a professional archaeologist may provide technical assistance to the MLD, including the excavation and removal of the human remains.

# 3.9 Hazards and Hazardous Materials

## 3.9.1 Introduction

This section analyzes the proposed action's potential effects related to hazardous, toxic, and radiological wastes. It describes existing hazard-related conditions in the action area and summarizes the overall Federal, state, and local regulatory framework for hazards and hazardous materials. Hazards-related environmental effects also are discussed and applicable mitigation proposed.

Hazardous materials and wastes are those substances that, because of their physical, chemical, or other characteristics, may pose a risk of endangering human health or safety or of endangering the environment (CHSC Section 25260). Types of hazardous materials include petroleum hydrocarbons, pesticides, and volatile organic compounds. Hazardous materials that would be used during construction activities for the proposed action include diesel fuel and other liquids in construction equipment.

## 3.9.2 Existing Conditions

### 3.9.2.1 Hazardous Materials

While no known hazardous materials sites are located within the action area, two hazardous materials sites are located within a 0.25-mile radius (State Water Resources Control Board 2015). The first site, "Plug-n-Jug Market" (T06113922828), is located at the corner of Locust Street and 5th Street in Knights Landing. The site has been cleaned up and its status is "complete—case closed." The second site, "Interstate Oil Knights Landing" (T10000000188), is located at the corner of Locust Street and 6th Street and is considered to be an open case. The site is approximately 1,000 feet from the action area and is in the process of being assessed for benzene, diesel, and gasoline.

### 3.9.2.2 Wildland Fires

The area surrounding the action area is not considered a fire-prone area.

### 3.9.2.3 Emergency Response and Evacuation

The Yolo County Sheriff's Department provides law enforcement services, and the Knights Landing Fire Department provides fire and emergency medical services.

### 3.9.2.4 Schools

The Science and Technology Academy charter school is located within 0.25 mile of the construction site and is located at 9544 Mill Street in Knights Landing.

# 3.9.3 Regulatory Setting

## 3.9.3.1 Federal

The principal Federal regulatory agency responsible for the safe use and handling of hazardous materials is the EPA. Two key Federal regulations pertaining to hazardous wastes are described below. Other applicable Federal regulations are contained primarily in CFR Titles 29, 40, and 49.

The following Federal policies related to public health and environmental hazards may apply to the implementation of the proposed action.

### Resource Conservation and Recovery Act

The Federal Resource Conservation and Recovery Act enables EPA to administer a regulatory process that extends from the manufacture of hazardous materials to their disposal, thus regulating the generation, transportation, treatment, storage, and disposal of hazardous waste at all facilities and sites in the nation.

### Comprehensive Environmental Response, Compensation, and Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act (also known as Superfund) was passed to facilitate the cleanup of the nation's toxic waste sites. In 1986, the act was amended by the Superfund Amendment and Reauthorization Act Title III (community right-to-know laws). Title III states that past and present owners of land contaminated with hazardous substances can be held liable for the entire cost of the cleanup, even if the material was dumped illegally when the property was under different ownership.

## 3.9.3.2 State

California regulations are equal to or more stringent than Federal regulations. EPA has granted the State of California primary oversight responsibility to administer and enforce hazardous waste management programs. State regulations require planning and management to ensure that hazardous wastes are handled, stored, and disposed of properly to reduce risks to human and environmental health. The following state regulations related to hazards and hazardous materials apply to CVFPB and RD 108's implementation, construction, operation, and maintenance of the proposed action.

### Hazardous Materials Release Response Plans and Inventory Act of 1985

The Hazardous Materials Release Response Plans and Inventory Act, also known as the Business Plan Act, requires businesses using hazardous materials to prepare a plan that describes their facilities, inventories, emergency response plans, and training programs. Hazardous materials are defined as unsafe raw or unused material that is part of a process or manufacturing step. They are not considered hazardous waste. Health concerns pertaining to the release of hazardous materials, however, are similar to those relating to hazardous waste.

### Hazardous Waste Control Act

The Hazardous Waste Control Act created the state hazardous waste management program, which is similar to but more stringent than the Federal Resource Conservation and Recovery Act program.

The act is implemented by regulations contained in Title 26, CCR, which describes the following elements required for the proper management of hazardous waste.

- Identification and classification.
- Generation and transportation.
- Design and permitting of recycling, treatment, storage, and disposal facilities.
- Treatment standards.
- Operation of facilities and staff training.
- Closure of facilities and liability requirements.

These regulations list more than 800 materials that may be hazardous and establish criteria for identifying, packaging, and disposing of such waste. Under the Hazardous Waste Control Act and Title 26, the generator of hazardous waste must complete a manifest that accompanies the waste from generator to transporter to the ultimate disposal location. Copies of the manifest must be filed with the DTSC.

### 3.9.3.3 Local

The following local regulations related to hazards and hazardous materials may apply to CVFPB and RD 108's implementation, construction, operation, and maintenance of the proposed action.

#### County of Yolo General Plan

The Health and Safety Element of the County of Yolo *2030 Countywide General Plan* contains goals aimed at reducing the risks associated with natural and human-made hazards within the county (County of Yolo 2009). Any violation of these goals would constitute a significant effect.

Goal HS-3: Protect the public and reduce damage to property from wildfire hazard.

Goal HS-4: Protect the community and the environment from hazardous materials and waste.

Policy HS-4.1: Minimize exposure to the harmful effects of hazardous materials and waste.

## 3.9.4 Significance Criteria

These effects are based on NEPA standards and standards of professional practice. For this analysis, an environmental effect related to hazardous materials is considered to be significant if the proposed action would result in any of the effects listed below.

- Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials.
- Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment.

## 3.9.5 Environmental Consequences

### 3.9.5.1 No Action

The No Action Alternative represents the continuation of existing conditions. As there are no known hazards or hazardous materials in the action area, there would be no effect relating to hazards or hazardous materials.

### 3.9.5.2 Proposed Action

**Effect HAZ-1: Incidental release of hazardous materials during construction (less than significant with mitigation incorporated)**

Implementation of the proposed action would require the use of hazardous materials, such as fuels and lubricants, to operate construction equipment and vehicles such as an excavator, a cement truck, and dump trucks. Construction contractors would be required to use, store, and transport hazardous materials in compliance with Federal, state, and local regulations during project construction. However, fuels and lubricants could be accidentally released into the environment at the construction site and along haul routes, causing environmental or human exposure to these hazards. Implementation of Mitigation Measure WQ-MM-1, described in Section 3.3, *Hydrology and Water Quality*, would ensure that the risk of accidental spills and releases into the environment, as well as any potential exposure to wet concrete, would be minimized and that this impact would be reduced to a less-than-significant level.

Chapter 4
# Cumulative Effects

## 4.1 Cumulative Effects

The following projects are planned or proposed in the vicinity of the proposed action. These projects have been completed, are in construction, or have been through environmental review, and mitigation or compensation measures have been developed to avoid or reduce any adverse effects to less-than-significant levels.

- **Sacramento River Bank Protection Project**. USACE is responsible for implementation of the Sacramento River Bank Protection Project (SRBPP) in conjunction with its non-Federal partner, CVFPB. The SRBPP is a continuing construction project authorized by Section 203 of the Flood Control Act of 1960. The purpose of this project is to provide protection from erosion to the existing levee and flood management facilities of the SRFCP. To date, project work has been carried out in two phases, and a total of about 820,000 feet of riverbank has been stabilized. Phase I consisted of 435,000 feet, and Phase II's original authorization was for 405,000 feet. An additional 80,000 feet (a supplement to Phase II) has been authorized under the Water Resources Development Act of 2007 and is being supported by a Post Authorization Change Report, Engineering Documentation Report, and EIS/EIR under development. This authorization would be applied by USACE to the Sacramento River and other sites within the SRFCP that are identified as critical levee erosion sites. There are no projects under the SRBPP that are presently under construction immediately adjacent to and upstream of the proposed action.
- **Sacramento River Flood Control System Evaluation, Phase III, Mid-Valley, Contract Area 3**. Phase III of the Mid-Valley Project is part of the Sacramento River Flood Control System Evaluation. The project proposes to repair levees at three sites in Yolo County—all northwest of the city of Sacramento—that have previously required flood fighting or have experienced seepage and boils during previous flood events. Ten other sites have been considered for repair, but are unfunded and are not likely to be repaired in the foreseeable future. The repairs will provide direct flood protection to the towns of Knights Landing, Verona, and Nicholas, and indirect flood protection to the cities of Sacramento and West Sacramento. The repair sites are located along sections of the Knights Landing Ridge Cut, southeast of Knights Landing. Work to be completed includes installation of cutoff walls and levee rehabilitation work to reinforce the land side of the levees. A Finding of No Significant Impact for the project was released on April 18, 2013, and construction is expected to begin in July 2015.

A cumulative effect is the effect on the environment that results from the incremental effect of the action when added to other past, present, and reasonably foreseeable future actions (40 CFR 1508.7). The following analysis focuses on considering the potential for effects identified in Chapter 3, *Affected Environment and Environmental Effects*, to make a considerable contribution to significant cumulative effects. The proposed action would not cause long-term significant effects on the resources discussed in Chapter 3. However, some of the resources have the potential to incur temporary, short-term effects during the construction period. An initial assessment of potential cumulative effects indicated that effects on hydrology and water quality, biological resources, air quality, and GHGs have the potential to contribute to cumulative effects. The potential cumulatively considerable effects on these resources, in combination with potential effects from the local projects described above, are discussed below.

### 4.1.1 Hydrology and Water Quality

Implementation of the proposed action would not alter the course or capacity of the CBD, and would not affect the course or capacity of downstream waterways. Construction of the proposed action could affect water quality in the vicinity of the action area through increases in turbidity and potential spills. However, implementation of the turbidity monitoring environmental commitment and Mitigation Measures WQ-MM-1 and WQ-MM-2 would prevent construction activities from contributing to cumulative effects when considered in conjunction with other projects in the area. Therefore, the proposed action would not have additional cumulative effects related to hydrology or water quality.

### 4.1.2 Biological Resources

Regionally, any losses of riparian habitat and perennial drainages as a result of proposed action implementation are cumulatively considerable because of the current scarcity of these habitats in comparison with their historical extent, the importance of these habitats to wildlife, the potential habitats they provide for special-status plants and animals, and their roles in maintaining water quality.

Construction of the proposed action would have minor effects on riparian habitat and the bank of the CBD, a perennial drainage. Without proposed action-specific mitigation, the losses of the riparian habitat and perennial drainage would contribute to the cumulative effects on these resources. However, implementation of the Mitigation Measure BIO-MM-7, described in Section 3.3, *Biological Resources*, would result in no net loss of riparian habitat and perennial drainage and their functions, and the incremental contribution of the proposed action to effects on riparian habitat and perennial drainages would not be cumulatively considerable. In addition, other projects in the area would be required to implement mitigation and compensation measures that would result in no net loss of riparian habitat and perennial drainages.

### 4.1.3 Air Quality

Construction of the proposed action is not expected to have any long-term effects on air quality because the operational activities are expected to be similar to existing conditions. However, construction would result in short-term, construction-related effects on air quality mainly related to the use of combustion emissions and dust emissions. Implementation of mitigation measures during construction would reduce these emissions to the extent possible. The proposed action would not require a change in the existing land use designations, and therefore long-term projected emissions of criteria pollutants would be the same with or without the proposed action. Also, the proposed action would not result in a significant effect on air quality. However, all air quality effects are cumulative, and the thresholds used by YSAQMD assume cumulative existing ongoing and future development. The minor increase in criteria pollutant emissions associated with construction and operation of the proposed action (see Table 3.5-5 in Section 3.5, *Air Quality*) would not exceed air district thresholds. YSAQMD's thresholds were established to assist the SVAB reach regional attainment with the Federal and state ambient air quality standards. Accordingly, neither construction nor operation of the proposed action would result in a cumulatively considerable or cumulative air quality effect.

### 4.1.4 Climate Change

It is unlikely that a single proposed action would have a significant effect on the environment with respect to climate change. However, the cumulative effect of human activities has been clearly linked to quantifiable changes in the composition of the atmosphere, which in turn has been shown to be the primary cause of global climate change (Intergovernmental Panel on Climate Change 2007). While the emissions of a single project will not cause global climate change, GHG emissions from multiple projects throughout the world could result in a cumulative effect on global climate change.

$CO_2$ is tracked as a contributor to climate change. YSAQMD emission models calculate air emissions based on construction phase and duration, type of equipment and machinery, action area, and other input criteria. The air quality analysis in Section 3.5, *Air Quality*, includes $CO_2$ emissions.

Climate change effects are inherently cumulative and are analyzed as such in Section 3.6, *Climate Change*. Effects related to climate change were determined to be less-than-significant.

# Chapter 5
# Regulatory Framework and Compliance

## 5.1 Introduction

This chapter provides preliminary information on the major requirements for permitting and environmental review and consultation for implementation of the proposed action. Certain local, state, and Federal regulations require issuance of permits before proposed action implementation; other regulations require agency consultation but may not require issuance of any authorization or entitlements before proposed action implementation.

## 5.2 Federal Laws and Regulations

### 5.2.1 American Indian Religious Freedom Act of 1978

The American Indian Religious Freedom Act of 1978 is applicable to Federal undertakings. This act established "the policy of the United States to protect and preserve for American Indians their inherent right of freedom to believe, express, and exercise the traditional religions, including but not limited to access to sites, use and possession of sacred objects, and the freedom to worship through ceremonial and traditional rites" (Public Law 95-431). The American Indian Religious Freedom Act applies to cultural resources.

**Compliance Status: Partial**

A request to the NAHC for potentially interested parties was faxed on April 29, 2015. A follow up email was sent to the NAHC on May 4, 2015. To date, no response has been received from the NAHC. On May 19, 2015, individual consultation letters regarding the proposed action were mailed with certified response preferences to a list of Native American individuals and organizations who may have interest in the proposed action. USACE staff sent letters to these contacts again on July 17, 2015, and will coordinate as necessary with interested parties. Potential effects on sacred sites are discussed in Section 3.8, *Cultural Resources*. Compliance will be complete upon consultation with applicable tribes.

### 5.2.2 Clean Air Act (42 USC 1857 et seq.), as Amended and Recodified (42 USC 7401 et seq.)

The Federal CAA was enacted to protect and enhance the nation's air quality in order to promote public health and welfare and the productive capacity of the nation's population. The CAA requires an evaluation of any Federal action to determine its potential impact on air quality in the proposed action region. California has a corresponding law, which must also be considered during the EIR process.

For specific projects, Federal agencies must coordinate with the appropriate air quality management district as well as with EPA. This coordination would determine whether the proposed action conforms to the CAA.

**Compliance Status: Complete**

The proposed action is not expected to violate any Federal or state air quality standards or impede the attainment of air quality objectives in the local air basins. The proposed action would have no significant adverse effects on the future air quality of the area.

## 5.2.3 Clean Water Act (33 USC 1251 et seq.)

### 5.2.3.1 Section 404

Section 404 of the CWA requires that a permit be obtained from USACE for the discharge of dredged or fill material into "waters of the United States, including wetlands."

**Compliance Status: Partial**

Section 404 of the CWA requires that a permit be obtained from USACE for the discharge of dredged or fill material into "waters of the United States, including wetlands." RD 108 submitted a preliminary jurisdiction determination and a Nationwide Permit Pre-Construction Notification (PCN) form to USACE regulatory staff on May 13, 2015. A revised PCN was provided to USACE regulatory staff on May 29, 2015. A Biological Opinion was issued by USFWS on July 10, 2015, and a Biological Opinion was issued by NMFS on August 10, 2015. Copies of the USFWS and NMFS Biological Opinions are provided as Appendices E and F, respectively. On August 19, 2015, SHPO commented on the proposed action with a finding of *no historic properties affected* pursuant to 36 CFR 800.4(d)(1), and concluded Section 106 of the NHPA consultation. A copy of the SHPO letter is provided as Appendix G. The 404 permit approval is pending a decision document from USACE regulatory staff and a decision on the 408 request.

### 5.2.3.2 Section 401

Under the CWA Section 401, applicants for a Federal license or permit to conduct activities that may result in the discharge of a pollutant into waters of the United States must obtain certification from the state in which the discharge would originate or, if appropriate, from the interstate water pollution control agency with jurisdiction over affected waters at the point where the discharge would originate. Therefore, all projects that have a Federal component and may affect state water quality (including projects that require Federal agency approval [such as issuance of a Section 404 permit]) must also comply with CWA Section 401. In California, the authority to grant water quality certification has been delegated to the State Water Board, and applications for water quality certification under CWA Section 401 are typically processed by the Regional Water Board with local jurisdiction. Water quality certification requires evaluation of potential impacts in light of water quality standards and CWA Section 404 criteria governing discharge of dredged and fill materials into waters of the United States.

**Compliance Status: Complete**

As Section 408 permission and the granting of a Section 404 permit for the proposed action constitute a Federal action that may affect state water quality, a request for certification under CWA Section 401 was submitted to the Regional Water Board on June 3, 2015. The Regional Water Board provided a Section 401 technically conditioned water quality certification on July 29, 2015.

### 5.2.4 Endangered Species Act (33 USC 1251 et seq.)

Section 7 of the ESA requires Federal agencies, in consultation with USFWS and/or NMFS, to ensure that their actions do not jeopardize the continued existence of endangered or threatened species, or result in the destruction or adverse modification of the critical habitat of these species.

**Compliance Status: Complete**

RD 108 submitted biological assessments to USACE on May 13, 2015, for use in formal consultations with USFWS and NMFS for effects on giant garter snake, Sacramento River winter-run Chinook salmon ESU, Central Valley spring-run Chinook salmon ESU, California Central Valley steelhead DPS, and southern DPS of North American green sturgeon. A Biological Opinion was issued by USFWS on July 10, 2015, and a Biological Opinion was issued by NMFS on August 10, 2015. Copies of the USFWS and NMFS Biological Opinions are provided in Appendix E and F, respectively.

### 5.2.5 Executive Order 11988, Floodplain Management

This Executive Order requires USACE to take action to avoid development in the base floodplain unless the development is the only practicable alternative. It also directs proposed actions to reduce the hazards and risk associated with flooding, minimize the effect of floods on human safety, and to restore and preserve the natural and beneficial values of the base floodplain.

**Compliance Status: Complete**

The proposed action would be constructed entirely within the base floodplain. However, the proposed action is water-dependent, and there is no practicable alternative to achieve the purpose and need of the proposed action. Furthermore, construction of the proposed action would not affect the hazards and risk associated with flooding, and there would be no effect on human safety.

### 5.2.6 Executive Order 11990, Protection of Wetlands

Executive Order 11990 (May 24, 1977) requires Federal agencies to prepare wetland assessments for proposed actions located in or affecting wetlands. Agencies must avoid undertaking new construction in wetlands unless no practicable alternative is available and the proposed action includes all practicable measures to minimize harm to wetlands.

**Compliance Status: Complete**

The proposed action is not located in a wetland and would not affect wetlands.

### 5.2.7 Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations

Executive Order 12898 (February 11, 1994) requires Federal agencies to identify and address adverse human health or environmental effects of Federal programs, policies, and activities that could be disproportionately high on minority and low-income populations. Federal agencies must ensure that Federal programs or activities do not directly or indirectly result in discrimination on the basis of race, color, or national origin. Federal agencies must provide opportunities for input into the NEPA process by affected communities and must evaluate the potentially significant and adverse environmental effects of proposed actions on minority and low-income communities during environmental document preparation. Even if a proposed Federal project would not result in significant adverse impacts on minority and low-income populations, the environmental document must describe how Executive Order 12898 was addressed during the NEPA process.

**Compliance Status: Complete**

The proposed action would not significantly affect low-income or minority populations, or have a disproportionate adverse effect on these populations in the action area.

### 5.2.8 Executive Order 13007, Indian Sacred Sites, and the April 29, 1994, Executive Memorandum

Executive Order 13007 (May 24, 1996) requires Federal agencies with land management responsibilities to accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners and avoid adversely affecting the physical integrity of such sacred sites. Where appropriate, agencies are to maintain the confidentiality of sacred sites. Among other things, Federal agencies must provide reasonable notice of proposed actions or land management policies that may restrict future access to or ceremonial use of, or adversely affect the physical integrity of, sacred sites. The agencies must comply with the April 29, 1994, Executive Memorandum, *Government-to-Government Relations with Native American Tribal Governments*.

**Compliance Status: Partial**

A request to the NAHC for potentially interested parties was faxed on April 29, 2015. A follow up email was sent to the NAHC on May 4, 2015. To date, no response has been received. On May 19, 2015, individual consultation letters regarding the proposed action were mailed with certified response preferences to a list of Native American individuals and organizations who may have interest in the proposed action. USACE staff sent letters to these contacts again on July 17, 2015, and will coordinate as necessary with interested parties. Potential effects on sacred sites are discussed in Section 3.8, *Cultural Resources*. Compliance will be complete upon consultation with applicable tribes.

### 5.2.9 Migratory Bird Treaty Act (16 USC 703 et seq.)

The MBTA implements a series of international treaties that provide for migratory bird protection. The MBTA authorizes the Secretary of the Interior to regulate the taking of migratory birds; the act provides that it is unlawful, except as permitted by regulations, "to pursue, take, or kill any migratory bird, or any part, nest or egg of any such bird..." (16 USC 703). This prohibition includes both direct and indirect acts, although harassment and habitat modification are not included unless they result in direct loss of birds, nests, or eggs.

**Compliance Status: Partial**

The proposed action would not affect nesting migratory birds and raptors based on a construction schedule extending from September through October. If construction activities are necessary during the nesting season (February 15 through August 30), preconstruction surveys will be required to identify the location of active special-status and non-special-status migratory bird or raptor nests and appropriate buffers will be implemented according to Mitigation Measure BIO-MM-6 to reduce potential effects on nesting birds and raptors.

### 5.2.10 Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Act establishes a management system for national marine and estuarine fishery resources. This legislation requires that all Federal agencies consult with NMFS regarding all actions or proposed actions permitted, funded, or undertaken that may adversely affect EFH. EFH is defined as "waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." The Magnuson-Stevens Act states that consultation regarding EFH should be consolidated, where appropriate, with the interagency consultation, coordination, and environmental review procedures required by other Federal statutes, such as NEPA, Fish and Wildlife Coordination Act, CWA, and ESA.

**Compliance Status: Complete**

The proposed action is located in an area that has been designated as EFH. As described above under ESA compliance, USACE has conducted formal consultation with NMFS under Section 7. That consultation process includes consideration of and compliance with the Magnuson-Stevens Act to determine effects on EFH. In the Biological Opinion issued on August 10, 2015 (Appendix F), NMFS stated that the proposed action may adversely affect EFH and provided conservation recommendations. RD 108 will comply with the terms of the consultation.

### 5.2.11 National Environmental Policy Act (42 USC 4321 et seq.)

NEPA is the nation's broadest environmental law, applying to all Federal agencies and most of the activities they manage, regulate, or fund that have the potential to affect the environment. It requires Federal agencies to disclose and consider the environmental implications of their proposed actions. NEPA establishes environmental policies for the nation, provides an interdisciplinary framework for Federal agencies to prevent environmental damage, and contains action-forcing procedures to ensure that Federal agency decisionmakers take environmental factors into account.

NEPA requires the preparation of an appropriate document to ensure that Federal agencies accomplish the law's purposes. The President's CEQ has adopted regulations and other guidance that provide detailed procedures that Federal agencies must follow to implement NEPA. This law applies to all environmental resources.

**Compliance Status: Partial**

This document is the instrument for NEPA compliance for the proposed action under the USACE's authority, as described in Chapter 1, *Introduction*, and is intended to support a Finding of No Significant Impact.

### 5.2.12 National Historic Preservation Act

Section 106 of the NHPA requires Federal agencies to evaluate the effects of their undertakings on historic properties, which are those properties listed or eligible for listing on the NRHP. Implementing regulations at 36 CFR Part 800 require that Federal agencies, in consultation with SHPO, identify historic properties within the APE of the proposed action and make an assessment of adverse effects if any are identified. If the proposed action is determined to have an adverse effect on historic properties, the Federal agency is required to consult further with SHPO and the Advisory Council on Historic Preservation to develop methods to resolve the adverse effects.

**Compliance Status: Complete**

The evaluation of cultural resources presented in this EA complies with the NHPA. Research (literature and archival research) and field surveys in the APE are summarized in Section 3.8, *Cultural Resources*. A separate cultural resources report was submitted to USACE on July 17, 2015, for use in Section 106 consultation with SHPO. On August 19, 2015, SHPO commented on the proposed action with a finding of *no historic properties affected* pursuant to 36 CFR 800.4(d)(1), and concluded Section 106 of the NHPA consultation.

### 5.2.13 River and Harbors Appropriation Act of 1899, Section 14 (Section 408)

Under Section 14 of the Rivers and Harbors Appropriation Act (33 USC 408, commonly referred to as Section 408), temporary or permanent alteration, occupation, or use of any public works, including levees, for any purpose is only allowable with the permission of the Secretary of the Army. Under the terms of 33 USC § 408, any proposed levee modification requires a determination by the Secretary that the proposed alteration, permanent occupation, or use of a Federal project is not injurious to the public interest and will not impair the usefulness of the levee. The authority to make this determination and approve modifications to Federal works under 33 USC 408 has been delegated to the Chief of Engineers, USACE.

**Compliance Status: Partial**

The proposed action would affect waters of the United States, as it includes activities that may change the hydraulic capacity of the floodway or the authorized geometry of the Federal project. As described in Chapter 1, RD 108 is seeking approval under 33 USC § 408, supported by this document. The CVFPB is requesting Section 408 permission from USACE for the proposed action on behalf of RD 108. Compliance will be complete upon approval by USACE.

### 5.2.14 Sustainable Fisheries Act

Under the Sustainable Fisheries Act, consultation is required by NMFS on any activity that might adversely affect EFH. EFH includes those habitats that fish rely on throughout their life cycles. It encompasses habitats necessary to allow sufficient production of commercially valuable aquatic species to support a long-term sustainable fishery and contribute to a healthy ecosystem. The action area has been designated as EFH by the Pacific Fishery Management Council.

**Compliance Status: Complete**

As described above under ESA compliance, USACE will conduct formal consultation with NMFS under Section 7. That consultation process includes consideration of and compliance with the Magnuson-Stevens Act to determine effects on EFH. In the Biological Opinion issued on August 10, 2015 (Appendix F), NMFS stated that the proposed action may adversely affect EFH and provided conservation recommendations. RD 108 will comply with the terms of the consultation.

# 5.3 State of California Laws and Regulations

The following state regulations may apply to CVFPB and RD 108's implementation, construction, operation, and maintenance of the proposed action.

## 5.3.1 California Environmental Quality Act (PRC Section 21000 et seq.)

CEQA requires state and local agencies to identify the significant environmental impacts of their actions and to avoid or mitigate those impacts, if feasible. The environmental review required imposes both procedural and substantive requirements. At a minimum, an initial review of the proposed action and its environmental effects must be conducted. CEQA applies to all discretionary activities proposed to be carried out or approved by California public agencies, including state, regional, county, and local agencies, unless an exemption applies. The act requires that public agencies comply with both procedural and substantive requirements. Procedural requirements include the preparation of the appropriate public notices (including notices of preparation), scoping documents, alternatives, environmental documents (including mitigation measures, mitigation monitoring plans, responses to comments, findings, and statements of overriding considerations), completion of agency consultation and State Clearinghouse review, and provisions for legal enforcement and citizen access to the courts. CEQA's substantive provisions require agencies to address environmental impacts disclosed in an appropriate document.

**Compliance Status: Complete**

A draft Initial Study was been prepared, separate from this EA, and was submitted to the State Clearinghouse on June 2, 2015, and was available for a 30-day public review period. The Final Initial Study was adopted by the RD 108 Board of Trustees on July 16, 2015, and was accompanied by a Mitigated Negative Declaration.

## 5.3.2 California Clean Air Act

**Compliance Status: Complete**

As discussed above under Section 5.2.1, *Clean Air Act*, the YSAQMD determines whether proposed action emission sources and emission levels significantly affect air quality based on Federal standards established by EPA and state standards set by ARB. The proposed action is not expected to violate any Federal or state air quality standards or impede the attainment of air quality objectives in the local air basins. The proposed action would have no significant adverse effects on the future air quality of the area.

## 5.3.3 California Endangered Species Act

CESA is similar to ESA but pertains only to state-listed endangered and threatened species. CESA requires state agencies to consult with CDFW when preparing documents under CEQA to ensure that the actions of the state lead agency do not jeopardize the continued existence of listed species. CESA directs agencies to consult with CDFW on projects or actions that could affect listed species, directs CDFW to determine whether there would be jeopardy to listed species, and allows CDFW to identify "reasonable and prudent alternatives" to the project consistent with conserving the species. Agencies can approve a project that affects a listed species if the agency determines that there are "overriding considerations"; however, the agencies are prohibited from approving projects that would cause the extinction of a listed species.

**Compliance Status: Partial**

The proposed action may affect several state-listed species. CESA compliance is discussed in Section 3.4, *Biological Resources*. Compliance will be complete upon consultation with CDFW.

## 5.3.4 California Fish and Game Code

### 5.3.4.1 Lake and Streambed Alteration (Section 1600 et seq.)

CDFW regulates work that will substantially affect resources associated with rivers, streams, and lakes in California, pursuant to CFGC Sections 1600–1607. Any action from a public project that substantially diverts or obstructs the natural flow or changes the bed, channel, or bank of any river, stream, or lake, or uses material from a streambed must be previously authorized by CDFW in a lake or streambed alteration agreement under Section 1602 of the CFGC.

**Compliance Status: Partial**

A Notification of Lake or Streambed Alteration application was submitted to CDFW on June 3, 2015. Compliance will be complete upon issuance of the final agreement from CDFW.

### 5.3.4.2 Natural Community Conservation Planning Act (Section 2800 et seq.)

The NCCPA (CFGC Section 2800 et seq.) was enacted to support broad-based planning for effective protection and conservation of the state's wildlife heritage, while continuing to allow appropriate development and growth. The purpose of natural community conservation planning is to sustain and restore those species and their habitats identified by CDFW that are necessary to maintain the continued viability of biological communities affected by human changes to the landscape. An NCCP identifies and provides for those measures necessary to conserve and manage natural biological diversity within the plan area while allowing compatible use of the land. CDFW may authorize the take of any identified species, including listed and non-special-status species, pursuant to Section 2835 of the NCCPA, if the conservation and management of such species is provided for in an NCCP approved by CDFW.

**Compliance Status: Partial**

The proposed action may affect several state-listed species. Effects on biological resources are discussed in Section 3.4, *Biological Resources*. Compliance will be complete upon consultation with CDFW.

## 5.3.5 California Register of Historic Resources

The CRHR includes resources that are listed in or formally determined eligible for listing in the NRHP (see Section 3.17, *Cultural Resources*) as well as some California State Landmarks and Points of Historical Interest (PRC Section 5024.1, 14, CCR Section 4850). Properties of local significance that have been designated under a local preservation ordinance (local landmarks or landmark districts) or that have been identified in a local historical resources inventory may be eligible for listing in the CRHR and are presumed to be significant resources for purposes of CEQA unless a preponderance of evidence indicates otherwise (State CEQA Guidelines Section 15064.5[a][2]). The eligibility criteria for listing in the CRHR are similar to those for NRHP listing but focus on the importance of the resources to California history and heritage.

**Compliance Status: Complete**

See Section 3.8, *Cultural Resources*, for a discussion of the CRHR. On August 19, 2015, SHPO commented on the proposed action with a finding of *no historic properties affected*.

## 5.3.6 Clean Water Act, Section 303(d)

Under CWA Section 303(d), the Regional Water Board and the State Water Board list water bodies as impaired when not in compliance with designated water quality objectives and standards. A TMDL program must be prepared for waters identified by the state as impaired. A TMDL is a quantitative assessment of a problem that affects water quality.

**Compliance Status: Full**

The proposed action would have no impact on TMDL issues for the CBD or the Sacramento River.

## 5.3.7 Porter-Cologne Water Quality Control Act

The Porter-Cologne Act established the State Water Board and nine Regional Water Boards as the primary state agencies with regulatory authority over California water quality and appropriative surface water rights allocations. Under this act (and the CWA), the state is required to adopt a water quality control policy and WDRs to be implemented by the State Water Board and nine Regional Water Boards. The State Water Board also establishes Basin Plans and statewide plans. The Regional Water Boards carry out State Water Board policies and procedures throughout the state. Basin Plans designate beneficial uses for specific surface water and groundwater resources and establish water quality objectives to protect those uses.

**Compliance Status: Complete**

The proposed action has the potential to affect water quality in surface water or groundwater in the action area, which is governed by the Regional Water Board. A Section 401 State Water Quality Certification for activities associated with implementation of the proposed action is required as a condition of Section 404. RD 108 submitted a 401 certification application to the Regional Water Board on June 3, 2015. The Regional Water Board provided a Section 401 technically conditioned water quality certification on July 29, 2015.

Chapter 6
# References

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Appendix A

# California Native Plant Society's Inventory Search

CNPS California Native Plant Society

# Inventory of Rare and Endangered Plants - 7th edition interface

v7-15feb 2-5-15

**Status:** search results - Wed, Mar. 11, 2015 17:17 ET c

{QUADS_123} =~ m/529C|513A|513B|530D|530A|514A|529D|529/ Search

Tip: Want to search by county? Try the **county index**.[all tips and help.][search history]

**Your Quad Selection:** Knights Landing (529C) 3812176, Taylor Monument (513A) 3812165, Grays Bend (513B) 3812166, Eldorado Bend (530D) 3812177, Kirkville (530A) 3812187, Woodland (514A) 3812167, Verona (529D) 3812175, Nicolaus (529A) 3812185, Sutter Causeway (529B) 3812186

**Hits 1 to 10 of 10**

**Requests that specify topo quads will return only Lists 1-3.**

To save selected records for later study, click the ADD button.

ADD checked items to Plant Press | check all | check none

Selections will appear in a new window.

| open | save | hits | scientific | common | family | CNPS |
|---|---|---|---|---|---|---|
| | ☑ | 1 | **Astragalus tener var. tener** | alkali milk-vetch | Fabaceae | List 1B.2 |
| | ☑ | 1 | **Atriplex depressa** | brittlescale | Chenopodiaceae | List 1B.2 |
| | ☑ | 1 | **Atriplex joaquinana** | San Joaquin spearscale | Chenopodiaceae | List 1B.2 |
| | ☑ | 1 | **Chloropyron palmatum** | palmate-bracted bird's-beak | Orobanchaceae | List 1B.1 |
| | ☑ | 1 | **Hibiscus lasiocarpos var. occidentalis** | woolly rose-mallow | Malvaceae | List 1B.2 |
| | ☑ | 1 | **Lepidium latipes var. heckardii** | Heckard's pepper-grass | Brassicaceae | List 1B.2 |
| | ☑ | 1 | **Lessingia hololeuca** | woolly-headed lessingia | Asteraceae | List 3 |
| | ☑ | 1 | **Sagittaria sanfordii** | Sanford's arrowhead | Alismataceae | List 1B.2 |
| | ☑ | 1 | **Trichocoronis wrightii var. wrightii** | Wright's trichocoronis | Asteraceae | List 2B.1 |
| | ☑ | 1 | **Trifolium hydrophilum** | saline clover | Fabaceae | List 1B.2 |

To save selected records for later study, click the ADD button.

ADD checked items to Plant Press | check all | check none

Selections will appear in a new window.

No more hits.

Appendix B
# California Natural Diversity Database Results

# Selected Elements by Scientific Name

## California Department of Fish and Wildlife

## California Natural Diversity Database

**Query Criteria:** Taxonomic Group is (Dune or Scrub or Herbaceous or Marsh or Riparian or Woodland or Forest or Alpine or Inland Waters or Marine or Estuarine or Riverine or Palustrine or Fish or Amphibians or Reptiles or Birds or Mammals or Mollusks or Arachnids or Crustaceans or Insects or Ferns or Gymnosperms or Monocots or Dicots or Lichens or Bryophytes) and Quad is (Knights Landing (3812176) or Taylor Monument (3812165) or Grays Bend (3812166) or Eldorado Bend (3812177) or Kirkville (3812187) or Woodland (3812167) or Verona (3812175) or Nicolaus (3812185) or Sutter Causeway (3812186))

| Species | Element Code | Federal Status | State Status | Global Rank | State Rank | Rare Plant Rank/CDFW SSC or FP |
|---|---|---|---|---|---|---|
| ***Agelaius tricolor***<br>tricolored blackbird | ABPBXB0020 | None | Endangered | G2G3 | S1S2 | SSC |
| ***Anthicus antiochensis***<br>Antioch Dunes anthicid beetle | IICOL49020 | None | None | G1 | S1 | |
| ***Anthicus sacramento***<br>Sacramento anthicid beetle | IICOL49010 | None | None | G1 | S1 | |
| ***Antrozous pallidus***<br>pallid bat | AMACC10010 | None | None | G5 | S3 | SSC |
| ***Ardea alba***<br>great egret | ABNGA04040 | None | None | G5 | S4 | |
| ***Ardea herodias***<br>great blue heron | ABNGA04010 | None | None | G5 | S4 | |
| ***Astragalus tener var. tener***<br>alkali milk-vetch | PDFAB0F8R1 | None | None | G2T2 | S2 | 1B.2 |
| ***Athene cunicularia***<br>burrowing owl | ABNSB10010 | None | None | G4 | S3 | SSC |
| ***Atriplex depressa***<br>brittlescale | PDCHE042L0 | None | None | G2 | S2 | 1B.2 |
| ***Branchinecta lynchi***<br>vernal pool fairy shrimp | ICBRA03030 | Threatened | None | G3 | S2S3 | |
| ***Buteo swainsoni***<br>Swainson's hawk | ABNKC19070 | None | Threatened | G5 | S3 | |
| ***Charadrius alexandrinus nivosus***<br>western snowy plover | ABNNB03031 | Threatened | None | G3T3 | S2 | SSC |
| ***Charadrius montanus***<br>mountain plover | ABNNB03100 | None | None | G3 | S2? | SSC |
| ***Chloropyron palmatum***<br>palmate-bracted salty bird's-beak | PDSCR0J0J0 | Endangered | Endangered | G1 | S1 | 1B.1 |
| ***Cicindela hirticollis abrupta***<br>Sacramento Valley tiger beetle | IICOL02106 | None | None | G5TH | SH | |
| ***Coastal and Valley Freshwater Marsh***<br>Coastal and Valley Freshwater Marsh | CTT52410CA | None | None | G3 | S2.1 | |
| ***Coccyzus americanus occidentalis***<br>western yellow-billed cuckoo | ABNRB02022 | Threatened | Endangered | G5T3Q | S1 | |
| ***Desmocerus californicus dimorphus***<br>valley elderberry longhorn beetle | IICOL48011 | Threatened | None | G3T2 | S2 | |

| Species | Element Code | Federal Status | State Status | Global Rank | State Rank | Rare Plant Rank/CDFW SSC or FP |
|---|---|---|---|---|---|---|
| ***Egretta thula***<br>snowy egret | ABNGA06030 | None | None | G5 | S4 | |
| ***Emys marmorata***<br>western pond turtle | ARAAD02030 | None | None | G3G4 | S3 | SSC |
| ***Extriplex joaquinana***<br>San Joaquin spearscale | PDCHE041F3 | None | None | G2 | S2 | 1B.2 |
| ***Falco columbarius***<br>merlin | ABNKD06030 | None | None | G5 | S3S4 | WL |
| ***Great Valley Mixed Riparian Forest***<br>Great Valley Mixed Riparian Forest | CTT61420CA | None | None | G2 | S2.2 | |
| ***Hibiscus lasiocarpos var. occidentalis***<br>woolly rose-mallow | PDMAL0H0R3 | None | None | G5T2 | S2 | 1B.2 |
| ***Lasionycteris noctivagans***<br>silver-haired bat | AMACC02010 | None | None | G5 | S3S4 | |
| ***Lasiurus blossevillii***<br>western red bat | AMACC05060 | None | None | G5 | S3 | SSC |
| ***Lasiurus cinereus***<br>hoary bat | AMACC05030 | None | None | G5 | S4 | |
| ***Lepidium latipes var. heckardii***<br>Heckard's pepper-grass | PDBRA1M0K1 | None | None | G4T2 | S2 | 1B.2 |
| ***Lepidurus packardi***<br>vernal pool tadpole shrimp | ICBRA10010 | Endangered | None | G3 | S2S3 | |
| ***Linderiella occidentalis***<br>California linderiella | ICBRA06010 | None | None | G2G3 | S2S3 | |
| ***Melospiza melodia***<br>song sparrow ("Modesto" population) | ABPBXA3010 | None | None | G5 | S3? | SSC |
| ***Nycticorax nycticorax***<br>black-crowned night heron | ABNGA11010 | None | None | G5 | S4 | |
| ***Oncorhynchus mykiss irideus***<br>steelhead - Central Valley DPS | AFCHA0209K | Threatened | None | G5T2Q | S2 | |
| ***Plegadis chihi***<br>white-faced ibis | ABNGE02020 | None | None | G5 | S3S4 | WL |
| ***Pogonichthys macrolepidotus***<br>Sacramento splittail | AFCJB34020 | None | None | G2 | S2 | SSC |
| ***Riparia riparia***<br>bank swallow | ABPAU08010 | None | Threatened | G5 | S2 | |
| ***Sagittaria sanfordii***<br>Sanford's arrowhead | PMALI040Q0 | None | None | G3 | S3 | 1B.2 |
| ***Spirinchus thaleichthys***<br>longfin smelt | AFCHB03010 | Candidate | Threatened | G5 | S1 | SSC |
| ***Taxidea taxus***<br>American badger | AMAJF04010 | None | None | G5 | S3 | SSC |

| Species | Element Code | Federal Status | State Status | Global Rank | State Rank | Rare Plant Rank/CDFW SSC or FP |
|---|---|---|---|---|---|---|
| ***Thaleichthys pacificus***<br>eulachon | AFCHB04010 | Threatened | None | G5 | S3 | SSC |
| ***Thamnophis gigas***<br>giant garter snake | ARADB36150 | Threatened | Threatened | G2 | S2 | |
| ***Trichocoronis wrightii var. wrightii***<br>Wright's trichocoronis | PDAST9F031 | None | None | G4T3 | S1 | 2B.1 |
| ***Trifolium hydrophilum***<br>saline clover | PDFAB400R5 | None | None | G2 | S2 | 1B.2 |
| ***Valley Oak Woodland***<br>Valley Oak Woodland | CTT71130CA | None | None | G3 | S2.1 | |

**Record Count: 44**

Appendix C

# U.S. Fish and Wildlife Service Species

# U.S. Fish & Wildlife Service

# Sacramento Fish & Wildlife Office

**Federal Endangered and Threatened Species that Occur in or may be Affected by Projects in the KNIGHTS LANDING (529C) U.S.G.S. 7 1/2 Minute Quad**

Report Date: March 12, 2015

## Listed Species

### Invertebrates

Branchinecta lynchi
vernal pool fairy shrimp (T)

Desmocerus californicus dimorphus
valley elderberry longhorn beetle (T)

Lepidurus packardi
vernal pool tadpole shrimp (E)

### Fish

Acipenser medirostris
green sturgeon (T) (NMFS)

Hypomesus transpacificus
delta smelt (T)

Oncorhynchus mykiss
Central Valley steelhead (T) (NMFS)
Critical habitat, Central Valley steelhead (X) (NMFS)

Oncorhynchus tshawytscha
Central Valley spring-run chinook salmon (T) (NMFS)
Critical Habitat, Central Valley spring-run chinook (X) (NMFS)
Critical habitat, winter-run chinook salmon (X) (NMFS)
winter-run chinook salmon, Sacramento River (E) (NMFS)

### Amphibians

Ambystoma californiense
California tiger salamander, central population (T)

Rana draytonii
California red-legged frog (T)

Reptiles
Thamnophis gigas
giant garter snake (T)

Birds
Coccyzus americanus occidentalis
Western yellow-billed cuckoo (T)

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## Key:

- (E) Endangered - Listed as being in danger of extinction.
- (T) Threatened - Listed as likely to become endangered within the foreseeable future.
- (P) Proposed - Officially proposed in the Federal Register for listing as endangered or threatened.
- (NMFS) Species under the Jurisdiction of the National Oceanic & Atmospheric Administration Fisheries Service. Consult with them directly about these species.
- Critical Habitat - Area essential to the conservation of a species.
- (PX) Proposed Critical Habitat - The species is already listed. Critical habitat is being proposed for it.
- (C) Candidate - Candidate to become a proposed species.
- (V) Vacated by a court order. Not currently in effect. Being reviewed by the Service.
- (X) Critical Habitat designated for this species

Appendix D

# Modeling Assumptions and Calculations

## Construction

## Construction Schedule

| Phase | Start | End | Wk Days |
|---|---|---|---|
| Coffer dam installation | 9/1/2015 | 9/2/2015 | 2 |
| Barrier construction | 9/3/2015 | 10/29/2015 | 40 |
| Erosion repairs | 9/1/2015 | 9/8/2015 | 5 |

## Heavy-Duty Offroad Equipment

| Phase | CalEEMod Eq Name | #/day | Hrs/day/Eq | HP | LF | Days |
|---|---|---|---|---|---|---|
| Coffer dam installation | Cranes | 1 | 8 | 226 | 0.29 | 2 |
| Barrier construction | Cranes | 1 | 4 | 226 | 0.29 | 30 |
| Barrier construction | Pumps | 1 | 3 | 84 | 0.74 | 5 |
| Erosion repairs | Tractors/Loaders/Backhoes | 1 | 8 | 98 | 0.37 | 3 |

| Pounds per day | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2015 | | | | | | | | | | | | | |
| ROG | NOX | CO | PM10 Ex | PM10 D | PM10 T | PM2.5 Ex | PM2.5 D | PM2.5 T | SOX | CO2 | CH4 | N2O | Other |
| 0.74 | 8.81 | 3.07 | 0.40 | | 0.40 | 0.37 | | 0.37 | 0.01 | 592.35 | 0.18 | 0.02 | |
| 0.37 | 4.40 | 1.53 | 0.20 | | 0.20 | 0.19 | | 0.19 | 0.00 | 296.18 | 0.09 | 0.01 | |
| 0.28 | 1.99 | 1.46 | 0.15 | | 0.15 | 0.15 | | 0.15 | 0.00 | 233.64 | 0.03 | 0.01 | |
| 0.36 | 3.47 | 2.45 | 0.27 | | 0.27 | 0.25 | | 0.25 | 0.00 | 330.86 | 0.10 | 0.01 | |

| Tons | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2015 | | | | | | | | | | | | | |
| ROG | NOX | CO | PM10 Ex | PM10 D | PM10 T | PM2.5 Ex | PM2.5 D | PM2.5 T | SOX | CO2 | CH4 | N2O | Other |
| 0.00 | 0.01 | 0.00 | 0.00 | | 0.00 | 0.00 | | 0.00 | 0.00 | 0.59 | 0.00 | 0.00 | |
| 0.01 | 0.07 | 0.02 | 0.00 | | 0.00 | 0.00 | | 0.00 | 0.00 | 4.44 | 0.00 | 0.00 | |
| 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 | | 0.00 | 0.00 | 0.58 | 0.00 | 0.00 | |
| 0.00 | 0.01 | 0.00 | 0.00 | | 0.00 | 0.00 | | 0.00 | 0.00 | 0.50 | 0.00 | 0.00 | |

## Employee Commute

Pounds per day — 2015

| Phase | Vehicle Type | Trips/Day | Mi/Day | Days | ROG | NOX | CO | PM10 Ex | PM10 D | PM10 T | PM2.5 Ex | PM2.5 D | PM2.5 T | SOX | CO2 | CH4 | N2O | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Coffer dam installation | LDA/LDT/MDV | 8 | 134 | 2 | 0.08 | 0.07 | 0.65 | 0.01 | 0.25 | 0.26 | 0.01 | 0.06 | 0.07 | 0.00 | 120.27 | | | 6.01 |
| Barrier construction | LDA/LDT/MDV | 16 | 269 | 40 | 0.16 | 0.14 | 1.31 | 0.03 | 0.49 | 0.52 | 0.01 | 0.12 | 0.13 | 0.00 | 240.53 | | | 12.03 |
| Erosion repairs | LDA/LDT/MDV | 8 | 134 | 5 | 0.08 | 0.07 | 0.65 | 0.01 | 0.25 | 0.26 | 0.01 | 0.06 | 0.07 | 0.00 | 120.27 | | | 6.01 |

Tons — 2015

| ROG | NOX | CO | PM10 Ex | PM10 D | PM10 T | PM2.5 Ex | PM2.5 D | PM2.5 T | SOX | CO2 | CH4 | N2O | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.12 | | | 0.01 |
| 0.00 | 0.00 | 0.03 | 0.00 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 4.81 | | | 0.24 |
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.30 | | | 0.02 |

## Haul Trucks

| | | | | | Pounds per day | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 2015 | | | | | | | | | | | | | |
| Sch Code | Vehicle Type | Trips/Day | Mi/day | Days | ROG | NOX | CO | PM10 Ex | PM10 D | PM10 T | PM2.5 Ex | PM2.5 D | PM2.5 T | SOX | CO2 | CH4 | N2O | Other |
| Coffer dam installation | T7 Single | 2 | 24 | 2 | 0.02 | 0.45 | 0.07 | 0.01 | 0.04 | 0.06 | 0.01 | 0.01 | 0.02 | 0.00 | 92.78 | 0.01 | 0.00 | |
| Barrier construction | T7 Single | 1 | 12 | 40 | 0.01 | 0.22 | 0.03 | 0.01 | 0.02 | 0.03 | 0.00 | 0.01 | 0.01 | 0.00 | 46.39 | 0.00 | 0.00 | |
| Erosion repairs | T7 Single | 5 | 60 | 5 | 0.05 | 1.12 | 0.17 | 0.03 | 0.11 | 0.14 | 0.02 | 0.03 | 0.05 | 0.00 | 231.96 | 0.01 | 0.01 | |
| | | | | | Tons | | | | | | | | | | | | | |
| | | | | | 2015 | | | | | | | | | | | | | |
| | | | | | ROG | NOX | CO | PM10 Ex | PM10 D | PM10 T | PM2.5 Ex | PM2.5 D | PM2.5 T | SOX | CO2 | CH4 | N2O | Other |
| | | | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.09 | 0.00 | 0.00 | |
| | | | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.93 | 0.00 | 0.00 | |
| | | | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.58 | 0.00 | 0.00 | |

## Electricity

| | | | | |
|---|---|---|---|---|
| | kWh | | | |
| Consumption | 250 | | | |
| | | | | |
| PG&E 2015 CO2 EF | 391 | lbs/MWh | Adjusted for RPS | |
| eGrid 2015 CH4 EF | 24.08 | lbs/GWh | Adjusted for RPS | |
| eGrid 2015 N2O EF | 5.10 | lbs/GWh | Adjusted for RPS | |
| | | | | |
| | CO2 | CH4 | N2O | CO2e |
| 2015 Emissions (MT) | 0.04 | 0.00 | 0.00 | 0.04 |

## Concrete

| | | |
|---|---|---|
| Cubic yards poured | 120 | |
| Assumed compression strength | 5000 | Highest for ready mix |
| Pounds $CO_2$/cubic yard | 555 | Nisbet et. al, 2002 |
| $CO_2$ (MT) | 30 | |

## EMFAC2014 Emission Factors

| Grams/Mile | ROG | NOx | CO | PM10 | PM2_5 | SOx | CO2 | CH4 |
|---|---|---|---|---|---|---|---|---|
| LDA/LDT/MDV | 0.2701215 | 0.2348522 | 2.2051351 | 0.0473192 | 0.0201272 | 0.0040884 | 405.8945 | 0.0166496 |
| T7 Single | 0.3500516 | 8.4615222 | 1.2792218 | 0.2537567 | 0.1847274 | 0.0167302 | 1753.6043 | 0.016259 |

Source: EMFAC2014 (2015 Emission Factors for Yolo County)

# Re-entrained Paved Road Dust Emission Factors

*Methodology*

Calculation Methodology: USEPA AP-42, Paved Roads, Section 13.2.1, Revised January 2011:

http://www.epa.gov/ttn/chief/ap42/ch13/final/c13s0201.pdf

Avg vehicle weight and silt loading on Local Roads within SVAB

http://www.arb.ca.gov/ei/areasrc/fullpdf/full7-9.pdf

Precipitation Days greater than 0.254mm (0.01 in)

http://www.wrcc.dri.edu/summary/Climsmcca.html

| **Pollutant** | **Variables** | | | | | **SVAB EF (g per mi)** |
|---|---|---|---|---|---|---|
| | **k** | **sL** | **W** | **P** | **N** | |
| $PM_{10}$ | 0.0022 | 0.32 | 2.4 | 58 | 365 | 0.82982 |
| $PM_{2.5}$ | 0.00054 | 0.32 | 2.4 | 58 | 365 | 0.20368 |

| | |
|---|---|
| E = particulate emission factor (grams of particulate matter/VMT) | |
| k = particle size multiplier (lb/VMT) | *default from AP-42* |
| sL = local roadway silt loading (g/m2) | *ARB Section 7.9, Table 3* |
| W = average weight of vehicles on the road (tons) | *ARB Section 7.9, Table 3* |
| P = number of wet days with at least 0.254mm of precipitation | *from WRCC* |
| N = number of days in the averaging period | *annual days (365)* |
| g to lb conversion | *0.002204623* |

# Operation

## Heavy-Duty Equipment

| Phase | CalEEMod Eq Name | #/day | Hrs/day/Eq | HP | LF | Days | ROG | NOX | CO | PM10 Ex | PM10 D | PM10 T | PM2.5 Ex | PM2.5 D | PM2.5 T | SOX | CO2 | CH4 | N2O | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Pounds per day | | | | | | | | | | | | | |
| | | | | | | | 2016 | | | | | | | | | | | | | |
| Annual Inspection | Cranes | 1 | 8 | 226 | 0.29 | 1 | 0.72 | 8.53 | 2.98 | 0.39 | | 0.39 | 0.36 | | 0.36 | 0.01 | 586.23 | 0.18 | 0.02 | |
| | | | | | | | Tons | | | | | | | | | | | | | |
| | | | | | | | 2016 | | | | | | | | | | | | | |
| | | | | | | | ROG | NOX | CO | PM10 Ex | PM10 D | PM10 T | PM2.5 Ex | PM2.5 D | PM2.5 T | SOX | CO2 | CH4 | N2O | Other |
| | | | | | | | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 | | 0.00 | 0.00 | 0.29 | 0.00 | 0.00 | |

## Employee Commute

| Phase | Vehicle Type | Trips/Day | Mi/Day | Days | ROG | NOX | CO | PM10 Ex | PM10 D | PM10 T | PM2.5 Ex | PM2.5 D | PM2.5 T | SOX | CO2 | CH4 | N2O | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | **Pounds per day** | | | | | | | | | | | | | |
| | | | | | **2016** | | | | | | | | | | | | | |
| Annual Inspection | LDA/LDT/MDV | 18 | 294 | 1 | 0.16 | 0.13 | 1.26 | 0.03 | 0.54 | 0.57 | 0.01 | 0.13 | 0.14 | 0.00 | 256.41 | | | 12.82 |
| | | | | | **Tons** | | | | | | | | | | | | | |
| | | | | | **2016** | | | | | | | | | | | | | |
| | | | | | **ROG** | **NOX** | **CO** | **PM10 Ex** | **PM10 D** | **PM10 T** | **PM2.5 Ex** | **PM2.5 D** | **PM2.5 T** | **SOX** | **CO2** | **CH4** | **N2O** | **Other** |
| | | | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.13 | | | 0.01 |

## Haul Trucks

| Sch Code | Vehicle Type | Trips/Day | Mi/day | Days | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Pounds per day | | | | | | | | | | | | | |
| | | | | | 2016 | | | | | | | | | | | | | |
| Sch Code | Vehicle Type | Trips/Day | Mi/day | Days | ROG | NOX | CO | PM10 Ex | PM10 D | PM10 T | PM2.5 Ex | PM2.5 D | PM2.5 T | SOX | CO2 | CH4 | N2O | Other |
| Annual Inspection | T7 Single | 6 | 72 | 1 | 0.04 | 1.15 | 0.16 | 0.03 | 0.13 | 0.17 | 0.02 | 0.03 | 0.06 | 0.00 | 275.50 | 0.02 | 0.01 | |
| | | | | | Tons | | | | | | | | | | | | | |
| | | | | | 2016 | | | | | | | | | | | | | |
| | | | | | ROG | NOX | CO | PM10 Ex | PM10 D | PM10 T | PM2.5 Ex | PM2.5 D | PM2.5 T | SOX | CO2 | CH4 | N2O | Other |
| | | | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.14 | 0.00 | 0.00 | |

## Electricity

| | | | | |
|---|---|---|---|---|
| | kWh | | | |
| Annual Electricity | 400 | | | |
| | | | | |
| PG&E 2016 CO2 EF | 370 | lbs/MWh | Adjusted for RPS | |
| eGrid 2016 CH4 EF | 23.20 | lbs/GWh | Adjusted for RPS | |
| eGrid 2016 N2O EF | 4.91 | lbs/GWh | Adjusted for RPS | |
| | | | | |
| | CO2 | CH4 | N2O | CO2e |
| 2016 Emissions (MT) | 0.07 | 0.00 | 0.00 | 0.07 |

## EMFAC2014 Emission Factors

| Grams/Mile | ROG | NOx | CO | PM10 | PM2_5 | SOx | CO2 | CH4 |
|---|---|---|---|---|---|---|---|---|
| LDA/LDT/MDV | 0.2404407 | 0.205897 | 1.9469264 | 0.0471721 | 0.0199895 | 0.003981 | 395.59061 | 0.014638 |
| T7 Single | 0.2761119 | 7.2512141 | 1.0156832 | 0.2104199 | 0.1432654 | 0.0165586 | 1735.6157 | 0.0128247 |

Source: EMFAC2014 (2016 Emission Factors for Yolo County)

## Re-entrained Paved Road Dust Emission Factors

*Methodology*

Calculation Methodology: USEPA AP-42, Paved Roads, Section 13.2.1, Revised January 2011:

http://www.epa.gov/ttn/chief/ap42/ch13/final/c13s0201.pdf

Avg vehicle weight and silt loading on Local Roads within SVAB

http://www.arb.ca.gov/ei/areasrc/fullpdf/full7-9.pdf

Precipitation Days greater than 0.254mm (0.01 in)

http://www.wrcc.dri.edu/summary/Climsmcca.html

| Pollutant | Variables | | | | | SVAB EF (g per mi) |
|---|---|---|---|---|---|---|
| | k | sL | W | P | N | |
| $PM_{10}$ | 0.0022 | 0.32 | 2.4 | 58 | 365 | 0.82982 |
| $PM_{2.5}$ | 0.00054 | 0.32 | 2.4 | 58 | 365 | 0.20368 |

| | |
|---|---|
| E = particulate emission factor (grams of particulate matter/VMT) | |
| k = particle size multiplier (lb/VMT) | *default from AP-42* |
| sL = local roadway silt loading (g/m2) | *ARB Section 7.9, Table 3* |
| W = average weight of vehicles on the road (tons) | *ARB Section 7.9, Table 3* |
| P = number of wet days with at least 0.254mm of precipitation | *from WRCC* |
| N = number of days in the averaging period | *annual days (365)* |
| g to lb conversion | *0.002204623* |

Appendix E

# U.S. Fish and Wildlife Service Biological Opinion

# United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
2800 Cottage Way, Suite W-2605
Sacramento, California 95825-1846


In Reply Refer to
08ESMF00-
2015-F-0703

JUL 10 2015

Mr. Michael Nepstad
Deputy Chief, Regulatory Division
U.S. Army Corps of Engineers, Sacramento District
1325 J Street
Sacramento, California 95814-2922

Subject: Formal Consultation on the Proposed Knights Landing Outfall Gates Project, Yolo County, California

Dear Mr. Nepstad:

This letter is in response to the Army Corps of Engineers' (Corps), June 3, 2015, request for initiation of formal consultation with the U.S. Fish and Wildlife Service (Service) on the proposed Knights Landing Outfall Gates Project (proposed project), in Yolo County, California. Your request was received by the Service on June 5, 2015. At issue are the proposed project's effects on the federally-listed as threatened giant garter snake (*Thamnophis gigas*). This response is provided under the authority of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*) (Act), and in accordance with the implementing regulations pertaining to interagency cooperation (50 CFR 402).

The Federal action we are consulting on is the issuance of a Section 404 Clean Water Act Permit to Reclamation District 108 (RD 108) (applicant) for the fill of waters of the U.S. associated with the construction of a fish barrier and the placement of bank protection on the downstream side of the Knights Landing Outfall Gates (KLOG) structure. Pursuant to 50 CFR 402.12(j), you submitted a biological assessment for our review and requested concurrence with the findings presented therein. These findings conclude that the proposed project may affect, and is likely to adversely affect, the giant garter snake. The proposed project is not within designated or proposed critical habitat for any federally-listed species.

Through a cooperative agreement between the Corps and the Bureau of Reclamation (Reclamation) this consultation will also cover Reclamation's action of funding the proposed project under the authority of the Central Valley Project Improvement Act (CVPIA). The CVPIA Section 3406(b)(1) authorizes Reclamation, on the behalf of the Secretary of the Department of the Interior, to develop and implement a program which makes all reasonable efforts to ensure natural production of anadromous fish in Central Valley rivers and streams will be sustainable, on a long-term basis, at levels not less than twice the average levels attained during the period of 1967-1991.

In considering your request, we based our evaluation of your findings on the following: (1) your June 3, 2015, letter initiating consultation; (2) the May 2015, *Knights Landing Outfall Gates Project USFWS Biological Assessment* (biological assessment), prepared by ICF International; (3) emails between the Service and the Corps; and (4) other information available to the Service.

**Consultation History**

| | |
|---|---|
| *May 14-June 25, 2015*: | Biweekly telephone conference attended by representatives of the Service, the Corps, Reclamation, National Marine Fisheries Service, Department of Water Resources, California Department of Fish and Wildlife, the applicant's consultants, and the applicant. |
| *June 5, 2015*: | The Service received the June 3, 2015, letter from the Corps requesting initiation of formal consultation with the May 2015 biological assessment enclosed. |
| *June 17, 2015:* | The Service sent the Corps an email for clarification regarding the amount of temporary impacts to upland habitat for the giant garter snake. |
| *June 24, 2015:* | The Service received an email from the Corps describing a change in the project area. |
| *June 29-July 1, 2015:* | The Service and the Corps exchanged emails regarding the amount of temporary impacts to upland habitat for the giant garter snake. |

## BIOLOGICAL OPINION

**Description of the Action**

RD 108 is proposing to construct a positive fish barrier on the downstream side of the existing KLOG structure to prevent adult salmon entry into the Colusa Basin Drain. Flows coming through the KLOG structure have the potential to draw salmon when water level differentials between the upstream and downstream side of the gates are such that downstream flows are attractive to migrating salmonids, but not at a velocity that is too great for their passage. While the extent of upstream fish passage at the KLOG structure has not been fully evaluated, RD 108 has decided to construct the barrier as an immediate and cost-effective solution to aid anadromous fish populations.

The proposed project includes the construction of new concrete wing walls, installation of a metal picket weir, installation of rock slope protection, and the removal of vegetation for construction access, which is further described below. All features of the proposed project will be constructed on the downstream side of the KLOG structure. The concrete wing walls and metal picket weir will be constructed on the existing concrete apron, and the metal picket weir will be designed to prevent salmon from entering into the gates.

*Construction Methods and Activities*

Mobilization and Dewatering

Prior to construction activities, chain link fencing will be set up to establish the limits of construction to the extent feasible. Site access, staging areas, and environmental controls will be installed. In order to dewater the site, all gates on the structure will be closed and a temporary water barrier will be installed on the downstream edge of the concrete apron. Any remaining water will be pumped downstream out of the construction site and all of the structure gates will remain closed to keep the site dry through the construction period. Flows in the Colusa Basin Drain will flow into the Knights Landing Ridge Cut, which is 2,000 feet upstream of the action area, while the gates are closed. Signage notifying the public of construction activities and temporary pedestrian access closures will be displayed on the landside of both levees. Road 108, which runs along the top of the west levee bank, will be closed between State Route (SR) 45 and Road 112 during construction.

Erosion Repair

Prior to the construction of the new wing walls and picket weirs, an existing erosion site immediately downstream of the KLOG structure on the east bank of the channel will be repaired. The erosion site is 100 feet long, extends 30 feet up the bank from the levee toe, and has started to undercut the east bank. The erosion site is bare of vegetation, but above the erosion area are several trees that will be at risk of collapse if the erosion continues. Repair will consist of placing 500 cubic yards of clean rock slope protection within 0.069 acre of channel bank by crane using a clamshell. This repair will return the bank to levee design conditions with a slope between 2.5:1 and 3:1. The crane will be positioned on the concrete platform located in the staging area on the east bank of the channel and adjacent to the KLOG structure. Material will be placed directly onto the erosion site and a bobcat will be used to reposition the rock as necessary.

Silt fencing/curtains will be set up around the extent of the in-water work area to prevent increasing turbidity in the Colusa Basin Drain and the Sacramento River due to any sediment that may be disturbed and suspended during construction. The toe of the silt fencing will be trenched so that the downslope face of the trench is flat and perpendicular to the line of flow. The fencing will be inspected daily and repaired as needed, with accumulated silt being removed when it reaches a depth of 6 inches. The erosion site repair will be the only portion of the proposed project that will involve the permanent placement of fill material within the natural substrate of the Colusa Basin Drain.

Fish Barrier Construction

Once the fish barrier construction site is dewatered and dry, the existing concrete sill immediately downstream of the gates will be removed to the edge of the existing wing walls to accommodate the five new concrete wing walls that will house the picket weirs. The new wing walls will be 37 feet long (including the existing wing walls), 14 feet high, and 14 inches thick, and there will be 16 feet between each wall. The new wing walls will be formed and constructed in place on the existing dewatered apron slab. Rebar will be dowelled into the existing slab and encapsulated by the new wing walls. A total of five walls will be built, creating four individual channels extending out from the KLOG structure, with two flap gates draining into each of the four channels. As there are two gates in each channel, an existing gate wing wall will remain in the middle of each new channel. The new wing walls will extend toward the downstream edge of the larger concrete apron, stopping 3 feet short of the end of the concrete slab. This 3-foot-wide space will accommodate the dewatering equipment during construction and will allow workers to walk between the wing walls and the edge of the slab for future routine maintenance during low-flow conditions. The existing catwalk will be removed in order to accommodate the new wing walls and a new catwalk will be installed 2 feet higher than the existing one.

Once the wing walls are constructed, the metal picket weirs will be installed in each of the four channels. The hinge point of the picket weirs will be placed at the upstream extent of the demolished concrete sill, below the edge of the existing wing walls, and the picket weirs will extend out 29 feet. The bars of the picket weirs will have an outside diameter of 1.5 inches with a 1 inch space between each of the bars. The picket weirs will be made of stainless steel and will be negatively buoyant. Cable winches will be installed at the top of the KLOG structure to raise and lower the picket weirs. Stilling wells will be installed to monitor water surface elevations and to inform operation of the picket weirs. The picket weirs will be designed with a maximum picket angle of 30 degrees from horizontal when the water surface is up to the top of the 14-foot-high wing walls. At very low flows, the downstream end of the pickets will not extend the length of the wing walls, maintaining the 3 foot clearance that will allow maintenance access. The picket weirs will allow water from the KLOG structure to continue to flow through the weir, but as the pickets rise during periods when salmon could be present, the pickets will prevent them from reaching the gates and continuing upstream through the gates. In addition, the picket weir will be designed, constructed, and operated to meet National Marine Fisheries and California Department of Fish and Wildlife requirements. Finally, two cameras will be installed on the KLOG structure so debris loading can be monitoring remotely, with each camera monitoring two bays.

Site Access and Staging

Equipment and materials will be transported from SR 45 on local roadways and levee-top roads to the construction site. Road 108, which runs along the top of the west bank levee and will provide access to the west bank, will be closed for the full duration of construction except for local, levee maintainer, and emergency access. The site will be accessed from both sides of the structure. The east bank will be accessed using the gavel road that begins at SR 45 and runs along the east bank levee top. Access for construction equipment will require the removal of small amounts of riparian scrub vegetation. One tree will be removed to allow for crane access to the erosion site and pruning of additional trees may be necessary. A 0.6 acre main staging area will be established on the top and landside of the east bank levee and another 0.4 acre staging area will be established in an empty lot on the landside of the east bank levee (see Figure 1). Access for erosion site repairs on the east bank will be from the top of the levee and workers will walk down to the erosion site from the levee top. Site access and the creation of the proposed staging areas will result in the temporary loss of 0.81 acre of upland habitat for the giant garter snake due to the implementation of conservation measures which will exclude them from these areas (see Figure 1).

Construction Equipment and Personnel

During construction of the proposed project, it is expected that 10 construction personnel will be onsite daily. Private worker vehicles will be parked along the levee-top roads on either side of the channel. Typical equipment used includes: crane with clamshell, bobcat, dump truck, and a concrete pumping truck.

Construction Schedule

Construction is expected to take place from 7am to 7 pm, Monday through Friday for 6 weeks, starting September 1, 2015. The actual construction start date will depend on current water elevations and permit acquisition. Cofferdam installation and erosion repair will begin once site access has been established and environmental controls have been installed. Cofferdam installation

Figure 1. Proposed project area and temporary impacts to suitable giant garter snake upland habitat


**Figure 3**
**Temporary Impacts on Suitable Giant Garter Snake Upland Habitat**

is expected to take 2 days and will be followed by erosion repair and fish barrier construction after the work area has been dewatered and is sufficiently dry. Construction of the wing walls and picket weirs is expected to take 40 days to complete and erosion repair will take about 5 days to complete.

Post-Construction Operation and Maintenance Activities

The fish barrier will be owned by the Central Valley Flood Protection Board and operated and maintained by the California Department of Water Resources' West Sacramento Maintenance personnel. The picket weirs will be deployed when the water surface elevations are between 3 feet and 14 feet above the concrete apron. The weirs will be lowered to be flush with the concrete apron when water surface elevations at the apron are below 3 feet or above 14 feet. Water level sensors in the stilling wells will record water surface elevations every 15 minutes and the actuator motor for the cable winches will be programmed to raise and lower the picket weirs remotely according to recorded water surface elevations so that the picket weirs maintain 2 feet of freeboard at their outboard end. The picket weirs will be lowered only after low water levels persist for more than 3 days. This will minimize initial raising of the weir, which has the potential to trap upstream migrating salmon.

The picket weirs will be checked annually for damage or more frequently if heavy debris loading is observed via the monitoring cameras. Accumulated debris will be removed by temporarily lowering the pickets and allowing the debris to flush downstream. Maintenance and inspection activities will take place during September when water levels are typically at their lowest. The gates on the KLOG structure will be closed to allow workers access to the picket weirs. The picket weirs will be inspected for damage and the actuator motors will be serviced. Extra picket weirs will be constructed so damaged picket weirs could be readily replaced if necessary. Any damaged picket weirs will be replaced by crane and the damaged picket weir repaired offsite. No dewatering will be necessary as part of operations and maintenance and the crane will be the only machinery needed during these activities. Some tree pruning on the east bank may be necessary to provide crane access but no additional tree removal is expected.

*Conservation Measures*

RD 108 will implement the following conservation measures to avoid and minimize effects on the giant garter snake during the construction of the proposed project. To ensure there implementation, the measures listed below will be included in the specifications for the proposed action.

Conservation Measure 1: Conduct Mandatory Biological Resources Awareness Training for All Project Personnel and Implement General Protection Measures

Before any ground disturbing activities occur in the action area (including vegetation clearing, grading and equipment staging), a Service-approved biologist will conduct a mandatory biological resources awareness training for all construction personnel about the giant garter snake. The training will include the natural history of the giant garter snake, representative photographs, the legal status of the species, and the conservation measures that will be implemented to protect the species. Proof of personnel attendance will be provided to the Service within 1 week of the training. If new construction personnel are added to the proposed action, the contractor will ensure that they receive the mandatory training before starting work.

RD 108 will clearly delineate the construction limits through the use of survey tape, pin flags, orange barrier fencing, or other materials, and prohibit any construction related traffic outside these boundaries. Requirements that will be followed by construction personnel are listed below.

- Construction vehicles will observe the posted speed limit on hard-surfaced roads and a 10 mph speed limit on unpaved roads during travel in the construction area.
- Construction vehicles and equipment will restrict off-road travel to the designated construction areas.
- Construction vehicles left onsite overnight will be thoroughly inspected each day for giant garter snakes before they are moved.
- All food-related trash will be disposed of in closed containers and removed from the construction area at least once per week during the construction period. Construction personnel will not feed or otherwise attract fish or wildlife to the construction site.
- No pets or firearms will be allowed in the construction area.
- To avoid entrapment of wildlife, all excavated steep-walled holes or trenches more than 1-foot-deep will either be properly covered or provided with one or more escape ramps constructed of earth fill or wooden planks at the end of each workday. To prevent possible resource damage from hazardous materials such as motor oil or gasoline, construction personnel will not service vehicles or construction equipment outside designated staging areas.

<u>Conservation Measure 2: Conduct Construction Activities during the Active Period for the Giant Garter Snake</u>

To the maximum extent possible, all construction activities within suitable giant garter snake aquatic and upland habitat (areas within 200 feet of aquatic habitat) will be conducted during the giant garter snake's active period (May 1 - October 1). During this timeframe, potential for injury and mortality are lessened because giant garter snakes are actively moving and avoiding danger. Cofferdam installation, dewatering, and erosion repairs will occur during this timeframe. Construction is scheduled from September 1 to October 15 to take advantage of the low-flow period in order to minimize in-water work, as well as to fit the approval timeline for associated permits. Because construction of the fish barrier cannot occur during the high flows caused by runoff from the agricultural fields upstream of the existing KLOG structure, the fish barrier construction must be conducted after October 1.

<u>Conservation Measure 3: Install and Maintain Exclusion and Construction Barrier Fencing around Suitable Giant Garter Snake Habitat</u>

To reduce the likelihood of giant garter snakes entering the construction area, RD 108 will install exclusionary fencing and orange construction barrier fencing along the portions of the construction area that provide suitable upland habitat. The exclusionary and construction barrier fencing will be installed during the active period for giant garter snakes to reduce the potential for injury and mortality.

The construction specifications will require that RD 108 or its contractor retain a Service-approved biologist to identify suitable habitat for the giant garter snake that is to be avoided during construction. Sensitive habitat areas adjacent to the construction area, including staging and access, will be fenced off to avoid inadvertent disturbance in these areas. Before construction, the contractor will work with the Service-approved biologist to identify the locations for exclusionary fencing and will place flags or flagging around the area to indicate the location of the fences. The exclusionary fencing will be installed the maximum distance practicable from identified aquatic habitat and will be in place before construction activities are initiated.

The exclusionary fencing will consist of 3-foot-tall silt fencing buried 4-6 inches below ground level. The fencing will ensure that giant garter snakes are excluded from the construction area and that suitable upland and aquatic habitat is protected throughout construction. The construction barrier fencing will be commercial quality, woven polypropylene, orange in color, and 4 feet tall.

Barrier and/or exclusionary fences will be inspected daily by the biological monitor during ground disturbing activities and weekly after ground disturbing activities until construction is complete or until the fences are removed, as approved by the biological monitor. The biological monitor will be responsible for ensuring that the contractor maintains the protective fencing around giant garter snake habitat throughout construction.

<u>Conservation Measure 4: Minimize Potential Impacts on Giant Garter Snake Habitat</u>

RD 108 will implement the following measures to minimize potential impacts on giant garter snake habitat:

- Staging areas will be located more than 200 feet from suitable giant garter snake aquatic habitat or will be fenced with exclusionary fencing prior to the start of construction and between May 1 and October 1.
- Any dewatered habitat will be sufficiently dry (no standing water) prior to excavating or filling of the dewatered habitat.
- Vegetation clearing within 200 feet of the banks of suitable giant garter snake aquatic habitat will be limited to the minimum area necessary.
- The movement of heavy equipment within 200 feet of the banks of suitable giant garter snake aquatic habitat will be confined to designated haul routes to minimize habitat disturbance.

<u>Conservation Measure 5: Prepare and Implement a Spill Prevention, Control, and Counter-Measure Plan</u>

A spill prevention, control, and counter-measure plan (SPCCP) is intended to prevent any discharge of oil into navigable waters or adjoining shorelines. RD 108 or its contractor will develop and implement an SPCCP to minimize the potential for and effects from spills of hazardous, toxic or petroleum substances during construction and operation activities. The SPCCP will be completed before any construction activities begin. Implementation of this measure will comply with State and Federal water regulations. RD 108 will review and approve the SPCCP before onset of construction activities and routinely inspect the construction area to verify that the measures are being properly implemented and maintained. RD 108 will notify its contractors immediately if there is a noncompliance issue.

Conservation Measure 6: Conduct Preconstruction Surveys and Monitoring for the Giant Garter Snake

Prior to ground disturbing activities within suitable giant garter snake aquatic and upland habitat, a Service approved biologist will conduct a preconstruction survey for the giant garter snake and will inspect the construction barrier and/or exclusionary fencing to ensure they are intact at the beginning of each work day. A Service-approved biologist will be onsite during all ground disturbing activities within suitable habitat to monitor construction actions and ensure that giant garter snake protection measures are being implemented properly. If any snakes are observed within the construction area during construction, the biological monitor will be notified immediately so that they can make a positive identification of the snake. If practical, photographs will be taken of any snake found dead or alive in the construction area. If a giant garter snake is found within the construction area, the biological monitor will have the authority to stop construction activities until appropriate corrective measures have been completed, or it is determined that the individual will not be harmed. Giant garter snakes encountered during construction activities will be allowed to move away from construction activities on their own. If a giant garter snake is unable to move away on its own, is trapped, or is injured, that individual will only be removed by a Service-approved biologist authorized to conduct relocation activities. The captured giant garter snake will be placed in the nearest suitable habitat that is outside of the construction area. RD 108 will provide verbal notification of relocation activities to the Service within 1 working day and will follow up with a written account of the details of the incident within 5 working days.

The biological monitor will prepare daily monitoring logs that include a description of construction activities; areas surveyed and monitored; communication with construction personnel, RD 108 and wildlife agencies; noncompliance issues and resolutions; and a list of all wildlife species observed during monitoring activities. The biological monitor will also record all observations of federally-listed species to the California Natural Diversity Database (CNDDB).

Conservation Measure 7: Implement Additional Protective Measures during Work in Suitable Habitat during the Giant Garter Snake's Dormant Period.

RD 108 will implement the following additional protective measures during time periods when work must occur during the giant garter snake dormant period (October 2 - April 30), when the species is more vulnerable to injury and mortality.

- A full-time biological monitor will be onsite for the duration of construction activities after October 1.
- All vegetation within 200 feet of aquatic habitat will be cleared prior to the giant garter snake hibernation period.
- No new excavation will be conducted within suitable upland habitat for giant garter snakes between October 2 and April 30.
- Piles of side-cast soil or debris will be removed from the construction area prior to October 1 to avoid attracting giant garter snakes to the construction area.

- Exclusionary fencing will be installed around the perimeter of the work area where construction activities associated with the fish barrier installation will take place. The fencing will enclose the work area to the maximum extent possible to prevent giant garter snakes from entering this area. Fencing will be installed during the active period for giant garter snakes to reduce the potential for injury and mortality during fence installation. The biological monitor will work with the contractor to determine where fencing should be placed and will monitor the fence installation. The exclusionary fencing will minimize opportunities for giant garter snake hibernation in the adjacent upland area.

**Action Area**

The action area is defined in 50 CFR § 402.02, as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." For the proposed project, the Service considers the action area to include the construction footprint, which encompasses the location in which the fish barrier will be constructed and the portion of the east bank of the Colusa Basin Drain where erosion control materials will be placed, as well as any areas used for access and staging. The action area also includes all areas up to 330 feet from the construction footprint in which noise from construction activities is expected to exceed ambient levels (derived from Service 2006).

**Analytical Framework for the Jeopardy Determination**

The following analysis relies on four components to support the jeopardy determination for the giant garter snake: (1) the *Status of the Species*, which evaluates the species' range wide condition, the factors responsible for that condition, and their survival and recovery needs; (2) the *Environmental Baseline*, which evaluates the condition of the species in the action area, the factors responsible for that condition, and the role of the action area in the species' survival and recovery; (3) the *Effects of the Action*, which determines the direct and indirect effects of the proposed Federal action and the effects of any interrelated or interdependent activities on the species; and (4) *Cumulative Effects*, which evaluates the effects of future, non-Federal activities in the action area on the species.

In accordance with the implementing regulations for Section 7 and Service policy, the jeopardy determination is made in the following manner: the effects of the proposed Federal action are evaluated in the context of the aggregate effects of all factors that have contributed to the current status of the giant garter snake. Additionally, for non-Federal activities in the action area, we will evaluate those actions likely to affect the species in the future, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both its survival and recovery in the wild.

The following analysis places an emphasis on using the range-wide survival and recovery needs of the giant garter snake, and the role of the action area in providing for those needs as the context for evaluating the significance of the effects of the proposed programmatic Federal action, taken together with cumulative effects, for purposes of making the jeopardy determination.

**Status of the Species**

For the most recent comprehensive assessment of the range-wide status of the giant garter snake, please refer to the *Giant Garter Snake (Thamnophis gigas) 5-year Review: Summary and Evaluation* (Service 2012). No change in the giant garter snake's listing status was recommended in the 5-year review. Threats evaluated and discussed in the final document have continued to act on the species since the 2012 5-year review was finalized, with loss of habitat being the most significant effect. While there continue to be losses of giant garter snake habitat throughout its range, to date no project has proposed a level of effect for which the Service has issued a biological opinion of jeopardy for the species.

**Environmental Baseline**

The 0.81 acre of upland habitat that will be temporarily unavailable to giant garter snakes represents a small proportion of habitat available throughout its range. The proposed project is located in the Colusa Basin watershed, which is recognized as a giant garter snake population unit in the 5-year review (Service 2012). There are four known recorded locations of the giant garter snake, some with numerous individual occurrences, within 5 miles of the proposed project (CNDDB 2015). The closest occurrence is 2.9 miles northwest of the project area within the Colusa Basin Drain (CNDDB 2015).

**Effects of the Action**

The proposed project will result in the temporary disturbance of 0.81 acre of upland habitat due to construction access and staging. These temporary effects to the upland habitat will be restored after construction. Any giant garter snakes attempting to move into or through the proposed project area will be unable to due to the conservation measures proposed by the applicant and instead will have to utilize habitat elsewhere. However, there is an abundance of upland habitat available to the species within the vicinity of the proposed project. Although there is suitable aquatic habitat for the giant garter snake on the upstream side of the KLOG structure within the Colusa Basin Drain, the proposed fish barrier and riprap placement is confined to the downstream side of the KLOG structure which is not suitable habitat for the giant garter snake due to the high-flow waters that come out of the gates.

The proposed capture and relocation of giant garter snakes to remove them from the action area will result in harassment of individuals. Stress or injury may occur as a result of handling, containment, and transport of individuals. The risk of injury or mortality of individuals due to improper handling, containment, or transport will be reduced or prevented by use of a Service-approved biologist.

**Cumulative Effects**

Cumulative effects include the effects of future State, tribal, county, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to Section 7 of the Act. The Service is not aware of any future actions that are reasonably certain to occur in the action area that could result in cumulative effects.

**Conclusion**

After reviewing the current status of the giant garter snake, the environmental baseline for the action area, the effects of the proposed project, and the cumulative effects, it is the Service's biological opinion that the Knights Landing Outfall Gates Project, as proposed, is not likely to jeopardize the continued existence of the giant garter snake. The Service reached this conclusion because the project-related effects to the species, when added to the environmental baseline and analyzed in consideration of all potential cumulative effects, will not rise to the level of precluding recovery of the giant garter snake or reducing the likelihood of survival of the giant garter snake.

## INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to Section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harass is defined by the Service regulations at 50 CFR 17.3 as an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. Harm is defined by the same regulations as an act which actually kills or injures wildlife. Harm is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavior patterns, including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of Section 7(b)(4) and Section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by the Corps so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, for the exemption in Section 7(o)(2) to apply. The Corps has a continuing duty to regulate the activity covered by this incidental take statement. If the Corps (1) fails to assume and implement the terms and conditions or (2) fails to require the applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant documents, the protective coverage of Section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Corps or RD 108 must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement [50 CFR §402.14(i)(3)].

### Amount or Extent of Take

The incidental take of the giant garter snake anticipated for the proposed project will result from the temporary loss of 0.81 acre of upland habitat. The temporary habitat loss will affect any giant garter snakes attempting to move into or through the proposed project area. Due to the fact that it is not possible to know how many giant garter snakes may try to enter the action area during proposed project construction, the Service cannot quantify the total number of giant garter snakes that we anticipate will be taken as a result of the proposed action. In instances in which the total number of individuals anticipated to be taken cannot be determined, the Service may use the amount of habitat impacted as a surrogate; since the take of individuals anticipated will result from the loss of giant garter snake habitat, the quantification of suitable habitat serves as a direct surrogate for the individuals that will be lost. In addition, there is a risk of non-lethal harm and harassment to individual giant garter snakes during the proposed capture and relocation efforts. Therefore, the Service is authorizing take incidental to the proposed project as the 0.81 acre of upland habitat that will be temporarily impacted by project activities and the capture and relocation of up to one giant garter snake within the 0.81 acre of suitable upland habitat. The Service does not anticipate any lethal take of the giant garter snake as a result of the proposed project.

Upon implementation of the following *Reasonable and Prudent Measures*, incidental take of giant garter snakes associated with the proposed project will become exempt from the prohibitions described in Section 9 of the Act. No other forms of take are exempted under this opinion.

**Effect of the Take**

In the accompanying biological opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the giant garter snake.

**Reasonable and Prudent Measures**

All necessary and appropriate measures to avoid or minimize effects on the giant garter snake resulting from implementation of this project have been incorporated into the project's proposed conservation measures. Therefore, the Service believes the following Reasonable and Prudent Measure is necessary and appropriate to minimize incidental take of the giant garter snake:

1. All conservation measures, as described in the biological assessment and restated here in the Description of the Action section of this biological opinion, shall be fully implemented and adhered to. Further, this Reasonable and Prudent Measure shall be supplemented by the Terms and Conditions below.

**Terms and Conditions**

In order to be exempt from the prohibitions of Section 9 of the Act, the Corps must ensure compliance with the following terms and conditions, which implement the reasonable and prudent measure described above. These terms and conditions are nondiscretionary.

1. The Corps shall include full implementation and adherence to the conservation measures as a condition of any permit or contract issued for the project.

2. In order to monitor whether the amount or extent of incidental take anticipated from implementation of the project is approached, the Corps shall adhere to the following reporting requirements. Should this anticipated amount or extent of incidental take be exceeded, the Corps must immediately reinitiate formal consultation as per 50 CFR 402.16.

    a. For those components of the action that will result in habitat degradation or modification whereby incidental take may occur, the Corps will notify the Service as soon as construction is completed, providing documentation that the removal did not exceed the 0.81 acre of upland habitat temporarily impacted or exceed the capture and relocation of one individual. Updates shall also include any information about changes in project implementation that result in habitat disturbance not described in the Description of the Action and not analyzed in this Biological Opinion.

    b. For those components of the action that will require the capture and relocation of any listed species, the Corps shall immediately contact the Service's Sacramento Fish and Wildlife Office (SFWO) at (916) 414-6600 to report the action. If capture and relocation need to occur after normal working hours, the Corps shall contact the SFWO at the earliest possible opportunity the next working day.

c. Any worker who inadvertently injures or kills any listed species or finds one dead, injured, or entrapped will immediately report the incident to the Service-approved biological monitor. The biological monitor will immediately notify RD 108, who will provide verbal notification to the Service's SFWO within 1 working day. RD 108 will follow up with a written notification to the Service within 5 working days.

## REINITIATION—CLOSING STATEMENT

This concludes formal consultation on the Knights Landing Outfall Gates Project. As provided in 50 CFR §402.16, reinitiation of formal consultation is required and shall be requested by the Federal agency or by the Service where discretionary Federal agency involvement or control over the action has been retained or is authorized by law and: (a) If the amount or extent of taking specified in the incidental take statement is exceeded; (b) If new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (c) If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion; or (d) If a new species is listed or critical habitat designated that may be affected by the identified action.

If you have any questions regarding this biological opinion, please contact Amber Aguilera, Fish and Wildlife Biologist, or Doug Weinrich, Assistant Field Supervisor, at (916) 414-6600.

Sincerely,

Jennifer M. Norris
Field Supervisor

## LITERATURE CITED

California Natural Diversity Data Base (CNDDB). 2015. California Department of Fish and Wildlife. RareFind version 5. Natural Heritage Division, Sacramento, California.

U.S. Fish and Wildlife Service (Service). 2012. Giant Garter Snake (*Thamnophis gigas)* 5-Year Review: Summary and Evaluation. June 2012.

_____ 2006. Estimating the Effects of Auditory and Visual Disturbance to Northern Spotted Owls and Marbled Murrelets in Northwestern California. Arcata, California.

Appendix F

# National Marine Fisheries Service Biological Opinion

**UNITED STATES DEPARTMENT OF COMMERCE**
**National Oceanic and Atmospheric Administration**
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
650 Capitol Mall, Suite 5-100
Sacramento, California 95814-4700

AUG 10 2015

**Refer to NMFS No: WCR-2015-2912**

Michael Nepstad
Deputy Chief
Regulatory Division
U.S. Army Corps of Engineers
Sacramento District
1325 J Street
Sacramento, California 95814-2922

Re: Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Knights Landing Outfall Gates Project at Knights Landing, California

Dear Mr. Nepstad:

Thank you for your letter of July 6, 2015, requesting initiation of consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq*.), and Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) of 1976, as amended (16 U.S.C. 1801 *et seq*.), for the Knights Landing Outfall Gates Project (SPK-2015-00225).

The United States Army Corps of Engineers (the Corps) serves as the lead Federal action agency in this consultation. The Corps proposes to issue a permit for placement of rock slope protection on the eroded bank immediately downstream of the existing Knights Landing outfall gates (KLOG) structure under Section 404 of the Clean Water Act. The Corps also proposes to issue a separate 408 permit that covers the construction, operation, and maintenance of a fish barrier at the downstream side of the KLOG structure under Section 14 of the Rivers and Harbors Act. The United States Bureau of Reclamation provides funding for the construction of the fish barrier under the authority of the Central Valley Project Improvement Act. The erosion repair and fish barrier construction project is proposed by Reclamation District 108. The completed fish barrier will be operated by California Department of Water Resources. The project is located on Colusa Basin Drain (CBD) that discharges water to the Sacramento River near Knights Landing, California. The primary purpose of installing the fish barrier is to prevent listed anadromous fish species from entering the CBD while maintaining outflows from the CBD.

The attached NMFS Biological Opinion (Opinion) reviews the effects of the proposed action on federally listed endangered Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*), threatened Central Valley spring-run Chinook salmon (*O. tshawytscha*), threatened California Central Valley steelhead (*O. mykiss*), the threatened Southern distinct population segment of North American green sturgeon (*Acipenser medirostris*), and their designated critical habitats, in accordance with section 7(a)(2) of the ESA.

Based on the best scientific and commercial information, the Opinion concludes that the proposed action is not likely to jeopardize the continued existence of the listed species or to destroy or adversely modify designated critical habitat. NMFS has also included an incidental take statement with reasonable and prudent measures and non-discretionary terms and conditions that are necessary and appropriate to avoid, minimize, or monitor incidental take of listed salmonids and green sturgeon associated with the project.

This letter also transmits NMFS' essential fish habitat (EFH) conservation recommendations for Pacific coast salmon as required by the MSA. The EFH consultation concludes that the execution of the proposed action will adversely affect the EFH of Pacific coast salmon in the action area. The Corps has a statutory requirement under section 305(b)(4)(B) of the MSA to submit a detailed response in writing to NMFS within 30 days of receipt of these conservation recommendations that includes a description of the measures proposed for avoiding, mitigating, or offsetting the impact of the proposed action on EFH (50 CFR 600.920 (k)). If unable to complete a final response within 30 days, the Corps should provide an interim written response within 30 days before submitting its final response.

Please contact Dr. Li-Ming (Lee) He in our California Central Valley Area Office via telephone at 916-930-5615 or email at li-ming.he@noaa.gov, if you have any questions regarding this consultation or require additional information.

Sincerely,

For William W. Stelle, Jr.
Regional Administrator

Enclosure

cc: Copy to file: ARN# 151422-WCR2015-SA00125

Mr. Evan Carnes, Regulatory Division, U.S. Army Corps of Engineers, Sacramento District, 1325 J Street, Sacramento, California 95814-2922
Ms. Shelly Hatleberg, Bureau of Reclamation, Mid-Pacific Region, 2800 Cottage Way, Sacramento, CA 95825
Mr. Lewis Bair, Reclamation District 108, 975 Wilson Bend Road, P.O. Box 50, Grimes, CA 95950
Mr. Gregg Ellis, ICF International, 630 K Street, Suite 400, Sacramento, CA 95814
Mr. Barry O'Regan, 1355 Halyard Drive, Suite 100, West Sacramento, CA 95691

**Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation**

**Knights Landing Outfall Gates Project**

NMFS Consultation Number: WCR-2015-2912

Action Agencies: U.S. Army Corps of Engineers (lead agency)
U.S. Bureau of Reclamation

Affected Species and NMFS' Determinations:

| ESA-Listed Species | Status | Is Action Likely to Adversely Affect Species or Critical Habitat? | Is Action Likely To Jeopardize the Species? | Is Action Likely To Destroy or Adversely Modify Critical Habitat? |
|---|---|---|---|---|
| Sacramento River winter-run Chinook salmon *(Oncorhynchus tshawytscha)* | Endangered | Yes | No | No |
| Central Valley spring-run Chinook salmon *(O. tshawytscha)* | Threatened | Yes | No | No |
| California Central Valley steelhead (*O. mykiss*) | Threatened | Yes | No | No |
| North American green sturgeon (*Acipenser medirostris*) | Threatened | Yes | No | No |

Essential Fish Habitat (EFH)

| Fishery Management Plan That Describes EFH in the Project Area | Does Action Have an Adverse Effect on EFH? | Are EFH Conservation Recommendations Provided? |
|---|---|---|
| Pacific coast salmon | Yes | Yes |

**Consultation Conducted By:** National Marine Fisheries Service, West Coast Region

**Issued By**:

for William W. Stelle, Jr.
Regional Administrator

**Date**:

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List of Acronyms

## Figures

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## List of Acronyms

| | |
|---|---|
| **ACID** | Anderson-Cottonwood Irrigation Dam |
| **BA** | Biological Assessment |
| **BCSSRP** | Battle Creek Salmon and Steelhead Restoration Program |
| **BMP** | Best Management Practices |
| **BO** | Biological Opinion |
| **CBD** | Colusa Basin Drain |
| **CCV** | California Central Valley |
| **CDFG** | California Department of Fish and Game |
| **CDFW** | California Department of Fish Wildlife |
| **CDWR** | California Department of Water Resources |
| **CFR** | Code of Federal Regulations |
| **cfs** | Cubic Feet per Second |
| **CNFH** | Coleman National Fish Hatchery |
| **Corps** | US Army Corps of Engineers |
| **CRR** | Cohort Replacement Rate |
| **CV** | Central Valley |
| **CVI** | Central Valley Index |
| **CVP** | Central Valley Project |
| **CWA** | Clean Water Act |
| **CWT** | Coded Wire Tag |
| **D-1641** | State Water Rights Decision 1641 |
| **DCC** | Delta Cross Channel |
| **Delta** | Sacramento-San Joaquin Delta |
| **DO** | Dissolved Oxygen |
| **DPS** | distinct population segment |
| **EFH** | Essential Fish Habitat |
| **EPA** | Environmental Protection Agency |
| **ESA** | Endangered Species Act |
| **ESU** | Evolutionarily Significant Unit |
| **FR** | Federal Register |
| **FRFH** | Feather River Fish Hatchery |
| **GCID** | Glenn-Colusa Irrigation District |
| **HU** | Hydrologic Unit |
| **IPCC** | Intergovernmental Panel on Climate Change |
| **ITS** | Incidental Take Statement |
| **JPE** | Juvenile Production Estimate |
| **KLOG** | Knights Landing Outfall Gates |
| **LSNFH** | Livingston Stone National Fish Hatchery |
| **LWM** | Large Woody Material |
| **mm** | millimeter |
| **MSA** | Magnuson-Stevens Fishery Conservation and Management Act |
| **nDPS** | Northern Distinct Population Segment |
| **NEPA** | National Environmental Policy Act |
| **NMFS** | National Marine Fisheries Service |
| **NOAA** | National Oceanic and Atmospheric Administration |
| **NRC** | National Research Council |

| | |
|---|---|
| **PCE** | primary constituent elements |
| **PVA** | Population Viability Analysis |
| **RBDD** | Red Bluff Diversion Dam |
| **Reclamation** | United States Department of the Interior, Bureau of Reclamation |
| **RM** | River Mile |
| **RSP** | Rock Slope Protection |
| **SDFPF** | Skinner Delta Fish Protection Facility |
| **sDPS** | Southern Distinct Population Segment |
| **SJRRP** | San Joaquin River Restoration Program |
| **SR** | Sacramento River |
| **SSC** | Suspended Sediment Concentration |
| **SWP** | State Water Project |
| **SWRCB** | State Water Resources Control Board |
| **TAF** | Thousand Acre Foot |
| **TCP** | Temperature Compliance Point |
| **TFCF** | Tracy Fish Collection Facility |
| **TRT** | Technical Review Team |
| **USFWS** | United States Fish and Wildlife Service |
| **VSP** | Viable Salmonid Populations |
| **WRO** | Water Rights Order |

Note: Throughout this document there are references cited as CDFG. This refers to the California Department of Fish and Game. This name was changed to California Department of Fish and Wildlife on January 1, 2013. However, for consistency on publications, references prior to January 1, 2013, will remain CDFG.

# 1. **INTRODUCTION**

This Introduction section provides information relevant to the other sections of this document and is incorporated by reference into Sections 2 and 3 below.

## 1.1. Background

NOAA's National Marine Fisheries Service (NMFS) prepared the biological opinion (Opinion) and incidental take statement portions of this document in accordance with section 7(b) of the Endangered Species Act (ESA) of 1973, as amended (16 USC 1531 *et seq*.), and implementing regulations at 50 CFR 402.

NMFS also completed an essential fish habitat (EFH) consultation on the proposed action, in accordance with section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) of 1976, as amended (16 U.S.C. 1801 *et seq*.), and implementing regulations at 50 CFR 600.

NMFS completed pre-dissemination review of this document using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). The document will be available through NMFS' Public Consultation Tracking System (pcts.nmfs.noaa.gov/pcts-web/homepage.pcts). A complete record of this consultation is on file at NMFS' California Central Valley Area Office in Sacramento, California.

## 1.2. Consultation History

On June 4, 2015, NMFS received via email the United States Army Corps of Engineers (the Corps) letter of request for section 7 consultation and an accompanying biological assessment (BA), and received the mailed hard copies of these documents on June 8, 2015.

On June 23, 2015, NMFS received the Corps' email to confirm that the Corps will be the lead Federal action agency in ESA section 7 consultation.

On June 25, 2015, NMFS sent via email to action agencies, applicant, and consultants an insufficiency letter and accompanying comments on the BA and the Corps' June 4 request letter.

On July 7, 2015, NMFS received via email the Corp's revised letter of request for formal consultation and an accompanying revised BA. NMFS initiated this consultation on July 7, 2015.

On July 13, 2015, NMFS received an email from the Corps, clarifying and affirming the Corps' discretion over the operation and maintenance of the fish barrier under Section 14 of the Rivers and Harbors Act.

## 1.3. Proposed Action

"Action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies (50 CFR 402.02).

The Corps serves as the lead Federal action agency on this ESA section 7 consultation for the proposed action. Specifically, the Corps proposes to issue a permit for placement of rock slope protection (RSP) on the eroded bank downstream of the existing Knights Landing outfall gates (KLOG) structure under Section 404 of the Clean Water Act. The Corps also proposes to issue a separate 408 permit that covers the construction, operation, and maintenance of the fish barrier under Section 14 of the Rivers and Harbors Act. Reclamation provides funding for the construction of the fish barrier under the authority of the Central Valley Project Improvement Act. The fish barrier construction and erosion repair project is proposed by Reclamation District 108. The completed fish barrier will be operated and maintained by California Department of Water Resources. The project is located on Colusa Basin Drain (CBD), in Section 14, Township 11 North, Range 2 East, Mount Diablo Meridian, Latitude 38.80001°, Longitude -121.72594°, Knights Landing, Yolo County, California. The primary purpose of installing the fish barrier is to prevent listed anadromous fish species from entering the Colusa Basin Canal while maintaining outflows from the Canal.

Approximately 10 individuals would be expected to be onsite daily during construction and repair from September 1 through October 31, 2015. Private worker vehicles would be parked along the levee top roads on either side of the channel. Equipment to be used at the construction site includes one of each of the following: crane with clamshell or long-reach excavator, dump truck, concrete pumping truck, and jackhammers.

The proposed action consists of the following activities: (1) placement of RSP for erosion repair, (2) construction of five new concrete wing walls, (3) installation of four metal picket weirs, and (4) operation and maintenance of the picket weirs. These repair and construction activities are scheduled to start on September 1, 2015 and end on October 30, 2015. Prior to these repair and construction activities, all existing radial gates on the KLOG structure will be closed during repair and construction and no water would flow through the gates. Flows in the CBD will be redirected into the Knights Landing Ridge Cut, which is approximately 2,000 feet upstream of the KLOG. Each of the four activities are described below.

### 1.3.1. Placement of Rock Slope Protection for Erosion Repair

The design of the existing outfall gate structure creates a hydraulic eddy that under certain flow conditions induces erosion of the right bank flood control levee immediately downstream of the KLOG structure. Prior to the construction of the new wing walls and installation of picket weirs, the erosion site needs to be repaired to prevent further erosion of the levee and KLOG foundation. The erosion site is approximately 100 feet long and extends approximately 30 feet up the bank from the levee toe. The physical habitat area which will be modified from the repair is estimated to be 0.07 acre. Several dead trees, which have been undercut by erosion and have fallen, will be removed prior to placement of RSP. One live tree will be removed to provide equipment access, affecting the riparian habitat area estimated to be 0.01 acre.

Repair will consist of placing approximately 500 cubic yards of clean rocks by crane using a clamshell or a long-reach excavator. This repair will return the bank to levee design conditions with a slope between 2.5:1and 3:1. It is estimated that an average of five cubic yards of riprap per running foot is required to adequately protect the bank from further erosion. The riprap will be contoured to provide a smooth transition with the existing rock protection immediately downstream of the erosion site. The maximum diameter of the riprap will be 18 inches and will be of a gradation that minimizes large voids that could be used by predator fish species.

The crane will be positioned on the concrete platform located in the staging area on the right bank of the waterway and adjacent to the KLOG structure. Material will be placed directly onto the erosion site, and a track loader will be used to reposition rock as necessary. Silt fencing/curtains will be set up around the extent of the in-water work area to prevent any sediment that may be disturbed and suspended during construction from increasing turbidity in the CBD and the Sacramento River. The toe of the silt fencing will be trenched so that the downslope face of the trench is flat and perpendicular to the line of flow. The fencing will be inspected daily and repaired as needed, with accumulated silt being removed when it reaches a depth of 6 inches.

### 1.3.2. Construction of Five New Concrete Wing Walls

Prior to the construction of new concrete wing walls, the construction site needs to be dewatered. A temporary water barrier will be installed on the downstream edge of the existing concrete apron. A traditional sheetpile cofferdam will not be used for the dewatering and construction purposes. Any remaining water in the existing concrete apron area between the temporary water barrier and the existing KLOG structure will be pumped downstream. The dewatered area is estimated to be 380 square feet. All KLOG gates will remain closed to keep the site dry through the construction period.

Once the construction site is dewatered and dry, the existing concrete sill immediately downstream of the gates (a very small footprint that sits on top of the existing, much larger concrete apron) will be removed to the edge of the existing wing walls using a jackhammer to accommodate the five new concrete wing walls that will house the picket weirs. The new wing walls are approximately 37 feet long (including the existing wing walls), 14 feet high, 14 inches thick, and 16 feet between each wall. The new wing walls will be constructed so that they incorporate the existing wing walls. The new wing walls will be formed and constructed in place on the existing dewatered apron slab. Rebar will be dowelled into the existing apron slab and encapsulated by the new wing walls. A total of five 14- inch-thick walls will be built, creating four individual channels extending out from the KLOG structure, with two radial/flap gates draining into each of the four channels. As there are two gates in each channel, an existing gate wing wall will remain in the middle of each new channel. The new wing walls will extend toward the downstream edge of the larger concrete apron, stopping 3 feet short of the end of the slab. This 3-foot-wide section will allow workers to walk between the wing walls and the edge of the slab for future routine maintenance during low-flow conditions. This space will also accommodate the dewatering structure for construction. The existing catwalk will be removed in order to accommodate the new wing walls, and a new catwalk will be installed approximately 2 feet higher than the existing one.

### 1.3.3. Installation of Four Metal Picket Weirs

Once the wing walls are constructed, the metal picket weirs will be installed in each of the four channels. The hinge point of the picket weirs will be placed at the upstream extent of the demolished concrete sill, below the edge of the existing wing walls, and the picket weirs will extend out approximately 29 feet. The bars of the picket weirs will have an outside diameter of 1.5 inches, and there will be 1 inch of space in between each of the bars. The picket weirs are made of stainless steel and will be negatively buoyant. Cable winches will be installed at the top of the KLOG structure and will be used to raise and lower the picket weirs, and stilling wells will be installed to monitor water surface elevations and inform operation of the picket weirs. The picket weirs will be designed with a maximum picket angle of 30 degrees from horizontal when the water surface is up to the top of the 14-foot high wing walls. At very low flows, the downstream end of the picket weirs will not exceed the length of the wing walls, maintaining the 3-foot clearance that will allow maintenance access. Once constructed, the picket weirs will allow water from the KLOG gates to continue to flow through the picket weirs, but as the picket weirs rise during periods when salmon could be present, the picket weirs will prevent them from reaching the gates and continuing upstream through the gates. In addition, the picket weirs will be designed, constructed, and operated to meet NMFS' requirements in the Anadromous Salmonid Passage Facility Design document (National Marine Fisheries Service 2008). Finally, cameras will be installed on the KLOG structure so debris loading can be monitored remotely.

#### 1.3.4. Operation and Maintenance of the Picket Weirs

Operations and maintenance activities associated with the proposed action include operation and maintenance of the picket weirs for a period of 30 years (until October 31, 2045). The operation of the existing KLOG gates will continue as current operations through the life of the project, except for the time of cleaning or repairing the picket weirs. Flow through the KLOG will not be changed by the proposed action. Maintenance activities include inspections of the picket weirs and associated facilities, repair as needed, removal of debris from the picket weirs, and servicing of the mechanical and electrical components of the picket weirs. Inspection, operation, and maintenance of the picket weirs will be conducted according to protocols that will be developed based on NMFS criteria (National Marine Fisheries Service 2008), particularly during adult migration seasons, to ensure that the picket weirs function as designed.

During maintenance or repair activities, the two existing radial gates that serve each channel/picket weir will be closed to provide suitable conditions for debris removal and to eliminate attraction flows into the affected channel and picket weir and allow for easier maintenance. After cleaning or repairing, the picket weir will be returned to its normal operating position, and the radial gates will be reopened. Each subsequent channel/picket weir will be maintained in a similar manner, as necessary.

### 1.4. Interrelated or Interdependent Actions

"Interrelated actions" are those that are part of a larger action and depend on the larger action for their justification. "Interdependent actions" are those that have no independent utility apart from the action under consideration (50 CFR 402.02). There are no interdependent or interrelated activities associated with the proposed action.

### 1.5. Action Area

"Action area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02).

The action area encompasses the area for access and staging and portion of the CBD between the existing KLOG structure and about 1,000 feet downstream of the KLOG structure, which is about 1,300 feet to the confluence of the Sacramento River, including the water column (up to the ordinary high water mark), canal bottom, riparian vegetation, and levee banks. The 1000-foot length of the channel represents the potential area of suspended sediment effects based on the reported limits of visible turbidity plumes in the Sacramento River during similar construction activities. The action area includes the areas where erosion repair and dewatering will occur for wing wall construction in the CBD.

# 2. ENDANGERED SPECIES ACT: BIOLOGICAL OPINION AND INCIDENTAL TAKE STATEMENT

The ESA establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat upon which they depend. As required by section 7(a)(2) of the ESA, Federal agencies must ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species, or adversely modify or destroy their designated critical habitat. Per the requirements of the ESA, Federal action agencies consult with NMFS and section 7(b)(3) requires that, at the conclusion of consultation, NMFS provides an opinion stating how the agency's actions would affect listed species and their critical habitat. If incidental take is expected, section 7(b)(4) requires NMFS to provide an incidental take statement (ITS) that specifies the impact of any incidental taking and includes non-discretionary reasonable and prudent measures and terms and conditions to minimize such impacts.

## 2.1. Analytical Approach

This biological opinion includes both a jeopardy analysis and an adverse modification analysis. The jeopardy analysis relies upon the regulatory definition of "to jeopardize the continued existence of a listed species," which is "to engage in an action that would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02). Therefore, the jeopardy analysis considers both survival and recovery of the species.

The adverse modification analysis considers the impacts of the Federal action on the conservation value of designated critical habitat. This biological opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statutory provisions of the ESA to complete the following analysis with respect to critical habitat.[1]

NMFS uses the following approach to determine whether a proposed action is likely to jeopardize listed species or destroy or adversely modify critical habitat:

(1) Identify the rangewide status of the species and critical habitat likely to be adversely affected by the proposed action.
(2) Describe the environmental baseline in the action area.

[1] Memorandum from William T. Hogarth to Regional Administrators, Office of Protected Resources, NMFS (Application of the "Destruction or Adverse Modification" Standard Under Section 7(a)(2) of the Endangered Species Act) (November 7, 2005).

(3) Analyze the effects of the proposed action on both species and their habitat using an "exposure-response-risk" approach.
(4) Describe any cumulative effects in the action area.
(5) Integrate and synthesize the above factors to assess the risk that the proposed action poses to species and critical habitat.
(6) Reach jeopardy and adverse modification conclusions.
(7) If necessary, define a reasonable and prudent alternative to the proposed action.

### 2.2. Rangewide Status of Listed Species and Critical Habitat

This Opinion examines the status of each species that would be adversely affected by the proposed action. The status is determined by the level of extinction risk that the listed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. This informs the description of the species' likelihood of both survival and recovery. The species status section also helps to inform the description of the species' current "reproduction, numbers, or distribution" as described in 50 CFR 402.02. The Opinion also examines the condition of critical habitat throughout the designated area, evaluates the conservation value of the various watersheds and coastal and marine environments that make up the designated area, and discusses the current function of the essential physical and biological features that help to form that conservation value.

The following federally listed species and designated critical habitats occur in the action area and may be affected by the proposed action:

(1) Sacramento River winter-run Chinook salmon evolutionarily significant unit (ESU) (*Oncorhynchus tshawytscha*) listed as endangered (70 FR 37160, June 28, 2005).

    Sacramento River winter-run Chinook salmon designated critical habitat (58 FR 33212, June 16, 1993).

(2) Central Valley (CV) spring-run Chinook salmon ESU (*O. tshawytscha*) listed as threatened (70 FR 37160, June 28, 2005).

    CV spring-run Chinook salmon designated critical habitat (70 FR 52488, September 2, 2005).

(3) California Central Valley (CCV) steelhead distinct population segment (DPS) (*O. mykiss*) listed as threatened (71 FR 834, January 5, 2006).

    CCV steelhead designated critical habitat (70 FR 52488, September 2, 2005).

(4) Southern DPS of North American green sturgeon (*Acipenser medirostris*) listed as threatened (71 FR 17757, April 7, 2006).

    Southern DPS of North American green sturgeon designated critical habitat (74 FR 52300, October 9, 2009).

NMFS completed an updated status review of five Pacific salmon ESUs and one steelhead DPS, and concluded that the species' status should remain as previously listed (76 FR 50447; August 15, 2011). The 2011 status reviews (NMFS 2011a, 2011b, 2011c) stated that, although the listings should remain unchanged, the status of these populations have worsened over the past five years since the 2005/2006 reviews and recommended that status be reassessed in two to three years as opposed to waiting another five years. NMFS is currently working on a status review to be completed by the end of 2015.

One factor affecting the rangewide status of the federally listed winter-run, spring-run, steelhead, and green sturgeon, and their aquatic habitat at large is climate change. It is undeniable that warming of the Earth's climate system is happening, and since the1950s, many observed changes are unprecedented over decades to millennia. The atmosphere and oceans have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of greenhouse gasses and their effects have increased. This trend continues as it is projected that the average global surface temperature may rise between 2.7°F and 8.6°F by the end of the 21st century (IPCC 2013). Much of that increase will manifest most noticeably in the oceans, as evidence suggests that the most dramatic changes to date have occurred in rising ocean temperatures, particularly in the Pacific (Karl *et al.* 2009).

In the last 100 years, sea level has risen along the California coast by 6.7 to 7.9 inches (NRC 2012). Although sea level along the California coast has been relatively constant since 1980, both global and relative North American Southwest sea levels are expected to increase at accelerated rates (Garfin 2014). This, in turn, will cause increased sedimentation, erosion, coastal flooding, and permanent inundation of low-lying natural ecosystems (e.g., salt marsh, riverine, mud flats) affecting the primary constituent elements (PCEs) of listed salmonid and sDPS green sturgeon rearing habitat.

For the Sacramento-San Joaquin Delta, the greatest impacts of sea level rise during the next 30 years will be seen during high tides, which when combined with rising sea level will allow more wave energy to reach farther inland and extend high tide periods driving increased salt water intrusion to the Delta. Owing to their anadromous life histories, listed species under NMFS jurisdiction would only be marginally impacted by the direct effects related to the increased salt water intrusion. However, DWR (2009) predicts that the reliability of the Central Valley Project and State Water Project (CVP/SWP) water supply systems will be reduced under future climate and sea level rise conditions because of the increased water demand required to fulfill water contract obligations while still meeting regulatory requirements, such as Delta water quality. By mid-century, the amount of additional water supply needed to fight saltwater intrusion and avoid dead draw on storage is expected to be 575-750 TAF. That additional water demand will further constrain the amount and quality of water available to the species, particularly in the dry summer months.

DWR (2009) also predicts that severe water shortage and CVP/SWP system interruption could occur in 1 out of every 6-8 years by mid-century. In 2015 California is experiencing its fourth straight year of below-average rainfall and very low snowmelt runoff. The impacts related to the current drought have primarily manifested themselves as reductions in surface water flows which in turn affect the quantity and quality of available habitat for key listed species. This drought has caused increases to water temperature, decreased river flows, as well as reduced access and passage, the effects of which have compounded the natural and anthropogenic threats to California anadromous species. Likewise, the condition of the State's snowpack during the last four years has continued to deteriorate which for the Central Valley watersheds that depend on Sierra snowpack melt has exacerbated the sensitivity to low flow and warm stream conditions at critical life stages.  While the optimum water temperature range for most salmonids, during most life stages, is 55-60 degrees Fahrenheit (Boles 1988, Moyle 2002), raising stream temperatures attributed to drought have also made salmon more susceptible to predators, parasites and disease (Marine and Cech 2004, Bartholomew *et al.* 2007).  With global climate change, droughts, like the one California is currently facing, and drought related impacts are becoming the new norm (NRC 2012).

### 2.2.1. Sacramento River Winter-run Chinook Salmon Evolutionarily Significant Unit

#### 2.2.1.1. History of Species Listing and Critical Habitat Designation

The Sacramento River winter-run Chinook salmon (winter-run) ESU, currently listed as endangered, was listed as a threatened species under emergency provisions of the ESA on August 4, 1989 (54 FR 32085), and formally listed as a threatened species in November 1990 (55 FR 46515).  On January 4, 1994, NMFS re-classified winter-run as an endangered species (59 FR 440).  NMFS concluded that winter-run in the Sacramento River warranted listing as an endangered species due to several factors, including: (1) the continued decline and increased variability of run sizes since its first listing as a threatened species in 1989; (2) the expectation of weak returns in future years as the result of two small year classes (1991 and 1993); and (3) continued threats to the "take" of winter-run (76 FR 50447, August 15, 2011).

On June 28, 2005, NMFS concluded that the winter-run ESU was "in danger of extinction" due to risks to the ESU's diversity and spatial structure and, therefore, continues to warrant listing as an endangered species under the ESA (70 FR 37160).  In August 2011, NMFS completed a 5-year status review of five Pacific salmon ESUs, including the winter-run ESU, and determined that the species' status should again remain as "endangered" (August 15, 2011, 76 FR 50447). The 2011 review concluded that although the listing remained unchanged since the 2005 review, the status of the population had declined over the past five years (2005–2010).

The winter-run ESU currently consists of only one population that is confined to the upper Sacramento River (spawning below Shasta and Keswick dams) in California's Central Valley. In addition, an artificial propagation program at the Livingston Stone National Fish Hatchery (LSNFH) produces winter-run that are considered to be part of this ESU (June 28, 2005, 70 FR 37160).  Most components of the winter-run life history (*e.g.*, spawning, egg incubation, freshwater rearing) have been compromised by the habitat blockage in the upper Sacramento River.  All historical spawning and rearing habitats have been blocked since the construction of Shasta Dam in 1943.  Remaining spawning and rearing areas are completely dependent on cold water releases from Shasta Reservoir in order to sustain the remnant population.

NMFS designated critical habitat for winter-run on June 16, 1993 (58 FR 33212).  Critical habitat was delineated as the Sacramento River from Keswick Dam at river mile (RM) 302 to Chipps Island, RM 0, at the westward margin of the Sacramento-San Joaquin Delta (Delta), including Kimball Island, Winter Island, and Brown's Island; all waters from Chipps Island westward to the Carquinez Bridge, including Honker Bay, Grizzly Bay, Suisun Bay, and the Carquinez Strait; all waters of San Pablo Bay westward of the Carquinez Bridge, and all waters of San Francisco Bay north of the San Francisco-Oakland Bay Bridge from San Pablo Bay to the

Golden Gate Bridge.  In the Sacramento River, critical habitat includes the river water, river bottom, and the adjacent riparian zone.

2.2.1.2. Critical Habitat and Essential Features

Critical habitat for winter-run is defined as specific areas (listed below) that contain the physical and biological features considered essential to the conservation of the species (Figure 1).  This designation includes the river water, river bottom (including those areas and associated gravel used by winter-run as spawning substrate), and adjacent riparian zone used by fry and juveniles for rearing (June 16, 1993, 58 FR 33212).  NMFS limits "adjacent riparian zones" to only those areas above a stream bank that provide cover and shade to the near shore aquatic areas. Although the bypasses (*e.g.*, Yolo, Sutter, and Colusa) are not currently designated critical habitat for winter-run, NMFS recognizes that they may be utilized when inundated with Sacramento River flood flows and are important rearing habitats for juvenile winter-run.  Also, juvenile winter-run may use tributaries of the Sacramento River for non-natal rearing (Maslin *et al.* 1997b, Pacific States Marine Fisheries Commission (PSMFC) 2014).  Critical habitat also includes the estuarine water column and essential foraging habitat and food resources used by winter-run as part of their juvenile outmigration or adult spawning migration.

The following is the status of the physical and biological habitat features that are considered to be essential for the conservation of winter-run (June 16, 1993, 58 FR 33212).

(1) Adult Migration Corridors

Adult migration corridors are defined as providing "access from the Pacific Ocean to appropriate spawning areas" and which provide access from the Pacific Ocean to appropriate spawning areas, providing satisfactory water quality, water quantity, water temperature, water velocity, cover, shelter, and safe passage conditions in order for adults to reach spawning areas.  Adult winter-run generally migrate to spawning areas during the winter and spring.  At that time of year, the migration route is accessible to the appropriate spawning grounds on the upper 60 miles of the Sacramento River, however much of this migratory habitat is degraded and they must pass through a fish ladder at the Anderson-Cottonwood Irrigation Dam (ACID).  In addition, the many flood bypasses are known to strand adults in agricultural drains due to inadequate screening (Vincik and Johnson 2013a).  Since the primary migration corridors are essential for connecting early rearing habitat with the ocean, even the degraded reaches are considered to have a high intrinsic conservation value to the species.

(2) Spawning Habitat

Spawning habitat is defined as "the availability of clean gravel for spawning substrate." Suitable spawning habitat for winter-run exists in the upper 60 miles of the Sacramento River between Keswick Dam and Red Bluff Diversion Dam (RBDD).  However, the majority of spawning habitat currently being used occurs in the first 10 miles below Keswick Dam.  The available spawning habit is completely outside the historical range utilized by winter-run upstream of Keswick Dam.  Because Shasta and Keswick dams block gravel recruitment, Reclamation annually injects spawning gravel into various areas of the upper Sacramento River.  With the supplemented gravel injections, the upper Sacramento River reach continues to support a small naturally-spawning winter-run population.  Even in degraded reaches, spawning habitat has a high conservation value as its function directly affects the spawning success and reproductive potential of listed salmonids.

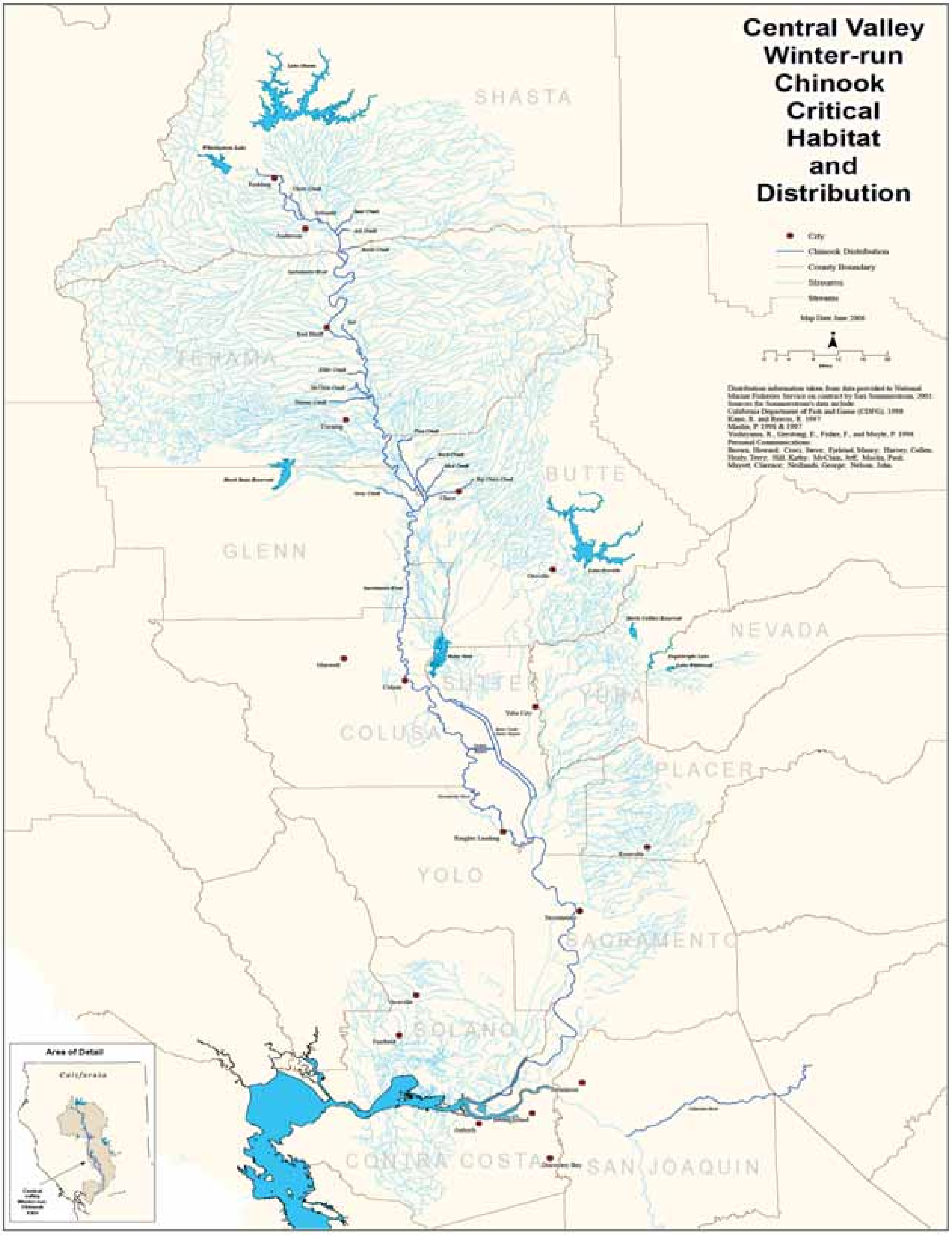



Figure 1. Winter-run Chinook salmon distribution and critical habitat in the Central Valley.

(3) Adequate River Flows

Adequate River flows are defined as providing “adequate river flows for successful spawning, incubation of eggs, fry development and emergence, and downstream transport of juveniles.” An April 5, 1960, Memorandum of Agreement between Reclamation and the California Department of Fish and Wildlife (CDFW, formerly California Department of Fish and Game) originally established flow objectives in the Sacramento River for the protection and preservation of fish and wildlife resources. In addition, Reclamation complies with the 1990 flow releases required in State Water Resource Control Board (SWRCB) Water Rights Order (WRO) 90-05 for the protection of Chinook salmon. This order includes a minimum flow release of 3,250 cubic feet per second (cfs) from Keswick Dam downstream to RBDD from September through February during all water year types, except critically dry.

(4) Water Temperatures

Water temperatures are defined as “water temperatures at 5.8–14.1°C (42.5–57.5°F) for successful spawning, egg incubation, and fry development.” Summer flow releases from Shasta Reservoir for agriculture and other consumptive uses drive operations of Shasta and Keswick dam water releases during the period of winter-run migration, spawning, egg incubation, fry development, and emergence. This pattern, the opposite of the pre-dam hydrograph, benefits winter-run by providing cold water for miles downstream during the hottest part of the year. The extent to which winter-run habitat needs are met depends on Reclamation’s other operational commitments, including those to water contractors, Delta requirements pursuant to State Water Rights Decision 1641 (D-1641), and Shasta Reservoir end of September storage levels required in the NMFS 2009 biological opinion on the long-term operations of the CVP/SWP (NMFS 2009a). WRO 90-05 and 91-1 require Reclamation to operate Shasta, Keswick, and Spring Creek Powerhouse to meet a daily average water temperature of 13.3°C (56°F) at RBDD. They also provide the exception that the water temperature compliance point (TCP) may be modified when the objective cannot be met at RBDD. Based on these requirements, Reclamation models monthly forecasts and determines how far downstream 13.3°C (56°F) can be maintained throughout the winter-run spawning, egg incubation, and fry development stages.

In every year since WRO 90-05 and 91-1 were issued, operation plans have included modifying the TCP to make the best use of the cold water available based on water temperature modeling and current spawning distribution. Once a TCP has been identified and established in May, it generally does not change, and therefore, water temperatures are typically adequate through the summer for successful winter-run egg incubation and fry development for those redds constructed upstream of the TCP (except for in some critically dry and drought years). However, by continually moving the TCP upstream, the value of that habitat is degraded by reducing the spawning area in size and imprinting upon the next generation to return further upstream.

(5) Habitat and Adequate Prey Free of Contaminants

Water quality conditions have improved since the 1980s due to stricter standards and Environmental Protection Agency (EPA) Superfund site cleanups (see Iron Mountain Mine remediation under Factors). No longer are there fish kills in the Sacramento River caused by the heavy metals (*e.g.,* lead, zinc and copper) found in the Spring Creek runoff. However, legacy contaminants such as mercury (and methyl mercury), polychlorinated biphenyls, heavy metals and persistent organochlorine pesticides continue to be found in watersheds throughout the Central Valley. In 2010, the EPA, listed the Sacramento River as impaired under the Clean Water Act, section 303(d), due to high levels of pesticides, herbicides, and heavy metals (http://www.waterboards.ca.gov/water_issues/programs/tmdl/2010state_ir_reports/category5_report.shtml). Although most of these contaminants are at low concentrations in the food chain, they continue to work their way into the base of the food web, particularly when sediments are disturbed and previously entombed compounds are released into the water column.

Adequate prey for juvenile salmon to survive and grow consists of abundant aquatic and terrestrial invertebrates that make up the majority of their diet before entering the ocean. Exposure to these contaminated food sources such as invertebrates may create delayed sublethal effects that reduce fitness and survival (Laetz *et al.* 2009). Contaminants are typically associated with areas of urban development, agriculture, or other anthropogenic activities (*e.g.*, mercury contamination as a result of gold mining or processing). Areas with low human impacts frequently have low contaminant burdens, and therefore lower levels of potentially harmful toxicants in the aquatic system. Freshwater rearing habitat has a high intrinsic conservation value even if the current conditions are significantly degraded from their natural state.

(6) Riparian and Floodplain Habitat

Riparian and floodplain habitat is defined as providing "for successful juvenile development and survival." The channelized, leveed, and riprapped river reaches and sloughs that are common in the Sacramento River system typically have low habitat complexity, low abundance of food organisms, and offer little protection from predators. Juvenile life stages of salmonids are dependent on the natural functioning of this habitat for successful survival and recruitment. Ideal habitat contains natural cover, such as riparian canopy structure, submerged and overhanging large woody material (LWM), aquatic vegetation, large rocks and boulders, side channels, and undercut banks which augment juvenile and adult mobility, survival, and food supply. Riparian recruitment is prevented from becoming established due to the reversed hydrology (*i.e*., high summer time flows and low winter flows prevent tree seedlings from establishing). However, there are some complex, productive habitats within historical floodplains [*e.g.*, Sacramento River reaches with setback levees (*i.e.*, primarily located upstream of the City of Colusa)] and flood bypasses (*i.e.*, fish in Yolo and Sutter bypasses experience rapid growth and higher survival due to abundant food resources) seasonally available that remain in the system. Nevertheless, the current condition of degraded riparian habitat along the mainstem Sacramento River restricts juvenile growth and survival (Michel 2010, Michel *et al.* 2012).

(7) Juvenile Emigration Corridors

Juvenile emigration corridors are defined as providing "access downstream so that juveniles can migrate from the spawning grounds to San Francisco Bay and the Pacific Ocean." Freshwater emigration corridors should be free of migratory obstructions, with water quantity and quality conditions that enhance migratory movements. Migratory corridors are downstream of the Keswick Dam spawning areas and include the mainstem of the Sacramento River to the Delta, as well as non-natal rearing areas near the confluence of some tributary streams.

Migratory habitat condition is strongly affected by the presence of barriers, which can include dams (*i.e.*, hydropower, flood control, and irrigation flashboard dams), unscreened or poorly screened diversions, degraded water quality, or behavioral impediments to migration. For successful survival and recruitment of salmonids, freshwater migration corridors must function sufficiently to provide adequate passage. Unscreened diversions that entrain juvenile salmonids are prevalent throughout the mainstem Sacramento River and in the Delta. Predators such as striped bass (*Morone saxatilis*) and Sacramento pikeminnow (*Ptychocheilus grandis*) tend to concentrate immediately downstream of diversions, resulting in increased mortality of juvenile Chinook salmon.

Water exports at the CVP/SWP facilities in the South Delta at times causes the flow in the river to move back upstream (reverse flow), further disrupting the emigration of juvenile winter-run by attracting and diverting them to the interior Delta, where they are exposed to increased rates of predation, other stressors in the Delta, and entrainment at pumping stations. NMFS' biological opinion on the long-term operations of the CVP/SWP (National Marine Fisheries Service 2009a) sets limits to the strength of reverse flows in the Old and Middle Rivers, thereby keeping salmon away from areas of highest mortality. Regardless of the condition, the remaining estuarine areas are of high conservation value because they provide factors which function to as rearing habitat and as an area of transition to the ocean environment.

(8) Summary of the Essential Features of Critical Habitat

Critical habitat for winter-run is composed of physical and biological features that are essential for the conservation of winter-run, including upstream and downstream access, and the availability of certain habitat conditions necessary to meet the biological requirements of the species. Currently, many of these physical and biological features are degraded, and provide limited high quality habitat. Additional features that lessen the quality of the migratory corridor for juveniles include unscreened diversions, altered flows in the Sacramento River and the Delta, and the lack of floodplain habitat.

In addition, water operations that limit the extent of cold water below Shasta Dam have reduced the available spawning habitat (based on water temperature). Although the habitat for winter-run has been highly degraded, the importance of the reduced spawning habitat, migratory corridors, and rearing habitat that remains is of high conservation value.

2.2.1.3.Life History

(1) Adult Migration and Spawning

Winter-run exhibit a unique life history pattern (Healey 1994) compared to other salmon populations in the Central Valley (*i.e.*, spring-run, fall-run, and late-fall run), in that they spawn in the summer, and the juveniles are the first to enter the ocean the following winter and spring. Adults first enter San Francisco Bay from November through June (Hallock and Fisher 1985) and migrate up the Sacramento River, past the RBDD from mid-December through early August (National Marine Fisheries Service 1997). The majority of the run passes RBDD from January through May, with the peak passage occurring in mid-March (Hallock and Fisher 1985). The timing of migration may vary somewhat due to changes in river flows, dam operations, and water year type (see Table 1) (Yoshiyama *et al.* 1998, Moyle 2002).

Winter-run tend to enter freshwater while still immature and travel far upriver and delay spawning for weeks or months upon arrival at their spawning grounds (Healey 1991). Spawning occurs primarily from mid-May to mid-August, with the peak activity occurring in June and July in the upper Sacramento River reach (50 miles) between Keswick Dam and RBDD (Vogel and Marine 1991). Winter-run deposit and fertilize eggs in gravel beds known as redds excavated by the female that then dies following spawning. Average fecundity was 5,192 eggs/female for the 2006–2013 returns to LSNFH, which is similar to other Chinook salmon runs [*e.g.*, 5,401 average for Pacific Northwest (Quinn 2005)]. Chinook salmon spawning requirements for depth and velocities are broad, and the upper preferred water temperature is between 55–57°F (13–14°C) degrees (Snider *et al.* 2001). The majority of winter-run adults return after three years.

Table 1. The temporal occurrence of adult (a) and juvenile (b) winter-run in the Sacramento River. Darker shades indicate months of greatest relative abundance.

| Winter run relative abundance | High | | | | Medium | | | | Low | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **a) Adults freshwater** | | | | | | | | | | | | |
| Location | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| Sacramento River basin[a,b] | | | | | | | | | | | | |
| Upper Sacramento River spawning[c] | | | | | | | | | | | | |
| **b) Juvenile emigration** | | | | | | | | | | | | |
| Location | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| Sacramento River at Red Bluff [d] | | | | | | | | | | | | |
| Sacramento River at Knights Landing[e] | | | | | | | | | | | | |
| Sacramento trawl at Sherwood Harbor[f] | | | | | | | | | | | | |
| Midwater trawl at Chipps Island[g] | | | | | | | | | | | | |

Sources: [a] (Yoshiyama *et al.* 1998); (Moyle 2002); [b](Myers *et al.* 1998) ; [c] (Williams 2006) ; [d] (Martin *et al.* 2001); [e] Knights Landing Rotary Screw Trap Data, CDFW (1999-2011); [f,g] Delta Juvenile Fish Monitoring Program, USFWS (1995-2012)

(2) Egg Incubation and Fry Emergence

Winter-run incubating eggs are vulnerable to adverse effects from floods, flow fluctuations, siltation, desiccation, disease, predation during spawning, poor gravel percolation, and poor water quality. The optimal water temperature for egg incubation ranges from 46–56°F (7.8–13.3°C) and a significant reduction in egg viability occurs in mean daily water temperatures above 57.5°F (14.2°C); (Seymour 1956, Boles 1988, U.S. Fish and Wildlife Service 1998, U.S. Environmental Protection Agency 2003, Richter and Kolmes 2005, Geist *et al.* 2006). Total embryo mortality can occur at temperatures above 62°F (16.7°C); (National Marine Fisheries Service 1997). Depending on ambient water temperature, embryos hatch within 40-60 days and alevin (yolk-sac fry) remain in the gravel beds for an additional 4–6 weeks. As their yolk-sacs become depleted, fry begin to emerge from the gravel and start exogenous feeding in their natal stream, typically in late July to early August and continuing through October (Fisher 1994).

(3) Juvenile Rearing and Outmigration

Juvenile winter-run have been found to exhibit variability in their life history dependent on emergence timing and growth rates (Beckman *et al.* 2007). Following spawning, egg incubation, and fry emergence from the gravel, juveniles begin to emigrate in the fall. Some juvenile winter-run migrate to sea after only 4 to 7 months of river life, while others hold and rear upstream and spend 9 to 10 months in freshwater. Emigration of juvenile winter-run fry and pre-smolts past RBDD (RM 242) may begin as early as mid-July, but typically peaks at the end of September (Table 1), and can continue through March in dry years (Vogel and Marine 1991, National Marine Fisheries Service 1997).

(4) Estuarine/Delta Rearing

Juvenile winter-run emigration into the Delta and estuary occurs primarily from November through early May based on data collected from trawls in the Sacramento River at Sherwood Harbor (West Sacramento), RM 57 (U.S. Fish and Wildlife Service 2001). The timing of emigration may vary somewhat due to changes in river flows, Shasta Dam operations, and water year type, but has been correlated with the first storm event when flows exceed 14,000 cfs at Knights Landing, RM 90, which trigger abrupt emigration towards the Delta (del Rosario *et al.* 2013). The average residence time in the Delta for juvenile winter-run is approximately 3 months based on median seasonal catch between Knights Landing and Chipps Island. In general, the earlier juvenile winter-run enter the Delta, the longer they stay and rear. Peak departure at Chipps Island regularly occurs in March (del Rosario *et al.* 2013). The Delta serves as an important rearing and transition zone for juvenile winter-run as they feed and physiologically adapt to marine waters during the smoltification process (change from freshwater to saltwater). The majority of juvenile winter-run in the Delta are 104 to 128 millimeters (mm) in size based on U.S. Fish and Wildlife Service (USFWS) trawl data (1995-2012), and from 5 to 10 months of age, by the time they depart the Delta (Fisher 1994, Myers *et al.* 1998).

(5) Ocean Rearing

Winter-run smolts enter the Pacific Ocean mainly in spring (March–April), and grow rapidly on a diet of small fishes, crustaceans, and squid. Salmon runs that migrate to sea at a larger size tend to have higher marine survival rates (Quinn 2005). The diet composition of Chinook salmon from California consist of anchovy, rockfish, herring, and other invertebrates (in order of preference, (Healey 1991). Most Chinook from the Central Valley move northward into Oregon and Washington, where herring make up the majority of their diet. However, winter-run upon entering the ocean, tend to stay near the California coast and distribute from Point Arena southward to Monterey Bay. Winter-run have high metabolic rates, feed heavily, and grow fast, compared to other fishes in their range. They can double their length and increase their weight more than ten-fold in the first summer at sea (Quinn 2005). Mortality is typically highest in the first summer at sea, but can depend on ocean conditions. Winter-run abundance has been correlated with ocean conditions, such as periods of strong up-welling, cooler temperatures, and El Nino events (Lindley *et al.* 2009c). Winter-run spend approximately 1-2 years rearing in the ocean before returning to the Sacramento River as 2-3 year old adults. Very few winter-run reach age 4. Once they reach age 3, they are large enough to become vulnerable to commercial and sport fisheries.

2.2.1.4. Population Viability

NMFS has developed a framework for analyzing the viability of salmonid populations by identifying attributes of a viable salmonid population (VSP). The intent of this framework is to provide parties with the ability to assess the effects of management and conservation actions and to ensure that their actions promote the listed species' survival and recovery. The VSP concept measures population performance in term of four key parameters: abundance, population growth rate, spatial structure, and diversity (McElhany *et al.* 2000b). We analyze each of the parameters below.

(1) Abundance

Historically, winter-run population estimates were as high as 120,000 fish in the 1960s, but declined to less than 200 fish by the 1990s (National Marine Fisheries Service 2011c). In recent years, since carcass surveys began in 2001 (Figure 2), the highest adult escapement occurred in 2005 and 2006 with 15,839 and 17,296, respectively. However, from 2007 to 2013, the population has shown a precipitous decline, averaging 2,486 during this period, with a low of 827 adults in 2011 (Figure 2). This recent declining trend is likely due to a combination of factors such as poor ocean productivity (Lindley *et al.* 2009c), drought conditions from 2007-2009, and low in-river survival (National Marine Fisheries Service 2011c). In 2014, the population was 3,015 adults, slightly above the 2007–2012 average, but below the high (17,296) for the last ten years.

Although impacts from hatchery fish (*i.e*., reduced fitness, weaker genetics, smaller size, diminished ability to avoid predators) are often cited as having deleterious impacts on natural in-river populations (Matala *et al.* 2012), the winter-run conservation program at LSNFH is strictly controlled by the USFWS to reduce such impacts. The average annual hatchery production at LSNFH is approximately 176,348 per year (2001–2010 average) compared to the estimated natural production that passes RBDD, which is 4.7 million per year based on the 2002–2010 average (Poytress and Carrillo 2011). Therefore, hatchery production typically represents approximately 3-4 percent of the total in-river juvenile production in any given year.

2014 was the third year of a drought which increased water temperatures in the upper Sacramento River. This caused significantly higher mortality (95-97%) in the upper spawning area. Due to the anticipated lower than average survival in 2014, hatchery production from LSNFH was tripled to offset the impact of the drought. In 2014, hatchery production represented 50-60% of the total in-river juvenile production. Drought conditions have continued into 2015 and hatchery production will again be increased.

(2) Productivity

Winter-run productivity was positive over the period 1998–2006, and adult escapement and juvenile production had been increasing annually until 2007, when productivity became negative (Figure 3) with declining escapement estimates. The long-term trend for winter-run, therefore, remains negative, as the productivity is subject to impacts from environmental and artificial conditions. The population growth rate based on cohort replacement rate (CRR) for the period

2007–2012 suggested a reduction in productivity (Figure 3), and indicated that the winter-run population was not replacing itself. In 2013, and 2014, winter-run experienced a positive CRR, possibly due to favorable in-river conditions in 2011, and 2012 (wet years), which may have increased juvenile survival to the ocean.

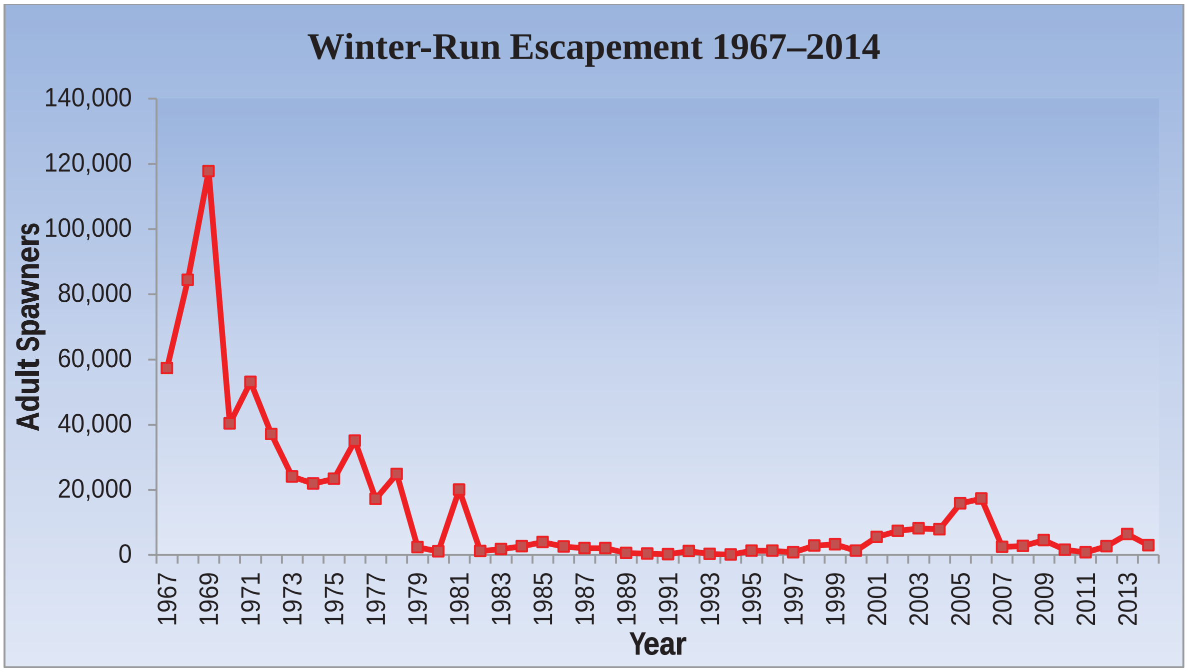



Figure 2. Winter-run Chinook salmon escapement numbers 1970-2014, includes hatchery broodstock and tributaries, but excludes sport catch. RBDD ladder counts used pre-2000, carcass surveys post 2001 (California Department of Fish and Game 2012).

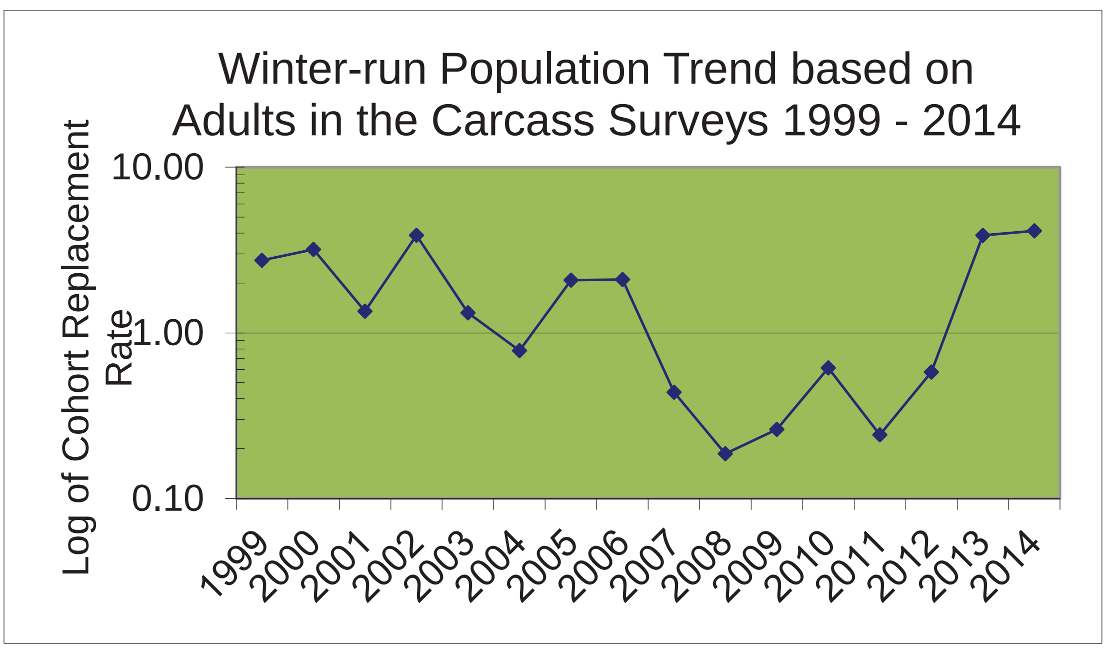



Figure 3. Winter-run population trend using cohort replacement rate derived from adult escapement, including hatchery fish, 1999–2014.

Lindley and Mohr (2003) assessed the viability of the population using a Bayesian model based on spawning escapement that allowed for density dependence and a change in population growth rate in response to conservation measures found a biologically significant expected quasi-extinction probability of 28 percent. Although the growth rate for the winter-run population improved up until 2006, it exhibits the typical variability found in most endangered species populations. The fact that there is only one population, dependent upon cold-water releases from Shasta Reservoir, makes it vulnerable to periods of prolonged drought (National Marine Fisheries Service 2011c). Productivity, as measured by the number of juveniles entering the Delta, or juvenile production estimate (JPE), has declined in recent years from a high of 3.8 million in 2007 to 124,521 in 2014 (Table 2). Due to uncertainties in the various JPE factors, it was updated in 2010 with the addition of confidence intervals (Cramer Fish Sciences model), and again in 2013, and 2014 with a change in survival based on acoustic tag data (National Marine Fisheries Service 2014b). However, juvenile winter-run productivity is still much lower than other Chinook salmon runs in the Central Valley and in the Pacific Northwest (Michel 2010).

Table 2**.** Winter-run adult and juvenile population estimates based on RBDD counts (1986–2001) and carcass counts (2001–2014), with corresponding 3-year-cohort replacement rates.

| **Return Year** | **Adult Population Estimate**[a] | **Cohort Replacement Rate**[b] | **Juvenile Production Estimate (JPE)**[c] |
|---|---|---|---|
| 1986 | 2596 | | |
| 1987 | 2185 | | |
| 1988 | 2878 | | |
| 1989 | 696 | 0.27 | |
| 1990 | 430 | 0.20 | |
| 1991 | 211 | 0.07 | |
| 1992 | 1240 | 1.78 | 40,100 |
| 1993 | 387 | 0.90 | 273,100 |
| 1994 | 186 | 0.88 | 90,500 |
| 1995 | 1297 | 1.05 | 74,500 |
| 1996 | 1337 | 3.45 | 338,107 |
| 1997 | 880 | 4.73 | 165,069 |
| 1998 | 2992 | 2.31 | 138,316 |
| 1999 | 3288 | 2.46 | 454,792 |
| 2000 | 1352 | 1.54 | 289,724 |
| 2001 | 8224 | 2.75 | 370,221 |
| 2002 | 7441 | 2.26 | 1,864,802 |
| 2003 | 8218 | 6.08 | 2,136,747 |
| 2004 | 7869 | 0.96 | 1,896,649 |
| 2005 | 15839 | 2.13 | 881,719 |
| 2006 | 17296 | 2.10 | 3,556,995 |
| 2007 | 2542 | 0.32 | 3,890,534 |
| 2008 | 2830 | 0.18 | 1,100,067 |
| 2009 | 4537 | 0.26 | 1,152,043 |
| 2010 | 1,596 | 0.63 | 1,144,860 |

| | | | |
|---|---|---|---|
| 2011 | 827 | 0.29 | 332,012 |
| 2012 | 2,674 | 0.59 | 162,051 |
| 2013 | 6,075 | 3.88 | 1,196,387 |
| 2014 | 3,015 | 4.13 | 124,521 |
| **median** | 3,709 | 0.95 | 874,931 |

[a] Population estimates include hatchery returns based on RBDD ladder counts until 2001, after which the methodology changed to carcass surveys (California Department of Fish and Game 2012).
[b] Assumes all adults return after three years. CRR is calculated using the adult spawning population, divided by the spawning population three years prior. Two year old returns were not used.
[c] Includes survival estimates from spawning to Delta (*i.e.*, Sacramento at I St Bridge) entrance, but does not include through-Delta survival.

(3) Spatial Structure

The distribution of winter-run spawning and initial rearing historically was limited to the upper Sacramento River (upstream of Shasta Dam), McCloud River, Pitt River, and Battle Creek, where springs provided cold water throughout the summer, allowing for spawning, egg incubation, and rearing during the mid-summer period (Slater 1963) (Yoshiyama *et al.* 1998). The construction of Shasta Dam in 1943 blocked access to all of these waters except Battle Creek, which currently has its own impediments to upstream migration (*i.e.*, a number of small hydroelectric dams situated upstream of the Coleman National Fish Hatchery weir). The Battle Creek Salmon and Steelhead Restoration Project (BCSSRP) is currently removing these impediments, which should restore spawning and rearing habitat for winter-run in the future. Approximately 299 miles of former tributary spawning habitat above Shasta Dam is inaccessible to winter-run. Yoshiyama *et al.* (2001) estimated that in 1938, the upper Sacramento River had a "potential spawning capacity" of approximately 14,000 redds equal to 28,000 spawners. Since 2001, the majority of winter-run redds have occurred in the first 10 miles downstream of Keswick Dam. Most components of the winter-run life history (*e.g.*, spawning, incubation, freshwater rearing) have been compromised by the construction of Shasta Dam.

The greatest risk factor for winter-run lies within its spatial structure (National Marine Fisheries Service 2011c). The remnant and remaining population cannot access 95 percent of their historical spawning habitat, and must therefore be artificially maintained in the Sacramento River by: (1) spawning gravel augmentation, (2) hatchery supplementation, and, (3) regulating the finite cold-water pool behind Shasta Dam to reduce water temperatures. Winter-run require cold water temperatures in the summer that simulate their upper basin habitat, and they are more likely to be exposed to the impacts of drought in a lower basin environment. Battle Creek is currently the most feasible opportunity for winter-run to expand its spatial structure, but restoration is not scheduled to be completed until 2017. The Central Valley Salmon and Steelhead Recovery Plan includes criteria for recovering the winter-run ESU, including re-establishing a population into historical habitats upstream of Shasta Dam (NMFS 2014). Additionally, NMFS (2009a) included a requirement for a pilot fish passage program above Shasta Dam.

(4) Diversity

The current winter-run population is the result of the introgression of several stocks (*e.g.*, spring-run and fall-run Chinook) that occurred when Shasta Dam blocked access to the upper watershed. A second genetic bottleneck occurred with the construction of Keswick Dam which blocked access and did not allow spatial separation of the different runs (Good *et al.* 2005). Lindley *et al.* (2007) recommended reclassifying the winter-run population extinction risk from low to moderate, if the proportion of hatchery origin fish from the LSNFH exceeded 15 percent due to the impacts of hatchery fish over multiple generations of spawners. Since 2005, the percentage of hatchery winter-run recovered in the Sacramento River has only been above 15 percent in two years, 2005 and 2012 (Figure 4).

Concern over genetic introgression within the winter-run population led to a conservation program at LSNFH that encompasses best management practices such as: (1) genetic confirmation of each adult prior to spawning, (2) a limited number of spawners based on the effective population size, and (3) use of only natural-origin spawners since 2009. These practices reduce the risk of hatchery impacts on the wild population. Hatchery-origin winter-run have made up more than 5 percent of the natural spawning run in recent years and in 2012, it exceeded 30 percent of the natural run (Figure 4). However, the average over the last 16 years (approximately 5 generations) has been 8 percent, still below the low-risk threshold (15 percent) used for hatchery influence (Lindley *et al.* (2007).

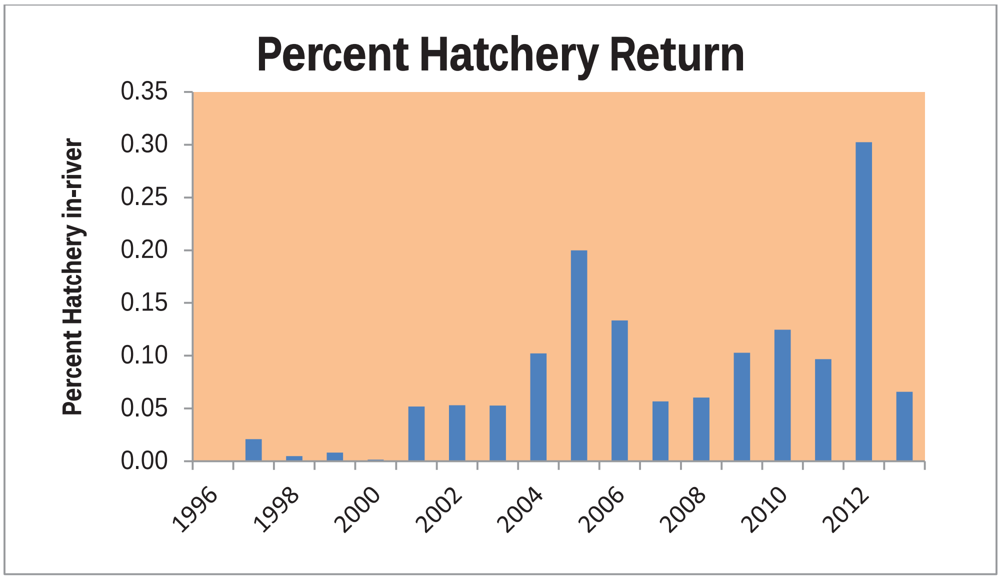



Figure 4. Percentage of hatchery-origin winter-run Chinook salmon naturally spawning in the Sacramento River (1996–2013). Source: CDFW carcass surveys, 2013.

(5) Summary of ESU Viability

There are several criteria (only one is required) that would qualify the winter-run ESU at moderate risk of extinction, and since there is still only one population that spawns below Keswick Dam, that population would be at high risk of extinction in the long-term according to the criteria in (Lindley *et al.* 2007). Recent trends in those criteria are: (1) continued low abundance (Figure 2); (2) a negative growth rate over 6 years (2006–2012), which is two complete generations (Figure 3); (3) a significant rate of decline since 2006; and (4) increased risk of catastrophe from oil spills, wild fires, or extended drought (climate change). The most recent 5-year status review (National Marine Fisheries Service 2011c) on winter-run concluded that the ESU had increased to a high risk of extinction. In summary, the most recent biological information suggests that the extinction risk for the winter-run ESU has increased from moderate risk to high risk of extinction since 2005 (last review), and that several listing factors have contributed to the recent decline, including drought and poor ocean conditions (National Marine Fisheries Service 2011c).

### 2.2.2. Central Valley Spring-run Chinook Salmon Evolutionarily Significant Unit

#### 2.2.2.1. History of Species Listing and Critical Habitat Designation

Central Valley spring-run Chinook salmon (spring-run) were originally listed as threatened on September 16, 1999 (64 FR 50394). This ESU consists of spring-run occurring in the Sacramento River basin. The Feather River Fish Hatchery (FRFH) spring-run population has been included as part of the spring-run ESU in the most recent CV spring-run listing decision (70 FR 37160, June 28, 2005). Although FRFH spring-run production is included in the ESU, these fish do not have a section 9 take prohibition. Critical habitat was designated for spring-run on September 2, 2005 (70 FR 52488).

In August 2011, NMFS completed an updated status review of five Pacific Salmon ESUs, including spring-run, and concluded that the species' status should remain as previously listed (76 FR 50447). The 2011 Status Review (NMFS 2011) additionally stated that although the listings will remain unchanged since the 2005 review, and the original 1999 listing (64 FR 50394), the status of these populations has worsened over the past five years and recommended that the status be reassessed in two to three years as opposed to waiting another five years.

#### 2.2.2.2. Critical Habitat and Primary Constituent Elements

Critical habitat for spring-run includes stream reaches of the Feather, Yuba, and American rivers, Big Chico, Butte, Deer, Mill, Battle, Antelope, and Clear creeks, and the Sacramento River, as well as portions of the northern Delta. Critical habitat includes the stream channels in the designated stream reaches (70 FR 52488). Critical habitat for spring-run is defined as specific areas that contain the PCEs and physical habitat elements essential to the conservation of the species. The PCEs for spring-run are described below.

(1) Spawning Habitat

Freshwater spawning sites are those with sufficient water quantity and quality conditions and substrate supporting spawning, incubation, and larval development. Most spawning habitat in the Central Valley for Chinook salmon is located in areas directly downstream of dams containing suitable environmental conditions for spawning and incubation. Spawning habitat for spring-run occurs on the mainstem Sacramento River between the RBDD and Keswick Dam and in tributaries such as Mill, Deer, and Butte creeks, as well as the Feather and Yuba rivers, Big Chico, Battle, Antelope, and Clear creeks. Even in degraded reaches, spawning habitat has a high conservation value as its function directly affects the spawning success and reproductive potential of spring-run.

(2) Freshwater Rearing Habitat

Freshwater rearing sites are those with water quantity and floodplain connectivity to form and maintain physical habitat conditions that support juvenile growth and mobility; water quality and forage supporting juvenile salmonid development; and natural cover such as shade, submerged and overhanging large woody material, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks. Both spawning areas and migratory corridors comprise rearing habitat for juveniles, which feed and grow before and during their outmigration. Non-natal, intermittent tributaries also may be used for juvenile rearing. Rearing habitat condition is strongly affected by habitat complexity, food supply, and the presence of predators of juvenile salmonids. Some complex, productive habitats with floodplains remain in the system, for example, the lower Cosumnes River, Sacramento River reaches with setback levees primarily located upstream of the City of Colusa, and flood bypasses (*i.e.*, Yolo and Sutter bypasses). However, the channelized, leveed, and riprapped river reaches and sloughs that are common in the Sacramento-San Joaquin system typically have low habitat complexity, low abundance of food organisms, and offer little protection from piscivorous fish and birds. Freshwater rearing habitat also has a high intrinsic conservation value even if the current conditions are significantly degraded from their natural state.

(3) Freshwater Migration Corridors

Ideal freshwater migration corridors are free of migratory obstructions, with water quantity and quality conditions that enhance migratory movements. They contain natural cover such as riparian canopy structure, submerged and overhanging large woody objects, aquatic vegetation, large rocks, and boulders, side channels, and undercut banks which augment juvenile and adult mobility, survival, and food supply. Migratory corridors are downstream of the spawning areas and include the lower mainstems of the Sacramento and San Joaquin rivers and the Delta. These corridors allow the upstream passage of adults, and the downstream emigration of juveniles. Migratory habitat condition is strongly affected by the presence of barriers, which can include dams (*i.e.*, hydropower, flood control, and irrigation flashboard dams), unscreened or poorly screened diversions, degraded water quality, or behavioral impediments to migration. For successful survival and recruitment of salmonids, freshwater migration corridors must function sufficiently to provide adequate passage. The stranding of adults has been known to occur in flood bypasses and associated weir structures (Vincik and Johnson 2013b) and a number of challenges exist on many tributary streams. For juveniles, unscreened or inadequately screened water diversions throughout their migration corridors and a scarcity of complex in-river cover have degraded this PCE. However, since the primary migration corridors are used by numerous populations, and are essential for connecting early rearing habitat with the ocean, even the degraded reaches are considered to have a high intrinsic conservation value to the species.

(4) Estuarine Areas

Estuarine areas, such as the San Francisco Bay and the downstream portions of the Sacramento-San Joaquin Delta, free of migratory obstructions with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh and salt water are included as a PCE. Natural cover such as submerged and overhanging large woody material, aquatic vegetation, and side channels, are suitable for juvenile and adult foraging.

The remaining estuarine habitat for these species is severely degraded by altered hydrologic regimes, poor water quality, reductions in habitat complexity, and competition for food and space with exotic species. Regardless of the condition, the remaining estuarine areas are of high conservation value because they provide factors which function to provide predator avoidance, as rearing habitat and as an area of transition to the ocean environment.

2.2.2.3.Life History

(1) Adult Migration and Holding

Chinook salmon runs are designated on the basis of adult migration timing. Adult spring-run leave the ocean to begin their upstream migration in late January and early February (California Department of Fish and Game 1998) and enter the Sacramento River beginning in March (Yoshiyama *et al.* 1998). Spring-run move into tributaries of the Sacramento River (*e.g.*, Butte, Mill, Deer creeks) beginning as early as February in Butte Creek and typically mid-March in Mill and Deer creeks (Lindley *et al.* 2004). Adult migration peaks around mid-April in Butte Creek, and mid- to end of May in Mill and Deer creeks, and is complete by the end of July in all three tributaries (Lindley et al. 2004, see Table III in text). Typically, spring-run utilize mid- to high-elevation streams that provide appropriate temperatures and sufficient flow, cover, and pool depth to allow over-summering while conserving energy and allowing their gonadal tissue to mature (Yoshiyama *et al.* 1998).

During their upstream migration, adult Chinook salmon require stream flows sufficient to provide olfactory and other orientation cues used to locate their natal streams. Adequate stream flows are necessary to allow adult passage to upstream holding habitat. The preferred temperature range for upstream migration is 3ºC (38ºF) to 13ºC (56ºF) (Bell 1991, CDFG 1998). Boles (1988) recommends water temperatures below 18ºC (65ºF) for adult Chinook salmon migration, and Lindley et al. (2004) report that adult migration is blocked when temperatures reach 21ºC (70ºF), and that fish can become stressed as temperatures approach 21ºC (70ºF). Reclamation reports that spring-run holding in upper watershed locations prefer water temperatures below 15.6 ºC (60ºF); although salmon can tolerate temperatures up to 18 ºC (65ºF) before they experience an increased susceptibility to disease (Williams 2006).

(2) Adult Spawning

Spring-run Chinook salmon spawning occurs in September and October (Moyle 2002). Chinook salmon typically mature between 2 and 6 years of age (Myers *et al.* 1998), but primarily at age 3 (Fisher 1994). Between 56 and 87 percent of adult spring-run that enter the Sacramento River basin to spawn are 3 years old (Calkins et al. 1940, Fisher 1994); spring-run tend to enter freshwater as immature fish, migrate far upriver, and delay spawning for weeks or months.

Spring-run spawning typically occurs in gravel beds that are located at the tails of holding pools (USFWS 1995, NMFS 2007). They prefer velocities ranging from1.2 feet/second to 3.5 feet/second, and water depths greater than 0.5 feet (YCWA et al. 2007) . The upper preferred water temperature for spawning is 13 ºC to 14 ºC (55ºF to 57ºF) (Chambers 1956, Smith 1973, Bjornn and Reiser 1991, CDFG 2001).

(3) Egg Incubation and Fry Emergence

The spring-run embryo incubation period encompasses the time period from egg deposition through hatching, as well as the additional time while alevins remain in the gravel while absorbing their yolk sac prior to emergence. The length of time for spring-run embryos to develop depends largely on water temperatures. In well-oxygenated intergravel environs where water temperatures range from about 5 to 13ºC (41 to 55.4ºF) embryos hatch in 40 to 60 days and remain in the gravel as alevins for another 4 to 6 weeks, usually after the yolk sac is fully absorbed (NMFS 2014). In Butte and Big Chico creeks, emergence occurs from November through January, and in the colder waters of Mill and Deer creeks, emergence typically occurs from January through as late as May (Moyle 2002).

Incubating eggs are vulnerable to adverse effects from floods, siltation, desiccation, disease, predation, poor gravel permeability, and poor water quality. Studies of Chinook salmon egg survival to emergence conducted by Shelton (1955) indicated 87 percent of fry emerged successfully from large gravel with adequate subgravel flow. A significant reduction in egg viability occurs at water temperatures above 14 ºC (57.5ºF) and total embryo mortality can occur at temperatures above 17 ºC (62ºF) (NMFS 1997). Alderdice and Velsen (1978) found that the upper and lower temperatures resulting in 50 percent pre-hatch mortality were 16ºC and 3ºC (61ºF and 37ºF), respectively, when the incubation temperature was held constant. As water temperatures increase, the rate of embryo malformations also increases, as well as the susceptibility to fungus and bacterial infestations. The length of development for Chinook salmon embryos is dependent on the ambient water temperature surrounding the egg pocket in the redd. Colder water necessitates longer development times as metabolic processes are slowed. Within the appropriate water temperature range for embryo incubation, embryos hatch in 40 to 60 days, and the alevins remain in the gravel for an additional 4 to 6 weeks before emerging from the gravel.

During the 4 to 6 week period when alevins remain in the gravel, they utilize their yolk-sac to nourish their bodies. As their yolk-sac is depleted, fry begin to emerge from the gravel to begin exogenous feeding in their natal stream. The newly emerged fry disperse to the margins of their natal stream, seeking out shallow waters with slower currents, finer sediments, and bank cover such as overhanging and submerged vegetation, root wads, and fallen woody debris, and begin feeding on zooplankton, small insects, and small invertebrates. As they switch from endogenous nourishment to exogenous feeding, the fry’s yolk-sac is reabsorbed, and the belly suture closes over the former location of the yolk-sac (button-up fry). Fry typically range from 25 mm to 40 mm during this stage. Some fry may take up residence in their natal stream for several weeks to a year or more, while others migrate downstream to suitable habitat. Once started downstream, fry may continue downstream to the estuary and rear, or may take up residence in river reaches farther downstream for a period of time ranging from weeks to a year (Healey 1991).

(4) Juvenile Rearing and Outmigration

Once juveniles emerge from the gravel, they initially seek areas of shallow water and low velocities while they finish absorbing the yolk sac and transition to exogenous feeding (Moyle 2002). Many also will disperse downstream during high-flow events. As is the case in other salmonids, there is a shift in microhabitat use by juveniles to deeper faster water as they grow larger. Microhabitat use can be influenced by the presence of predators which can force fish to select areas of heavy cover and suppress foraging in open areas (Moyle 2002).

When juvenile Chinook salmon reach a length of 50 mm to 57 mm, they move into deeper water with higher current velocities, but still seek shelter and velocity refugia to minimize energy expenditures. In the mainstems of larger rivers, juveniles tend to migrate along the margins and avoid the elevated water velocities found in the thalweg of the channel. When the channel of the river is greater than 9 feet to 10 feet in depth, juvenile salmon tend to inhabit the surface waters (Healey 1982). Migrational cues, such as increasing turbidity from runoff, increased flows, changes in day length, or intraspecific competition from other fish in their natal streams may spur outmigration of juveniles when they have reached the appropriate stage of development (Kjelson *et al.* 1982, Brandes and McLain 2001).

As fish begin their emigration, they are displaced by the river's current downstream of their natal reaches. Similar to adult movement, juvenile salmonid downstream movement is primarily crepuscular. The daily migration of juveniles passing RBDD is highest in the four hour period prior to sunrise (Martin *et al.* 2001). Juvenile Chinook salmon migration rates vary considerably depending on the physiological stage of the juvenile and hydrologic conditions. Kjelson *et al.* (1982) found that Chinook salmon fry travel as fast as 30 km per day in the Sacramento River. As Chinook salmon begin the smolt stage, they prefer to rear further downstream where ambient salinity is up to 1.5 to 2.5 parts per thousand (Healey 1980, Levy and Northcote 1981).

Spring-run fry emerge from the gravel from November to March (Moyle 2002) and the emigration timing is highly variable, as they may migrate downstream as young-of-the-year, or as juveniles, or yearlings. The modal size of fry migrants at approximately 40 mm between December and April in Mill, Butte, and Deer creeks reflects a prolonged emergence of fry from the gravel (Lindley *et al.* 2004). Studies in Butte Creek (Ward *et al.* 2003, McReynolds *et al.* 2007) found the majority of spring-run migrants to be fry, which emigrated primarily during December, January, and February; and that these movements appeared to be influenced by increased flow. Small numbers of spring-run were observed to remain in Butte Creek to rear and migrated as yearlings later in the spring. Juvenile emigration patterns in Mill and Deer creeks are very similar to patterns observed in Butte Creek, with the exception that Mill and Deer creek juveniles typically exhibit a later young-of-the-year migration and an earlier yearling migration (Lindley *et al.* 2004). The California Department of Fish and Game (1998) observed the emigration period for spring-run extending from November to early May, with up to 69 percent of the young-of-the-year fish outmigrating through the lower Sacramento River and Delta during this period. Peak movement of juvenile spring-run in the Sacramento River at Knights Landing occurs in December, and again in March and April. However, juveniles also are observed between November and the end of May (Snider and Titus 2000).

Fry and parr may rear within riverine or estuarine habitats of the Sacramento River, the Delta, and their tributaries. In addition, CV spring-run Chinook salmon juveniles have been observed rearing in the lower reaches of non-natal tributaries and intermittent streams in the Sacramento Valley during the winter months (Maslin et al. 1997, CDFG 2001). Within the Delta, juvenile Chinook salmon forage in shallow areas with protective cover, such as intertidal and subtidal mudflats, marshes, channels, and sloughs (McDonald 1960, Dunford 1975). Cladocerans, copepods, amphipods, and larvae of diptera, as well as small arachnids and ants are common prey items (Kjelson *et al.* 1982, Sommer *et al.* 2001a, MacFarlane and Norton 2002). Shallow water habitats are more productive than the main river channels, supporting higher growth rates, partially due to higher prey consumption rates, as well as favorable environmental temperatures (Sommer *et al.* 2001a). Optimal water temperatures for the growth of juvenile Chinook salmon in the Delta are between 12ºC to 14 ºC (54ºF to 57ºF) (Brett 1952).

(5) Estuarine Rearing

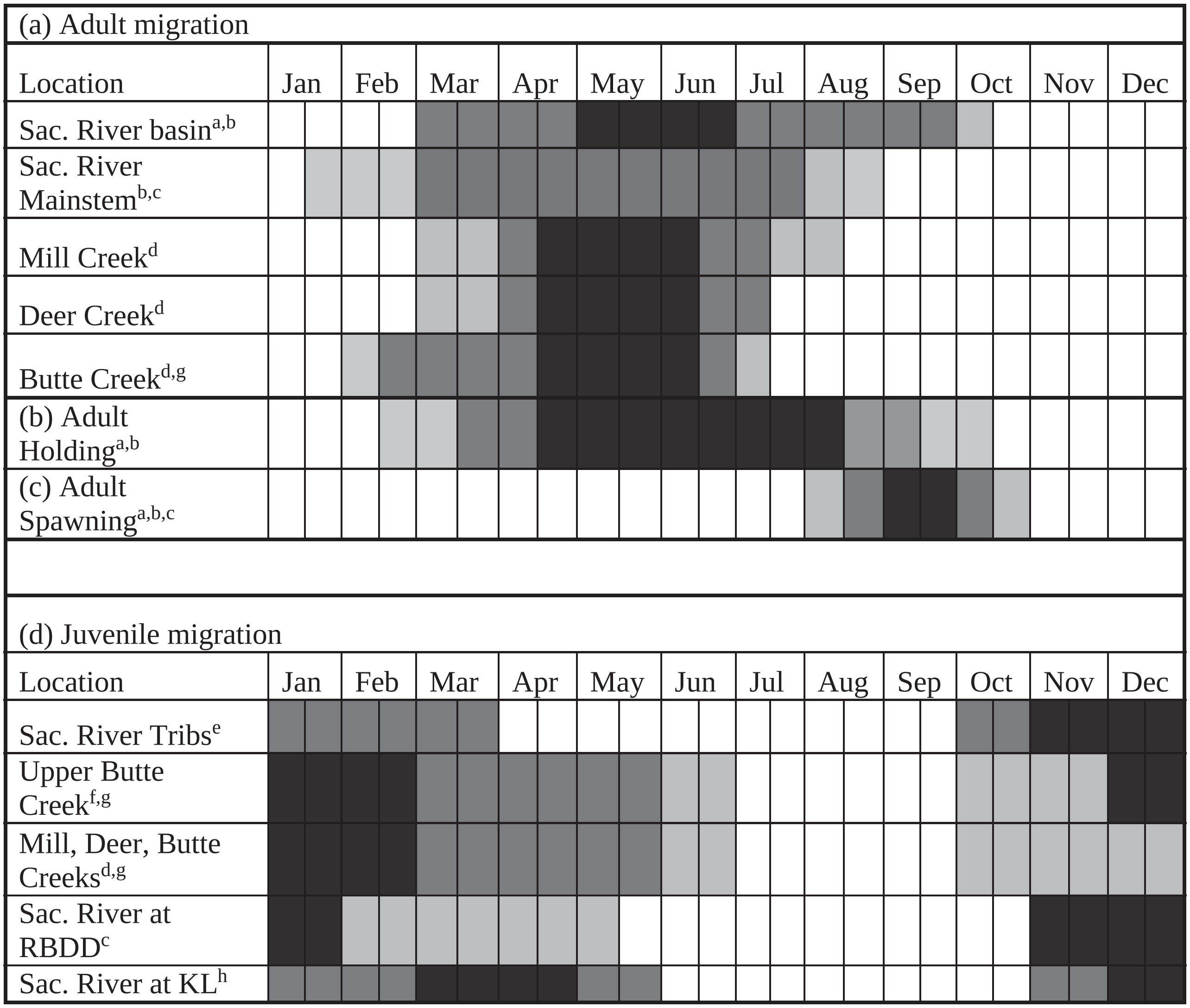
Within the estuarine habitat, juvenile Chinook salmon movements are dictated by the tidal cycles, following the rising tide into shallow water habitats from the deeper main channels, and returning to the main channels when the tide recedes (Levy and Northcote 1982, Levings 1982, Levings et al. 1986, Healey 1991). As juvenile Chinook salmon increase in length, they tend to school in the surface waters of the main and secondary channels and sloughs, following the tides into shallow water habitats to feed (Allen and Hassler 1986). In Suisun Marsh, Moyle *et al.* (1989) reported that Chinook salmon fry tend to remain close to the banks and vegetation, near protective cover, and in dead-end tidal channels. Kjelson *et al.* (1982) reported that juvenile Chinook salmon demonstrated a diel migration pattern, orienting themselves to nearshore cover and structure during the day, but moving into more open, offshore waters at night. The fish also distributed themselves vertically in relation to ambient light. During the night, juveniles were distributed randomly in the water column, but would school up during the day into the upper 3 meters of the water column. Available data indicate that juvenile Chinook salmon use Suisun Marsh extensively both as a migratory pathway and rearing area as they move downstream to the Pacific Ocean.

(6) Ocean Rearing

Once in the ocean, juvenile Chinook salmon tend to stay along the California Coast (Moyle 2002). This is likely due to the high productivity caused by the upwelling of the California Current. These food-rich waters are important to ocean survival, as indicated by a decline in survival during years when the current does not flow as strongly and upwelling decreases (Moyle 2002, Lindley et al. 2009a). After entering the ocean, juveniles become voracious predators on small fish and crustaceans, and invertebrates such as crab larvae and amphipods. As they grow larger, fish increasingly dominate their diet. They typically feed on whatever pelagic plankton is most abundant, usually herring, anchovies, juvenile rockfish, and sardines. The Ocean stage of the Chinook life cycle lasts one to five years. Information on salmon abundance and distribution in the ocean is based upon CWT recoveries from ocean fisheries. For over 30 years, the marine distribution and relative abundance of specific stocks, including ESA-listed ESUs, has been estimated using a representative CWT hatchery stock (or stocks) to serve as proxies for the natural and hatchery-origin fish within ESUs. One extremely important assumption of this approach is that hatchery and natural stock components are assumed to be similar in their life histories and ocean migration patterns.

Ocean harvest of Central Valley Chinook salmon is estimated using an abundance index, called the Central Valley Index (CVI). The CVI is the ratio of Chinook salmon harvested south of Point Arena (where 85 percent of Central Valley Chinook salmon are caught) to escapement (adult spawner populations that have “escaped” the ocean fisheries and made it into the rivers to spawn). CWT returns indicate that Sacramento River Chinook salmon congregate off the California coast between Point Arena and Morro Bay.

Table 3. The temporal occurrence of adult (a) and juvenile (b) Central Valley spring-run Chinook salmon in the Sacramento River. Darker shades indicate months of greatest relative abundance.




Relative Abundance: = High = Medium = Low

Sources: [a]Yoshiyama et al. (1998); [b]Moyle (2002); [c]Myers *et al.* (1998); [d]Lindley et al. (2004); [e]CDFG (1998); [f]McReynolds et al. (2007); [g]Ward et al. (2003); [h]Snider and Titus (2000)
Note: Yearling spring-run Chinook salmon rear in their natal streams through the first summer following their birth. Downstream emigration generally occurs the following fall and winter. Most young-of-the-year spring-run Chinook salmon emigrate during the first spring after they hatch.

### 2.2.2.4. Population Viability

(1) <u>Abundance</u>

Historically spring-run Chinook salmon were the second most abundant salmon run in the Central Valley and one of the largest on the west coast (CDFG 1990). These fish occupied the upper and middle elevation reaches (1,000 to 6,000 feet) of the San Joaquin, American, Yuba, Feather, Sacramento, McCloud and Pit rivers, with smaller populations in most tributaries with sufficient habitat for over-summering adults (Stone 1872, Rutter 1904, Clark 1929a).

The Central Valley drainage as a whole is estimated to have supported spring-run Chinook salmon runs as large as 600,000 fish between the late 1880s and 1940s (CDFG 1998). The San Joaquin River historically supported a large run of spring-run Chinook salmon, suggested to be one of the largest runs of any Chinook salmon on the West Coast with estimates averaging 200,000 – 500,000 adults returning annually (CDFG 1990). Construction of Friant Dam on the San Joaquin River began in 1939, and when completed in 1942, blocked access to all upstream habitat.

The FRFH spring-run population represents the only remaining evolutionary legacy of the spring-run populations that once spawned above Oroville Dam, and has been included in the ESU based on its genetic linkage to the natural spawning population, and the potential development of a conservation strategy, for the hatchery program. On the Feather River, significant numbers of spring-run, as identified by run timing, return to the FRFH. Since 1954, spawning escapement has been estimated using combinations of in-river estimates and hatchery counts, with estimates ranging from 2,908 in 1964 to 2 fish in 1978 (California Department of Water Resources 2001). However, after 1981, CDFG (now CDFW) ceased to estimate in-river spawning spring-run because spatial and temporal overlap with fall-run Chinook salmon spawners made it impossible to distinguish between the two races. Spring-run estimates after 1981 have been based solely on salmon entering the hatchery during the month of September. The 5-year moving averages from 1997 to 2006 had been more than 4,000 fish, but from 2007 to 2011, the 5-year moving averages have declined each year to a low of 1,783 fish in 2011 (CDFG Grandtab 2013). Genetic testing has indicated that substantial introgression has occurred between fall-run and spring-run populations within the Feather River system due to temporal overlap and hatchery practices (CDWR 2001). Because Chinook salmon have not always been spatially separated in the FRFH, spring-run and fall-run Chinook salmon have been spawned together, thus compromising the genetic integrity of the spring-run stock (CDFG and CDWR 2012, Good et al. 2005). In addition, coded-wire tag (CWT) information from these hatchery returns has indicated that fall-run and spring-run have overlapped (CDWR 2001). For the reasons discussed above, the FRFH spring-run numbers are not included in the following discussion of ESU abundance trends.

Monitoring of the Sacramento River mainstem during spring-run spawning timing indicates some spawning occurs in the river. Here, the lack of physical separation of spring-run Chinook salmon from fall-run Chinook salmon is complicated by overlapping migration and spawning periods. Significant hybridization with fall-run Chinook salmon has made identification of spring-run Chinook salmon in the mainstem very difficult to determine, and there is speculation as to whether a true spring-run Chinook salmon population still exists in the Sacramento River downstream of Keswick Dam. Although the physical habitat conditions downstream of Keswick Dam are capable of supporting spring-run, higher than normal water temperatures in some years have led to substantial levels of egg mortality. Less than 15 Chinook salmon redds per year were observed in the Sacramento River from 1989 to 1993, during September aerial redd counts (USFWS 2003). Redd surveys conducted in September between 2001 and 2011 have observed an average of 36 Chinook salmon redds from Keswick Dam downstream to the RBDD, ranging from 3 to 105 redds; 2012 observed zero redds, and 2013, 57 redds in September (CDFG, unpublished data, 2013). This is typically when spring-run Chinook salmon spawn, however, these redds also could be early spawning fall-run Chinook salmon. Therefore, even though physical habitat conditions may be suitable for spawning and incubation, spring-run Chinook salmon depend on spatial segregation and geographic isolation from fall-run Chinook salmon to maintain genetic diversity. With fall-run Chinook salmon spawning occurring in the same time and place as potential spring-run Chinook salmon spawning, it is likely extensive introgression between the populations has occurred (CDFG 1998). For these reasons, Sacramento River mainstem spring-run are not included in the following discussion of ESU abundance trends.

Sacramento River tributary populations in Mill, Deer, and Butte creeks are likely the best trend indicators for the Spring-run ESU as a whole because these streams contain the majority of the abundance, and are currently the only independent populations within the ESU. Generally, these streams have shown a positive escapement trend since 1991, displaying broad fluctuations in adult abundance, ranging from 1,013 in 1993 to 23,788 in 1998 (Table 4). Escapement numbers are dominated by Butte Creek returns, which averaged over 7,000 fish from 1995 to 2005, but then declined in years 2006 through 2011 with an average of just over 3,000 (although 2008 was nearly 15,000 fish). During this same period, adult returns on Mill and Deer creeks have averaged over 2,000 fish total and just over 1,000 fish total, respectively. From 2001 to 2005, the Spring-run ESU experienced a trend of increasing abundance in some natural populations, most dramatically in the Butte Creek population (Good *et al.* 2005). Although trends were generally positive during this time, annual abundance estimates display a high level of fluctuation, and the overall number of Spring-run remained well below estimates of historic abundance.

Additionally, in 2002 and 2003, mean water temperatures in Butte Creek exceeded 21$^{o}$C for 10 or more days in July (Williams 2006). These persistent high water temperatures, coupled with high fish densities, precipitated an outbreak of Columnaris (*Flexibacter columnaris*) and Ichthyophthiriasis (*Ichthyophthirius multifiis*) diseases in the adult spring-run over-summering in Butte Creek. In 2002, this contributed to a pre-spawning mortality of approximately 20 to 30 percent of the adults. In 2003, approximately 65 percent of the adults succumbed, resulting in a loss of an estimated 11,231 adult spring-run in Butte Creek due to the diseases.

From 2005 through 2011, abundance numbers in most of the tributaries declined. Adult returns from 2006 to 2009, indicate that population abundance for the entire Sacramento River basin is declining from the peaks seen in the five years prior to 2006. Declines in abundance from 2005 to 2011, placed the Mill Creek and Deer Creek populations in the high extinction risk category due to the rates of decline, and in the case of Deer Creek, also the level of escapement (NMFS 2011). Butte Creek has sufficient abundance to retain its low extinction risk classification, but the rate of population decline in years 2006 through 2011 was nearly sufficient to classify it as a high extinction risk based on this criteria. Nonetheless, the watersheds identified as having the highest likelihood of success for achieving viability/low risk of extinction include, Butte, Deer and Mill creeks (NMFS 2011). Some other tributaries to the Sacramento River, such as Clear Creek and Battle Creek have seen population gains in the years from 2001 to 2009, but the overall abundance numbers have remained low. 2012 appeared to be a good return year for most of the tributaries with some, such as Battle Creek, having the highest return on record (799). Additionally, 2013 escapement numbers increased, in most tributary populations, which resulted in the second highest number of spring-run returning to the tributaries since 1998. However, 2014 appears to be lower, just over 5,000 fish, which indicates a highly fluctuating and unstable ESU abundance.

(2) Productivity

The productivity of a population (*i.e.,* production over the entire life cycle) can reflect conditions (*e.g.,* environmental conditions) that influence the dynamics of a population and determine abundance. In turn, the productivity of a population allows an understanding of the performance of a population across the landscape and habitats in which it exists and its response to those habitats (McElhany *et al.* 2000b). In general, declining productivity equates to declining population abundance. McElhany *et al.* (2000b) suggested criteria for a population's natural productivity should be sufficient to maintain its abundance above the viable level (a stable or increasing population growth rate). In the absence of numeric abundance targets, this guideline is used. Cohort replacement rates (CRR) are indications of whether a cohort is replacing itself in the next generation.

From 1993 to 2007 the 5-year moving average of the tributary population CRR remained over 1.0, but then declined to a low of 0.47 in years 2007 through 2011. The productivity of the Feather River and Yuba River populations and contribution to the Spring-run ESU currently is unknown, however the FRFH currently produces 2,000,000 juveniles each year. The CRR for the 2012 combined tributary population was 3.84, and 8.68 in 2013, due to increases in abundance for most populations. Although 2014 returns were lower than the previous two years, the CRR was still positive.

(3) Spatial Structure

The Central Valley Technical Review Team (TRT) estimated that historically there were 18 or 19 independent populations of Spring-run, along with a number of dependent populations, all within four distinct geographic regions, or diversity groups (Figure 5) (Lindley *et al.* 2004). Of these populations, only three independent populations currently exist (Mill, Deer, and Butte creeks tributary to the upper Sacramento River) and they represent only the northern Sierra Nevada diversity group. Additionally, smaller populations are currently persisting in Antelope and Big Chico creeks, and the Feather and Yuba rivers in the northern Sierra Nevada diversity group (CDFG 1998). All historical populations in the basalt and porous lava diversity group and the southern Sierra Nevada diversity group have been extirpated, although Battle Creek in the basalt and porous lava diversity group has had a small persistent population in Battle Creek since 1995, and the upper Sacramento River may have a small persisting population spawning in the mainstem river as well. The northwestern California diversity group did not historically contain independent populations, and currently contains two small persisting populations, in Clear Creek, and Beegum Creek (tributary to Cottonwood Creek) that are likely dependent on the northern Sierra Nevada diversity group populations for their continued existence.

Construction of low elevation dams in the foothills of the Sierras on the San Joaquin, Mokelumne, Stanislaus, Tuolumne, and Merced rivers, has thought to have extirpated Spring-run from these watersheds of the San Joaquin River, as well as on the American River of the Sacramento River basin. However, observations in the last decade suggest that perhaps spring-running populations may currently occur in the Stanislaus and Tuolumne rivers (Franks 2013 unpublished data) .

Table 4. Central Valley Spring-run Chinook salmon population estimates from CDFW Grand Tab (2013) with corresponding cohort replacement rates for years since 1986.

| Year | Sacramento River Basin Escapement Run Size[a] | FRFH Population | Tributary Populations | 5-Year Moving Average Tributary Population Estimate | Trib CRR[b] | 5-Year Moving Average of Trib CRR | 5-Year Moving Average of Basin Population Estimate | Basin CRR | 5-Year Moving Average of Basin CRR |
|---|---|---|---|---|---|---|---|---|---|
| **1986** | 3,638 | 1,433 | 2,205 | | | | | | |
| **1987** | 1,517 | 1,213 | 304 | | | | | | |
| **1988** | 9,066 | 6,833 | 2,233 | | | | | | |
| **1989** | 7,032 | 5,078 | 1,954 | | 0.89 | | | 1.93 | |
| **1990** | 3,485 | 1,893 | 1,592 | 1,658 | 5.24 | | 4,948 | 2.30 | |
| **1991** | 5,101 | 4,303 | 798 | 1,376 | 0.36 | | 5,240 | 0.56 | |
| **1992** | 2,673 | 1,497 | 1,176 | 1,551 | 0.60 | | 5,471 | 0.38 | |
| **1993** | 5,685 | 4,672 | 1,013 | 1,307 | 0.64 | 1.54 | 4,795 | 1.63 | 1.36 |
| **1994** | 5,325 | 3,641 | 1,684 | 1,253 | 2.11 | 1.79 | 4,454 | 1.04 | 1.18 |
| **1995** | 14,812 | 5,414 | 9,398 | 2,814 | 7.99 | 2.34 | 6,719 | 5.54 | 1.83 |
| **1996** | 8,705 | 6,381 | 2,324 | 3,119 | 2.29 | 2.73 | 7,440 | 1.53 | 2.03 |
| **1997** | 5,065 | 3,653 | 1,412 | 3,166 | 0.84 | 2.77 | 7,918 | 0.95 | 2.14 |
| **1998** | 30,534 | 6,746 | 23,788 | 7,721 | 2.53 | 3.15 | 12,888 | 2.06 | 2.23 |
| **1999** | 9,838 | 3,731 | 6,107 | 8,606 | 2.63 | 3.26 | 13,791 | 1.13 | 2.24 |
| **2000** | 9,201 | 3,657 | 5,544 | 7,835 | 3.93 | 2.44 | 12,669 | 1.82 | 1.50 |
| **2001** | 16,869 | 4,135 | 12,734 | 9,917 | 0.54 | 2.09 | 14,301 | 0.55 | 1.30 |
| **2002** | 17,224 | 4,189 | 13,035 | 12,242 | 2.13 | 2.35 | 16,733 | 1.75 | 1.46 |
| **2003** | 17,691 | 8,662 | 9,029 | 9,290 | 1.63 | 2.17 | 14,165 | 1.92 | 1.43 |
| **2004** | 13,612 | 4,212 | 9,400 | 9,948 | 0.74 | 1.79 | 14,919 | 0.81 | 1.37 |
| **2005** | 16,096 | 1,774 | 14,322 | 11,704 | 1.10 | 1.23 | 16,298 | 0.93 | 1.19 |
| **2006** | 10,948 | 2,181 | 8,767 | 10,911 | 0.97 | 1.31 | 15,114 | 0.62 | 1.21 |
| **2007** | 9,726 | 2,674 | 7,052 | 9,714 | 0.75 | 1.04 | 13,615 | 0.71 | 1.00 |
| **2008** | 6,368 | 1,624 | 4,744 | 8,857 | 0.33 | 0.78 | 11,350 | 0.40 | 0.69 |
| **2009** | 3,801 | 989 | 2,812 | 7,539 | 0.32 | 0.69 | 9,388 | 0.35 | 0.60 |
| **2010** | 3,792 | 1,661 | 2,131 | 5,101 | 0.30 | 0.54 | 6,927 | 0.39 | 0.49 |
| **2011** | 4,967 | 1,969 | 3,067 | 3,961 | 0.65 | 0.47 | 5,731 | 0.78 | 0.53 |
| **2012** | 18,275 | 3,738 | 10,810 | 4,713 | 3.84 | 1.09 | 7,441 | 0.79 | 0.54 |
| **2013** | 38,556 | 4,294 | 18,499 | 7,464 | 8.68 | 2.76 | 13,878 | 2.00 | 0.86 |
| **2014** | | | | | | | | | |
| **Median** | 10,962 | 3,734 | 6,508 | 6,324 | 2.08 | 1.83 | 10,258 | 1.00 | 1.29 |

[a] NMFS is only including the escapement numbers from the Feather River Fish Hatchery (FRFH) and the Sacramento River tributaries in this table. Sacramento River Basin run size is the sum of the escapement numbers from the FRFH and the tributaries.

[b] Abbreviations: CRR = Cohort Replacement Rate, Trib = tributary

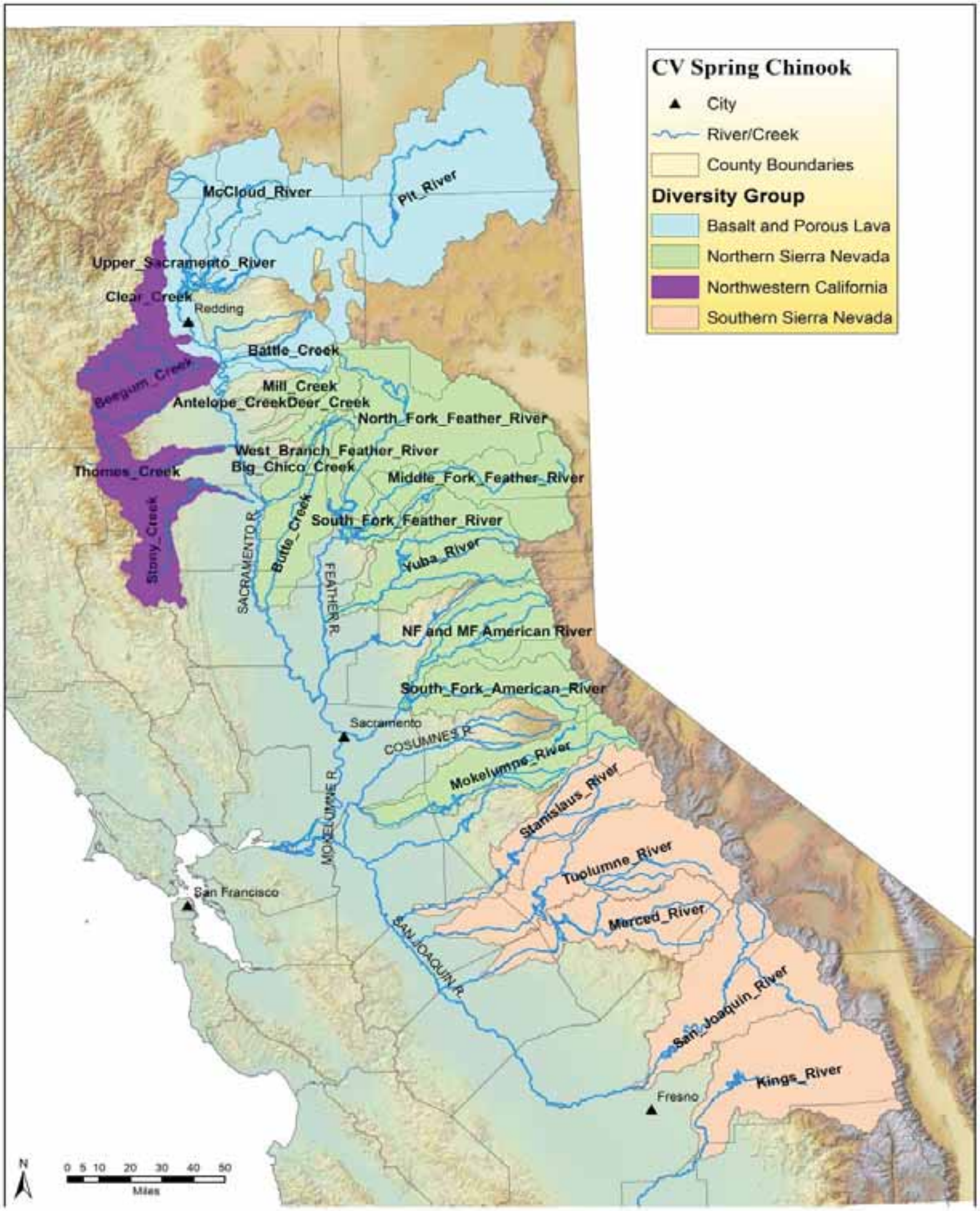



Figure 5**.** Diversity Groups for the Central Valley spring-run Chinook salmon ESU.

Spatial structure refers to the arrangement of populations across the landscape, the distribution of spawners within a population, and the processes that produce these patterns. Species with a restricted spatial distribution and few spawning areas are at a higher risk of extinction from catastrophic environmental events (*e.g.*, a single landslide) than are species with more widespread and complex spatial structure. Species or population diversity concerns the phenotypic (morphology, behavior, and life-history traits) and genotypic (DNA) characteristics of populations. Phenotypic diversity allows more populations to use a wider array of environments and protects populations against short-term temporal and spatial environmental changes. Genotypic diversity, on the other hand, provides populations with the ability to survive long-term changes in the environment. To meet the objective of representation and redundancy, diversity groups need to contain multiple populations to survive in a dynamic ecosystem subject to unpredictable stochastic events, such as pyroclastic events or wild fires.

With only one of four diversity groups currently containing viable independent populations, the spatial structure of Spring-run is severely reduced. Butte Creek spring-run adult returns are currently utilizing all available habitat in the creek; and it is unknown if individuals have opportunistically migrated to other systems. The persistent populations in Clear Creek and Battle Creek, with habitat restoration projects completed and more underway, are anticipated to add to the spatial structure of the Spring-run ESU if they can reach viable status in the basalt and porous lava and northwestern California diversity group areas. The spatial structure of the spring-run ESU would still be lacking due to the extirpation of all San Joaquin River basin spring-run populations, however recent information suggests that perhaps a self-sustaining population of spring-run is occurring in some of the San Joaquin River tributaries, most notably the Stanislaus and the Tuolumne rivers.

A final rule was published to designate a nonessential experimental population of Spring-run to allow reintroduction of the species below Friant Dam on the San Joaquin River as part of the San Joaquin River Restoration Program (SJRRP, 78 FR 251; December 31, 2013). Pursuant to ESA section 10(j), with limited exceptions, each member of an experimental population shall be treated as a threatened species. However, the rule includes proposed protective regulations under ESA section 4(d) that would provide specific exceptions to prohibitions under ESA section 9 for taking Spring-run within the experimental population area, and in specific instances elsewhere. The first release of Spring-run juveniles into the San Joaquin River occurred in April, 2014. A second release occurred in 2015, and future releases are planned to continue annually during the spring. The SJRRP's future long-term contribution to the Spring-run ESU has yet to be determined.

Snorkel surveys (Kennedy and Cannon 2005) conducted between October 2002 to October 2004 on the Stanislaus River identified adults in June 2003 and 2004, as well as observed Chinook fry in December of 2003, which would indicate spring-run spawning timing. In addition, monitoring on the Stanislaus since 2003 and on the Tuolumne since 2009, has indicated upstream migration of adult spring-run (Anderson *et al.* 2007b). Genetic testing is needed to confirm that these fish are spring-run, to determine which strain they are. Finally, rotary screw trap (RST) data provided by Stockton USFWS corroborates the spring-run adult timing, by indicating that there are a small number of fry migrating out of the Stanislaus and Tuolumne at a period that would coincide with spring-run juvenile emigration (Franks 2013 unpublished data). Plans are underway to re-establish a spring-run population in the San Joaquin River downstream of Friant Dam, as part of the San Joaquin River Restoration Program. Interim flows for this began and spring-run are expected to be released in 2013. The San Joaquin River Restoration Programs' future long-term contribution to the Spring-run ESU is uncertain.

Lindley *et al.* (2007) described a general criteria for "representation and redundancy" of spatial structure, which was for each diversity group to have at least two viable populations. More specific recovery criteria for the spatial structure of each diversity group have been laid out in the NMFS Central Valley Salmon and Steelhead Recovery Plan (NMFS 2014). According to the criteria, one viable population in the Northwestern California diversity group, two viable populations in the basalt and porous lava diversity group, four viable populations in the northern Sierra Nevada diversity group, and two viable populations in the southern Sierra Nevada diversity group, in addition to maintaining dependent populations are needed for recovery. It is clear that further efforts will need to involve more than restoration of currently accessible watersheds to make the ESU viable. The NMFS Central Valley Salmon and Steelhead Recovery Plan calls for reestablishing populations into historical habitats currently blocked by large dams, such as the reintroduction of a population upstream of Shasta Dam, and to facilitate passage of fish upstream of Englebright Dam on the Yuba River (NMFS 2014).

(4) Diversity

Diversity, both genetic and behavioral, is critical to success in a changing environment. Salmonids express variation in a suite of traits, such as anadromy, morphology, fecundity, run timing, spawn timing, juvenile behavior, age at smolting, age at maturity, egg size, developmental rate, ocean distribution patterns, male and female spawning behavior, and physiology and molecular genetic characteristics (including rate of gene-flow among populations). Criteria for the diversity parameter are that human-caused factors should not alter variation of traits. The more diverse these traits (or the more these traits are not restricted), the more adaptable a population is, and the more likely that individuals, and therefore the species, would survive and reproduce in the face of environmental variation (McElhany *et al.* 2000b). However, when this diversity is reduced due to loss of entire life history strategies or to loss of habitat used by fish exhibiting variation in life history traits, the species is in all probability less able to survive and reproduce given environmental variation.

The Spring-run ESU is comprised of two known genetic complexes. Analysis of natural and hatchery spring-run stocks in the Central Valley indicates that the northern Sierra Nevada diversity group spring-run populations in Mill, Deer, and Butte creeks retains genetic integrity as opposed to the genetic integrity of the Feather River population, which has been somewhat compromised. The Feather River spring-run have introgressed with the Feather River fall-run Chinook salmon, and it appears that the Yuba River spring-run population may have been impacted by FRFH fish straying into the Yuba River (and likely introgression with wild Yuba River fall-run has occurred). Additionally, the diversity of the spring-run ESU has been further reduced with the loss of the majority if not all of the San Joaquin River basin spring-run populations. Efforts underway like the San Joaquin River Restoration Project (to reintroduce a spring-run population below Friant Dam), are needed to improve the diversity of Spring-run.

(5) Summary of ESU Viability

Since the populations in Butte, Deer and Mill creeks are the best trend indicators for ESU viability, we can evaluate risk of extinction based on VSP parameters in these watersheds. Lindley *et al.* (2007) indicated that the spring-run populations in the Central Valley had a low risk of extinction in Butte and Deer creeks, according to their population viability analysis (PVA) model and other population viability criteria (*i.e.*, population size, population decline, catastrophic events, and hatchery influence, which correlate with VSP parameters abundance, productivity, spatial structure, and diversity). The Mill Creek population of spring-run was at moderate extinction risk according to the PVA model, but appeared to satisfy the other viability criteria for low-risk status. However, the Spring-run ESU failed to meet the "representation and redundancy rule" since there are only demonstrably viable populations in one diversity group (northern Sierra Nevada) out of the three diversity groups that historically contained them, or out of the four diversity groups as described in the NMFS Central Valley Salmon and Steelhead Recovery Plan. Over the long term, these three remaining populations are considered to be vulnerable to catastrophic events, such as volcanic eruptions from Mount Lassen or large forest fires due to the close proximity of their headwaters to each other. Drought is also considered to pose a significant threat to the viability of the spring-run populations in these three watersheds due to their close proximity to each other. One large event could eliminate all three populations.

Until 2012, the status of Spring-run ESU had deteriorated on balance since the 2005 status review and the Lindley *et al.* (2007) assessment, with two of the three extant independent populations (Deer and Mill creeks) of spring-run slipping from low or moderate extinction risk to high extinction risk. Additionally, Butte Creek remained at low risk, although it was on the verge of moving towards high risk, due to rate of population decline. In contrast, spring-run in Battle and Clear creeks had increased in abundance since 1998, reaching levels of abundance that place these populations at moderate extinction risk. Both of these populations have likely increased at least in part due to extensive habitat restoration. The Southwest Fisheries Science Center concluded in their viability report that the status of Spring-run ESU has probably deteriorated since the 2005 status review and that its extinction risk has increased (Williams *et al.* 2011). The degradation in status of the three formerly low- or moderate-risk independent populations is cause for concern.

The most recent viability assessment of Spring-run was conducted during NMFS' 2011 status review (NMFS 2011). This review found that the biological status of the ESU had worsened since the last status review (2005) and recommend that its status be reassessed in two to three years as opposed to waiting another five years, if the decreasing trend continues and the ESU does not respond positively to improvements in environmental conditions and management actions. In 2012 and 2013, tributary populations have had an increase in returning adults, averaging over 13,000, in contrast to returns in 2006 through 2011 averaging less than 5,000; however with 2014 returns of just over 5,000 fish, indicates the ESU remains highly fluctuating. A status review is currently underway and expected to be completed before the end of 2015.

### 2.2.3. California Central Valley Steelhead Distinct Population Segment

#### 2.2.3.1. History of Species Listing and Critical Habitat Designation

California Central Valley steelhead DPS (CCV steelhead) were originally listed as threatened on March 19, 1998 (63 FR 13347). Following a new status review (Good *et al.* 2005) and after application of the agency's hatchery listing policy, NMFS reaffirmed its status as threatened and also listed the Feather River Hatchery and Coleman National Fish Hatchery (CNFH) stocks as part of the DPS in 2006 (71 FR 834). In June 2004, after a complete status review of 27 west coast salmonid evolutionarily significant units (ESUs) and DPSs, NMFS proposed that CCV steelhead remain listed as threatened (69 FR 33102). On January 5, 2006, NMFS reaffirmed the threatened status of the CCV steelhead and applied the DPS policy to the species because the resident and anadromous life forms of *O. mykiss* remain "markedly separated" as a consequence of physical, ecological and behavioral factors, and therefore warranted delineation as a separate DPS (71 FR 834). On August 15, 2011, NMFS completed another 5-year status review of CCV steelhead and recommended that the CCV steelhead DPS remain classified as a threatened species (NMFS 2011). Critical habitat was designated for CCV steelhead on September 2, 2005 (70 FR 52488).

2.2.3.2.Critical Habitat and Primary Constituent Elements

Critical habitat for CCV steelhead includes stream reaches such as those of the Sacramento, Feather, and Yuba Rivers, and Deer, Mill, Battle, and Antelope creeks in the Sacramento River basin; the San Joaquin River, including its tributaries, and the waterways of the Delta (Figure 1). Currently the CCV steelhead DPS and critical habitat extends up the San Joaquin River up to the confluence with the Merced River. Critical habitat includes the stream channels in the designated stream reaches and the lateral extent as defined by the ordinary high-water line. In areas where the ordinary high-water line has not been defined, the lateral extent will be defined by the bankfull elevation (defined as the level at which water begins to leave the channel and move into the floodplain; it is reached at a discharge that generally has a recurrence interval of 1 to 2 years on the annual flood series) (Bain and Stevenson 1999; 70 FR 52488). Critical habitat for CCV steelhead is defined as specific areas that contain the PCEs and physical habitat elements essential to the conservation of the species. Following are the inland habitat types used as PCEs for CCV steelhead.

(1) Spawning Habitat

Freshwater spawning sites are those with water quantity and quality conditions and substrate supporting spawning, egg incubation, and larval development. Most of the available spawning habitat for steelhead in the Central Valley is located in areas directly downstream of dams due to inaccessibility to historical spawning areas upstream and the fact that dams are typically built at high gradient locations. These reaches are often impacted by the upstream impoundments, particularly over the summer months, when high temperatures can have adverse effects upon salmonids spawning and rearing below the dams. Even in degraded reaches, spawning habitat has a high conservation value as its function directly affects the spawning success and reproductive potential of listed salmonids.

(2) Freshwater Rearing Habitat

Freshwater rearing sites are those with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and survival; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging LWM, log jams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks. Both spawning areas and migratory corridors comprise rearing habitat for juveniles, which feed and grow before and during their outmigration. Non-natal, intermittent tributaries also may be used for juvenile rearing. Rearing habitat condition is strongly affected by habitat complexity, food supply, and the presence of predators of juvenile salmonids. Some complex, productive habitats with floodplains remain in the system (*e.g.*, the lower Cosumnes River, Sacramento River reaches with setback levees [*i.e.*, primarily located upstream of the City of Colusa]) and flood bypasses (*i.e.*, Yolo and Sutter bypasses). However, the channelized, leveed, and riprapped river reaches and sloughs that are common in the Sacramento-San Joaquin system typically have low habitat complexity, low abundance of food organisms, and offer little protection from either fish or avian predators. Freshwater rearing habitat also has a high conservation value even if the current conditions are significantly degraded from their natural state. Juvenile life stages of salmonids are dependent on the function of this habitat for successful survival and recruitment.

(3) Freshwater Migration Corridors

Ideal freshwater migration corridors are free of migratory obstructions, with water quantity and quality conditions that enhance migratory movements. They contain natural cover such as riparian canopy structure, submerged and overhanging large woody objects, aquatic vegetation, large rocks, and boulders, side channels, and undercut banks which augment juvenile and adult mobility, survival, and food supply. Migratory corridors are downstream of the spawning areas and include the lower mainstems of the Sacramento and San Joaquin rivers and the Delta. These corridors allow the upstream and downstream passage of adults, and the emigration of smolts. Migratory habitat condition is strongly affected by the presence of barriers, which can include dams (*i.e.*, hydropower, flood control, and irrigation flashboard dams), unscreened or poorly screened diversions, degraded water quality, or behavioral impediments to migration. For successful survival and recruitment of salmonids, freshwater migration corridors must function sufficiently to provide adequate passage. For this reason, freshwater migration corridors are considered to have a high conservation value even if the migration corridors are significantly degraded compared to their natural state.

(4) Estuarine Areas

Estuarine areas free of migratory obstructions with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh and salt water are included as a PCE. Natural cover such as submerged and overhanging LWM, aquatic vegetation, and side channels, are suitable for juvenile and adult foraging. Estuarine areas are considered to have a high conservation value as they provide factors which function to provide predator avoidance and as a transitional zone to the ocean environment.

2.2.3.3.Life History

(1) Egg to Parr

The length of time it takes for eggs to hatch depends mostly on water temperature. Steelhead eggs hatch in three to four weeks at 10°C (50°F) to 15°C (59°F) (Moyle 2002). After hatching, alevins remain in the gravel for an additional two to five weeks while absorbing their yolk sacs, and emerge in spring or early summer (Barnhart 1986). Fry emerge from the gravel usually about four to six weeks after hatching, but factors such as redd depth, gravel size, siltation, and temperature can speed or retard this time (Shapovalov and Taft 1954). Upon emergence, fry inhale air at the stream surface to fill their air bladders, absorb the remains of their yolks in the course of a few days, and start to feed actively, often in schools (Barnhart 1986, NMFS 1996).

The newly emerged juveniles move to shallow, protected areas associated within the stream margin (McEwan and Jackson 1996). As steelhead parr increase in size and their swimming abilities improve, they increasingly exhibit a preference for higher velocity and deeper mid-channel areas (Hartman 1965; Everest and Chapman 1972; Fontaine 1988).

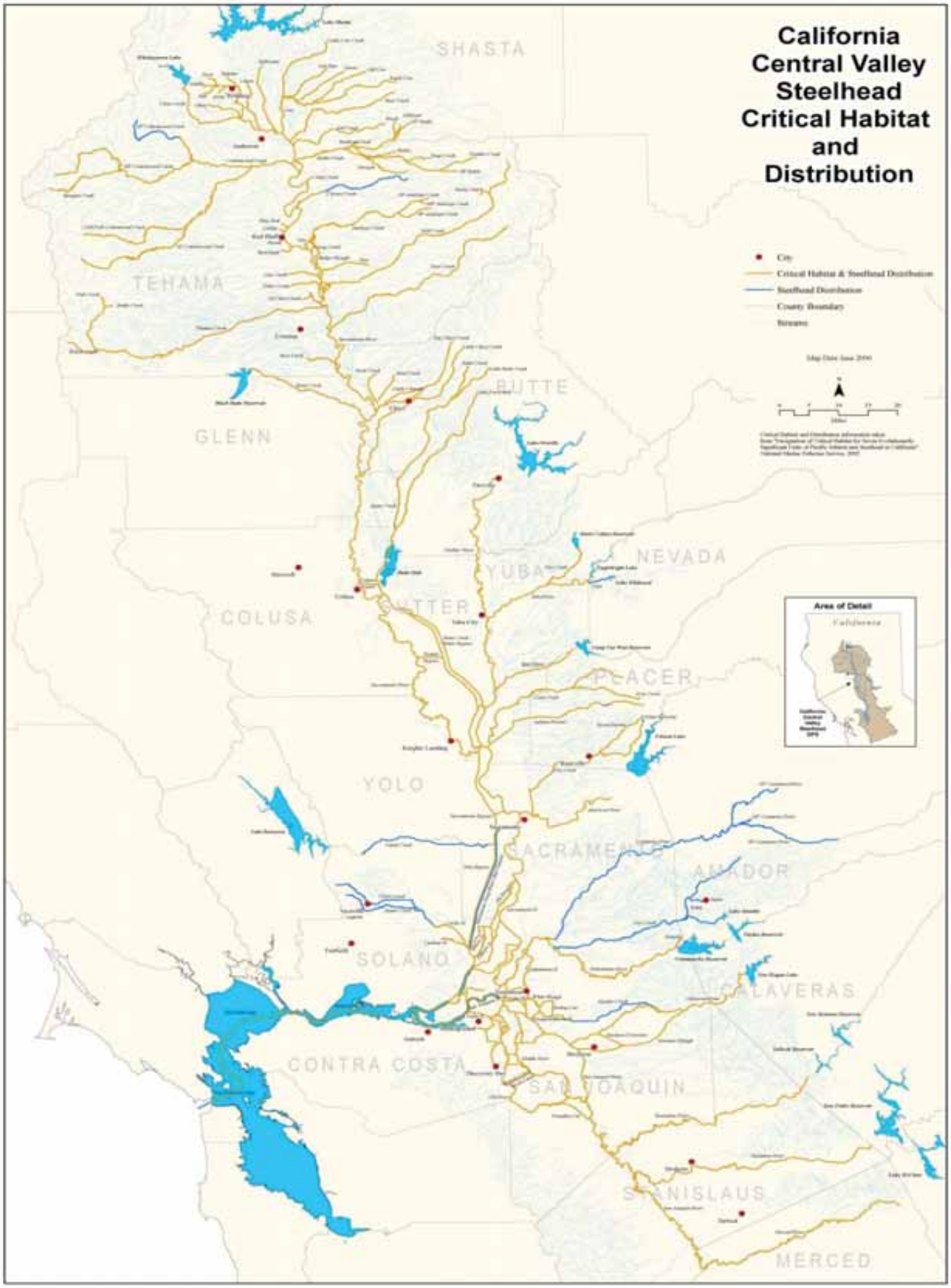



Figure 6. California Central Valley steelhead designated critical habitat.

Productive juvenile rearing habitat is characterized by complexity, primarily in the form of cover, which can be deep pools, woody debris, aquatic vegetation, or boulders. Cover is an important habitat component for juvenile steelhead both as velocity refugia and as a means of avoiding predation (Meehan and Bjornn 1991). Optimal water temperatures for growth range from 15°C (59°F) to 20°C (68°F) (McCullough et al. 2001, Spina 2006). Cherry et al. (1975) found preferred temperatures for rainbow trout ranged from 11°C (51.8°F) to 21°C (69.8°F) depending on acclimation temperatures (cited in Myrick and Cech 2001).

(2) Smolt Migration

Juvenile steelhead will often migrate downstream as parr in the summer or fall of their first year of life, but this is not a true smolt migration (Loch et al. 1988). Smolt migrations occur in the late winter through spring, when juveniles have undergone a physiological transformation to survive in the ocean, and become slender in shape, bright silvery in coloration, with no visible parr marks. Emigrating steelhead smolts use the lower reaches of the Sacramento River and the Delta primarily as a migration corridor to the ocean. There is little evidence that they rear in the Delta or on floodplains, though there are few behavioral studies of this life-stage in the California Central Valley (Table 5).

(3) Ocean Behavior

Unlike Pacific salmon, steelhead do not appear to form schools in the ocean (Behnke 1992). Steelhead in the southern part of their range appear to migrate close to the continental shelf, while more northern populations may migrate throughout the northern Pacific Ocean (Barnhart 1986). It is possible that California steelhead may not migrate to the Gulf of Alaska region of the north Pacific as commonly as more northern populations such as those in Washington and British Colombia. (Burgner 1993) reported that no coded-wire tagged steelhead from California hatcheries were recovered from the open ocean surveys or fisheries that were sampled for steelhead between 1980 and 1988. Only a small number of disk-tagged fish from California were captured. This behavior might explain the small average size of Central Valley steelhead relative to populations in the Pacific Northwest, as food abundance in the nearshore coastal zone may not be as high as in the Gulf of Alaska.

Pearcy (1990) found that the diets of juvenile steelhead caught in coastal waters of Oregon and Washington were highly diverse and included many species of insects, copepods, and amphipods, but by biomass the dominant prey items were small fishes (including rockfish and greenling) and euphausids.

There are no commercial fisheries for steelhead in California, Oregon, or Washington, with the exception of some tribal fisheries in Washington waters.

(4) Spawning

CCV steelhead generally enter freshwater from August to November (with a peak in September (Hallock et al. 1961), and spawn from December to April, with a peak in January through March, in rivers and streams where cold, well oxygenated water is available (Table 5) (Williams 2006; Hallock et al. 1961; McEwan and Jackson 1996). The timing of upstream migration is correlated with high flow events, such as freshets, and the associated change in water temperatures

(Workman et al. 2002). Adults typically spend a few months in freshwater before spawning (Williams 2006), but very little is known about where they hold between entering freshwater and spawning in rivers and streams. The threshold of a 56°F maximum water temperature that is commonly used for Chinook salmon is often extended to steelhead, but temperatures for spawning steelhead are not usually a concern as this activity occurs in the late fall and winter months when water temperatures are low. Female steelhead construct redds in suitable gravel and cobble substrate, primarily in pool tailouts and heads of riffles.

Few direct counts of fecundity are available for CCV steelhead populations, but since the number of eggs laid per female is highly correlated with adult size, adult size can be used to estimate fecundity with reasonable precision. Adult steelhead size depends on the duration of and growth rate during their ocean residency (Meehan and Bjornn 1991). CCV steelhead generally return to freshwater after one or two years at sea (Hallock et al. 1961), and adults typically range in size from two to twelve pounds (Reynolds et al. 1993). Steelhead about 55 cm (FL) long may have fewer than 2,000 eggs, whereas steelhead 85 cm (FL) long can have 5,000 to 10,000 eggs, depending on the stock (Meehan and Bjornn 1991). The average for CNFH since 1999 is about 3,900 eggs per female (USFWS 2011).

Unlike Pacific salmon, steelhead are iteroparous, meaning they are capable of spawning multiple times before death (Busby et al. 1996). However, it is rare for steelhead to spawn more than twice before dying; and repeat spawners tend to be biased towards females (Busby et al. 1996). Iteroparity is more common among southern steelhead populations than northern populations (Busby et al. 1996). Although one-time spawners are the great majority, Shapolov and Taft (1954) reported that repeat spawners were relatively numerous (17.2 percent) in Waddell Creek. Null et al. (2013) found between 36 percent and 48 percent of kelts released from CNFH in 2005 and 2006 survived to spawn the following spring, which is in sharp contrast to what Hallock (1989) reported for CNFH in the 1971 season, where only 1.1 percent of adults were fish that had been tagged the previous year. Most populations have never been studied to determine the percentage of repeat spawners. Hatchery steelhead are typically less likely than wild fish to survive to spawn a second time (Leider et al. 1986).

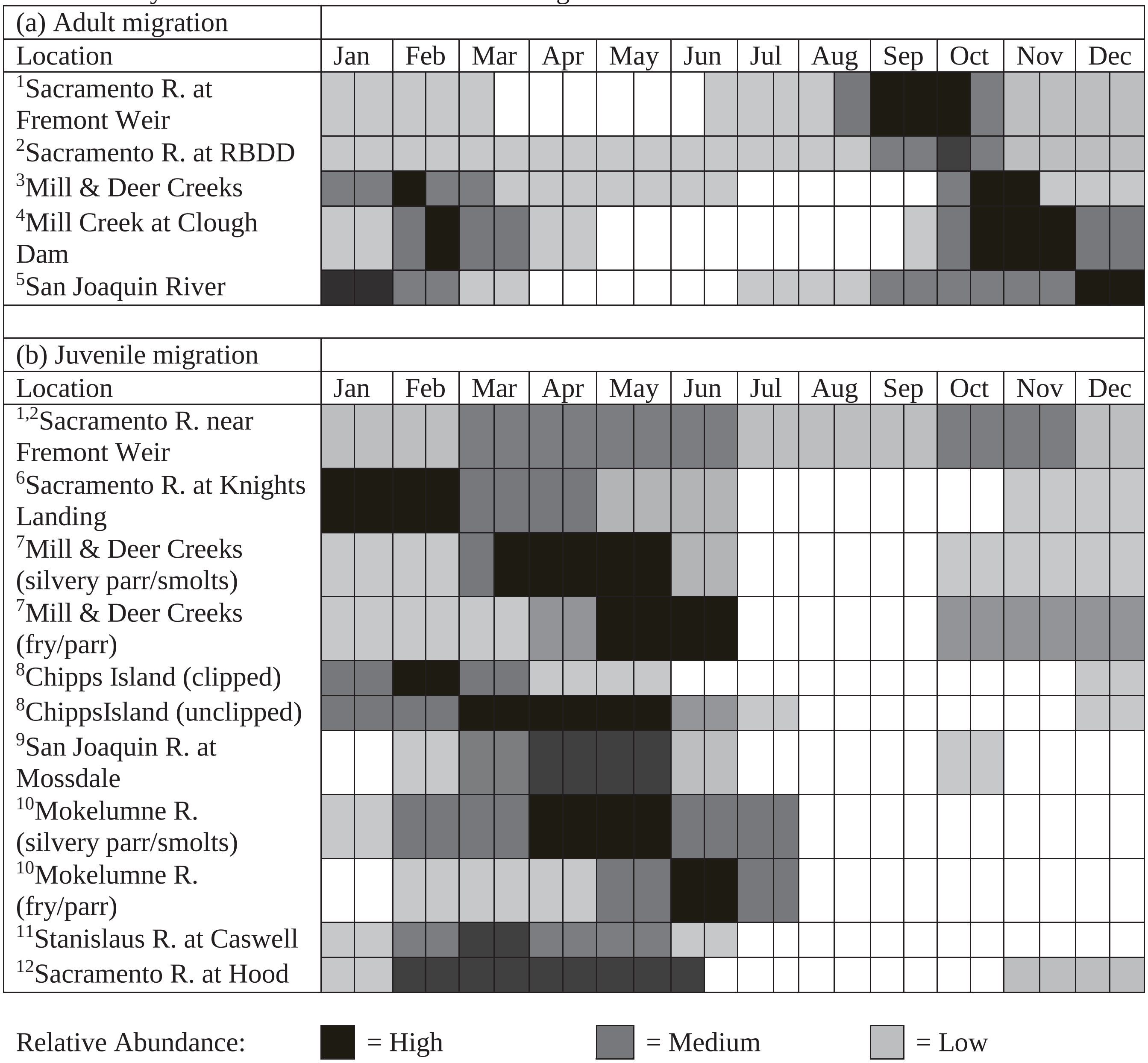
(5) Kelts

Post-spawning steelhead (kelts) may migrate downstream to the ocean immediately after spawning, or they may spend several weeks holding in pools before outmigrating (Shapovalov and Taft 1954). Recent studies have shown that kelts may remain in freshwater for an entire year after spawning (Teo et al. 2011), but that most return to the ocean (Null et al. 2013).

2.2.3.4. Population Viability

As an approach to determining the conservation status of salmonids, NMFS has developed a framework for identifying attributes of a viable salmonid population (VSP). The intent of this framework is to provide parties with the ability to assess the effects of management and conservation actions and ensure their actions promote the listed species' survival and recovery. This framework is known as the VSP concept (McElhany *et al.* 2000b). The VSP concept measures population performance in term of four key parameters: abundance, population growth rate, spatial structure, and diversity.

Table 5. The temporal occurrence of (a) adult and (b) juvenile CCV steelhead at locations in the Central Valley. Darker shades indicate months of greatest relative abundance.




Sources: [1](Hallock 1957); [2](McEwan 2001); [3](Harvey 1995); [4]CDFW unpublished data; [5]CDFG Steelhead Report Card Data 2007; [6]NMFS analysis of 1998-2011 CDFW data; [7](Johnson and Merrick 2012); [8]NMFS analysis of 1998-2011 USFWS data; [9]NMFS analysis of 2003-2011 USFWS data; [10]unpublished EBMUD RST data for 2008-2013; [11]Oakdale RST data (collected by FishBio) summarized by John Hannon (Reclamation) ; [12](Schaffter 1980).

(1) Abundance

Historic CCV steelhead run sizes are difficult to estimate given the paucity of data, but may have approached one to two million adults annually (McEwan 2001). By the early 1960s the steelhead run size had declined to about 40,000 adults (McEwan 2001). Hallock *et al.* (1961) estimated an average of 20,540 adult steelhead through the 1960s in the Sacramento River upstream of the Feather River. Steelhead counts at the RBDD declined from an average of

11,187 for the period from 1967 to 1977, to an average of approximately 2,000 through the early 1990's, with an estimated total annual run size for the entire Sacramento-San Joaquin system, based on RBDD counts, to be no more than 10,000 adults (McEwan and Jackson 1996, McEwan 2001). Steelhead escapement surveys at RBDD ended in 1993 due to changes in dam operations, and comprehensive steelhead population monitoring has not taken place in the Central Valley since then, despite 100 percent marking of hatchery steelhead smolts since 1998. Efforts are underway to improve this deficiency, and a long term adult escapement monitoring plan is being planned (Eilers et al. 2010).

Current abundance data is limited to returns to hatcheries and redd surveys conducted on a few rivers. The hatchery data is the most reliable, as redd surveys for steelhead are often made difficult by high flows and turbid water usually present during the winter-spring spawning period.

CNFH operates a weir on Battle Creek, where all upstream fish movement is blocked August through February, during the hatchery spawning season. Counts of steelhead captured at and passed above this weir represent one of the better data sources for the Central Valley DPS. However, changes in hatchery policies and transfer of fish complicate the interpretation of these data. In 2005, per NMFS request, CNFH stopped transferring all adipose-fin clipped steelhead above the weir, resulting in a large decrease in the overall numbers of steelhead above the weir in recent years (Figure 7). In addition, in 2003, CNFH transferred about 1,000 clipped adult steelhead to Keswick Reservoir, and these fish are not included in the data. The result is that the only unbiased time series for Battle Creek is the number of unclipped (wild) steelhead since 2001, which have declined slightly since that time, mostly because of the high returns observed in 2002 and 2003.

Prior to 2002, hatchery and natural-origin steelhead in Battle Creek were not differentiable, and all steelhead were managed as a single, homogeneous stock, although USFWS believes the majority of returning fish in years prior to 2002 were hatchery-origin. Abundance estimates of natural-origin steelhead in Battle Creek began in 2001. These estimates of steelhead abundance include all *O. mykiss*, including resident and anadromous fish (Figure 7).

Steelhead returns to CNFH have fluctuated greatly over the years. From 2003 to 2012, the number of hatchery origin adults has ranged from 624 to 2,968. Since 2003, adults returning to the hatchery have been classified as wild (unclipped) or hatchery produced (adipose clipped). Wild adults counted at the hatchery each year represent a small fraction of overall returns, but their numbers have remained relatively steady, typically 200-500 fish each year (Figure 8).

Redd counts are conducted in the American River and in Clear Creek (Shasta County). An average of 151 redds have been counted in Clear Creek from 2001 to 2010 (Figure 9; data from USFW), and an average of 154 redds have been counted on the American River from 2002-2010 (Figure 10; data from Hannon and Deason 2008, Hannon et al. 2003, Chase 2010).

The East Bay Municipal Utilities District (EBMUD) has included steelhead in their redd surveys on the Lower Mokelumne River since the 1999-2000 spawning season, and the overall trend is a slight increase. However, it is generally believed that most of the *O. mykiss* spawning in the Mokelumne River are resident fish (Satterthwaite *et al.* 2010), which are not part of the CCV steelhead DPS.

The returns of steelhead to the Feather River Hatchery have decreased greatly over time, with only 679, 312, and 86 fish returning in 2008, 2009 and 2010, respectively (Figure 11). This is despite the fact that almost all of these fish are hatchery fish, and stocking levels have remained fairly constant, suggesting that smolt and/or ocean survival was poor for these smolt classes. The average return in 2006-2010 was 649, while the average from 2001 to 2005 was 1,963. However, preliminary return data for 2011(CDFG) shows a slight rebound in numbers, with 712 adults returning to the hatchery through April 5th, 2011.

The Clear Creek steelhead population appears to have increased in abundance since Saeltzer Dam was removed in 2000, as the number of redds observed in surveys conducted by the USFWS has steadily increased since 2001 (Figure 12). The average redd index from 2001 to 2011 is 157, representing somewhere between 128 and 255 spawning adult steelhead on average each year. The vast majority of these steelhead are wild fish, as no hatchery steelhead are stocked in Clear Creek.

Catches of steelhead at the fish collection facilities in the southern Delta are another source of information on the relative abundance of the CCV steelhead DPS, as well as the proportion of wild steelhead relative to hatchery steelhead (CDFG; ftp.delta.dfg.ca.gov/salvage). The overall catch of steelhead at these facilities has been highly variable since 1993 (Figure 13). The percentage of unclipped steelhead in salvage has also fluctuated, but has generally declined since 100 percent clipping started in 1998. The number of stocked hatchery steelhead has remained relatively constant overall since 1998, even though the number stocked in any individual hatchery has fluctuated.

The years 2009 and 2010 showed poor returns of steelhead to the Feather River Hatchery and CNFH, probably due to three consecutive drought years in 2007-2009, which would have impacted parr and smolt growth and survival in the rivers, and possibly due to poor coastal upwelling conditions in 2005 and 2006, which strongly impacted fall-run Chinook salmon post-smolt survival (Lindley *et al.* 2009b). Wild (unclipped) adult counts appear not to have decreased as greatly in those same years, based on returns to the hatcheries and redd counts conducted on Clear Creek, and the American and Mokelumne Rivers. This may reflect greater fitness of naturally produced steelhead relative to hatchery fish, and certainly merits further study.

Overall, steelhead returns to hatcheries have fluctuated so much from 2001 to 2011 that no clear trend is present, other than the fact that the numbers are still far below those seen in the 1960's and 1970's, and only a tiny fraction of the historical estimate. Returns of natural origin fish are very poorly monitored, but the little data available suggest that the numbers are very small, though perhaps not as variable from year to year as the hatchery returns.

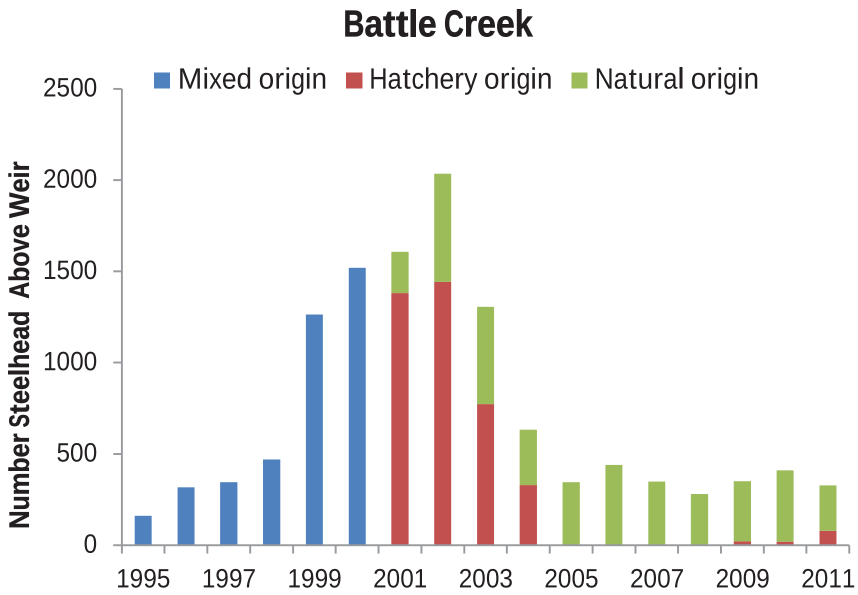



Figure 7. Steelhead returns to Battle Creek from 1995-2009. Starting in 2001, *O. mykiss* were classified as either wild (unclipped) or hatchery produced (clipped). Includes fish passed above the weir during broodstock collection and fish passing through the fish ladder March 1 to August 31. Data are from USFWS.

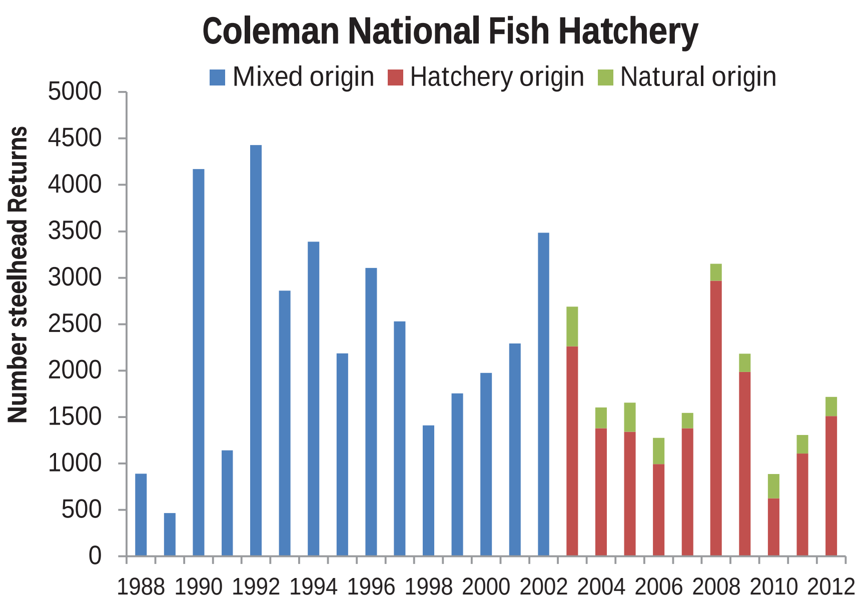



Figure 8. Annual steelhead returns to Coleman National Fish Hatchery. Adipose fin-clipping of hatchery smolts started in 1998 and since 2003 all returns have been categorized either natural or hatchery origin.

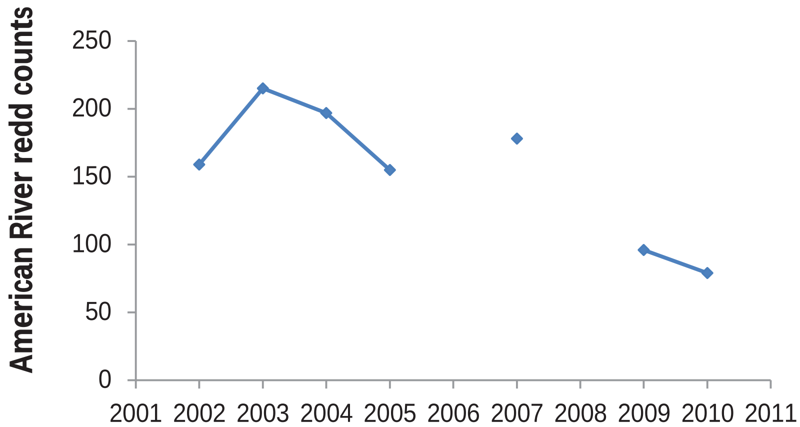



Figure 9. American River steelhead redd counts from USBR surveys 2002–2010. Surveys could not be conducted in some years due to high flows and low visibility.

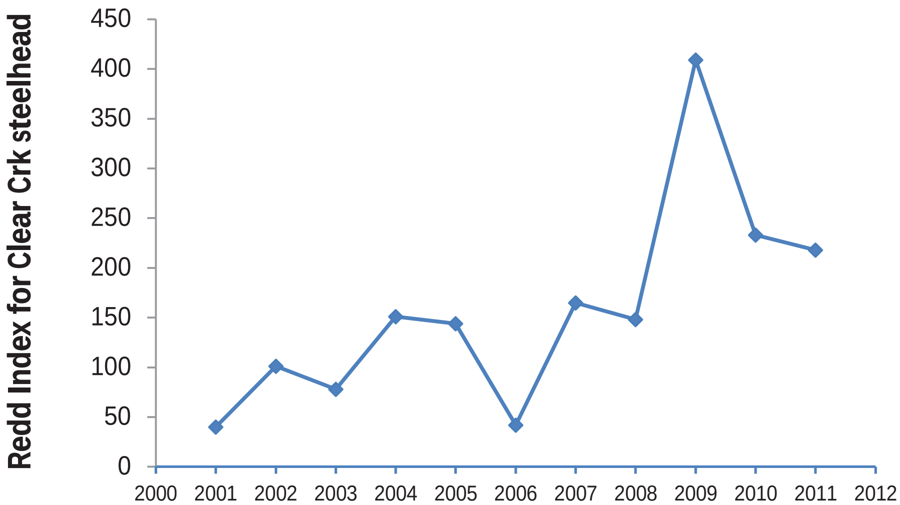



Figure 10. Clear Creek steelhead redd counts from USFWS surveys 2001–2011.

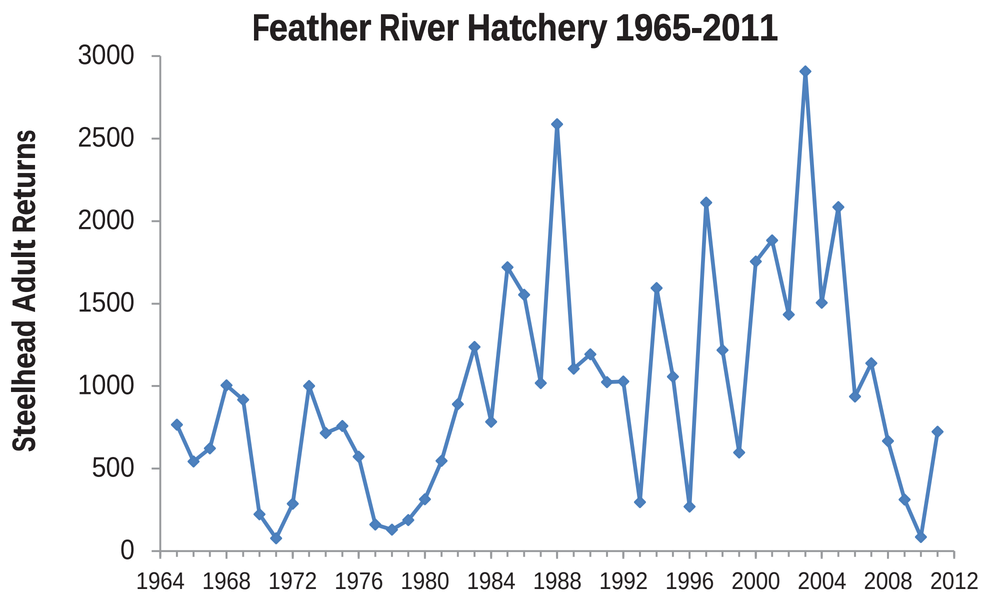



Figure 11. Feather River Hatchery steelhead returns 1965–2011. Almost all fish are hatchery origin.

(2) Productivity

An estimated 100,000 to 300,000 naturally produced juvenile steelhead are estimated to leave the Central Valley annually, based on rough calculations from sporadic catches in trawl gear (Good et al. 2005). The Mossdale trawls on the San Joaquin River conducted annually by CDFW and USFWS capture steelhead smolts, although usually in very small numbers. These steelhead recoveries, which represent migrants from the Stanislaus, Tuolumne, and Merced rivers, suggest that the productivity of CCV steelhead in these tributaries is very low. In addition, the Chipps Island midwater trawl dataset from the USFWS provides information on the trend (Williams et al. 2011).

Nobriga and Cadrett (2001) used the ratio of adipose fin-clipped (hatchery) to unclipped (wild) steelhead smolt catch ratios in the Chipps Island trawl from 1998 through 2000 to estimate that about 400,000 to 700,000 steelhead smolts are produced naturally each year in the Central Valley. Good et al. (2005) made the following conclusion based on the Chipps Island data:

*"If we make the fairly generous assumptions (in the sense of generating large estimates of spawners) that average fecundity is 5,000 eggs per female, 1 percent of eggs survive to reach Chipps Island, and 181,000 smolts are produced (the 1998-2000 average), about 3,628 female steelhead spawn naturally in the entire Central Valley. This can be compared with McEwan's (2001) estimate of 1 million to 2 million spawners before 1850, and 40,000 spawners in the 1960s".*

In the Mokelumne River, East Bay Municipal Utilities District (EBMUD) has included steelhead in their redd surveys on the Lower Mokelumne River since the 1999-2000 spawning season (NMFS 2011). Based on data from these surveys, the overall trend suggests that redd numbers have slightly increased over the years (2000-2010). However, according to Satterthwaite et al.

(2010), it is likely that most of the *O. mykiss* spawning in the Mokelumne River are non-anadromous (or resident) fish rather than steelhead. The Mokelumne River steelhead population is supplemented by Mokelumne River Hatchery production. In the past, this hatchery received fish imported from the Feather River and Nimbus hatcheries (Merz 2002). However, this practice was discontinued for Nimbus stock after 1991, and discontinued for Feather River stock after 2008. Recent genetic studies show that the Mokelumne River Hatchery steelhead are closely related to Feather River fish, suggesting that there has been little carry-over of genes from the Nimbus stock.

Analysis of data from the Chipps Island midwater trawl conducted by the USFWS indicates that natural steelhead production has continued to decline, and that hatchery origin fish represent an increasing fraction of the juvenile production in the Central Valley. Beginning in 1998, all hatchery produced steelhead in the Central Valley have been adipose fin clipped (ad-clipped). Since that time, the trawl data indicates that the proportion of ad-clipped steelhead juveniles captured in the Chipps Island monitoring trawls has increased relative to wild juveniles, indicating a decline in natural production of juvenile steelhead. The proportion of hatchery fish exceeded 90 percent in 2007, 2010, and 2011 (Figure 12). Because hatchery releases have been fairly consistent through the years, this data suggests that the natural production of steelhead has been declining in the Central Valley.

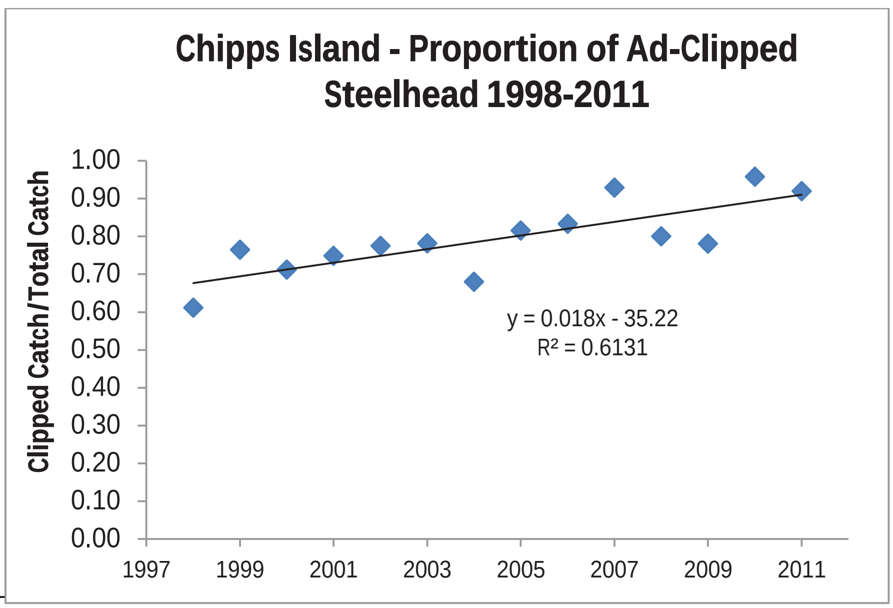



Figure 12. Catch of steelhead at Chipps Island in the USFWS midwater trawl survey 1998–2011. Fraction of the catch bearing an adipose fin clip. All hatchery steelhead have been marked starting in 1998.

Salvage of juvenile steelhead at the CVP and SWP fish collection facilities also indicates a reduction in the natural production of steelhead (Figure 13). The percentage of unclipped juvenile steelhead collected at these facilities declined from 55 percent to 22 percent over the years 1998 to 2010 (NMFS 2011).

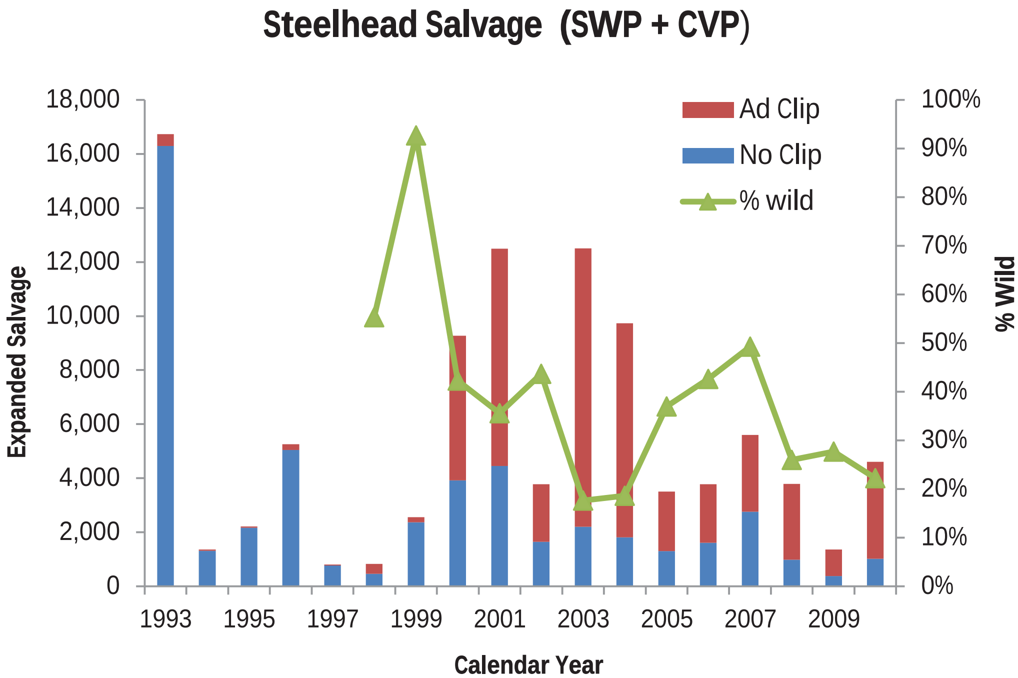



Figure 13. Steelhead salvaged in the Delta fish collection facilities from 1993 to 2010. All hatchery steelhead have been adipose fin-clipped since 1998. Data are from CDFG at ftp.delta.dfg.ca.gov/salvage.

In contrast to the data from Chipps Island and the CVP and SWP fish collection facilities, some populations of wild CCV steelhead appear to be improving (Clear Creek) while others (Battle Creek) appear to be better able to tolerate the recent poor ocean conditions and dry hydrology in the Central Valley compared to hatchery produced fish (NMFS 2011). Since 2003, fish returning to the CNFH have been identified as wild (adipose fin intact) or hatchery produced (ad-clipped). Returns of wild fish to the hatchery have remained fairly steady at 200-300 fish per year, but represent a small fraction of the overall hatchery returns. Numbers of hatchery origin fish returning to the hatchery have fluctuated much more widely; ranging from 624 to 2,968 fish per year.

(3) Spatial Structure

About 80 percent of the historical spawning and rearing habitat once used by anadromous *O. mykiss* in the Central Valley is now upstream of impassible dams (Lindley et al. 2006). The extent of habitat loss for steelhead most likely was much higher than that for salmon because steelhead were undoubtedly more extensively distributed. Due to their superior jumping ability, the timing of their upstream migration which coincided with the winter rainy season, and their less restrictive preferences for spawning gravels, steelhead could have utilized at least hundreds of miles of smaller tributaries not accessible to the earlier-spawning salmon (Yoshiyama et al. 1996). Many historical populations of CCV steelhead are entirely above impassable barriers and may persist as resident or adfluvial rainbow trout, although they are presently not considered part of the DPS. Steelhead were found as far south as the Kings River (and possibly Kern River systems in wet years) (McEwan 2001). Native American groups such as the Chunut people have had accounts of steelhead in the Tulare Basin (Latta 1977).

Steelhead are well-distributed throughout the Central Valley below the major rim dams (Good et al. 2005; NMFS 2011). Zimmerman *et al.* (2009) used otolith microchemistry to show that *O. mykiss* of anadromous parentage occur in all three major San Joaquin River tributaries, but at low levels, and that these tributaries have a higher percentage of resident *O. mykiss* compared to the Sacramento River and its tributaries.

Monitoring has detected small numbers of steelhead in the Stanislaus, Mokelumne, and Calaveras rivers, and other streams previously thought to be devoid of steelhead (McEwan 2001). On the Stanislaus River, steelhead smolts have been captured in rotary screw traps at Caswell State Park and Oakdale each year since 1995 (S.P. Cramer Fish Sciences 2000). A counting weir has been in place in the Stanislaus River since 2002 and in the Tuolumne River since 2009 to detect adult salmon; these weirs have also detected *O. mykiss* passage. In 2012, 15 adult *O. mykiss* were detected passing the Tuolumne River weir and 82 adult *O. mykiss* were detected at the Stanislaus River weir (FISHBIO 2012, 2013a). In addition, rotary screw trap sampling has occurred since 1995 in the Tuolumne River, but only one juvenile *O. mykiss* was caught during the 2012 season (FISHBIO 2013b). Rotary screw traps are well known to be very inefficient at catching steelhead smolts, so the actual numbers of smolts produced in these rivers could be much higher. Rotary screw trapping on the Merced River has occurred since 1999. A fish counting weir was installed on this river in 2012. Since installation, one adult *O. mykiss* has been reported passing the weir. Juvenile *O. mykiss* were not reported captured in the rotary screw traps on the Merced River until 2012, when a total of 381 were caught (FISHBIO 2013c). The unusually high number of *O. mykiss* captured may be attributed to a flashy storm event that rapidly increased flows over a 24 hour period. Annual Kodiak trawl surveys are conducted on the San Joaquin River at Mossdale by CDFW. A total of 17 *O. mykiss* were caught during the 2012 season (CDFW 2013).

The low adult returns to the San Joaquin tributaries and the low numbers of juvenile emigrants typically captured suggest that existing populations of CCV steelhead on the Tuolumne, Merced, and lower San Joaquin rivers are severely depressed. The loss of these populations would severely impact CCV steelhead spatial structure and further challenge the viability of the CCV steelhead DPS.

Efforts to provide passage of salmonids over impassable dams have the potential to increase the spatial diversity of Central Valley steelhead populations if the passage programs are implemented for steelhead. In addition, the SJRRP calls for a combination of channel and structural modifications along the San Joaquin River below Friant Dam, releases of water from Friant Dam to the confluence of the Merced River, and the reintroduction of spring-run and fall-run Chinook salmon. If the SJRRP is successful, habitat improved for spring-run could also benefit CCV steelhead (NMFS 2011).

(4) Diversity

*a. Genetic Diversity:* California Central Valley steelhead abundance and growth rates continue to decline, largely the result of a significant reduction in the amount and diversity of habitats available to these populations (Lindley et al. 2006). Recent reductions in population size are also supported by genetic analysis (Nielsen et al. 2003). Garza and Pearse (2008) analyzed the genetic relationships among Central Valley steelhead populations and found that unlike the situation in coastal California watersheds, fish below barriers in the Central Valley were often more closely related to below barrier fish from other watersheds than to *O. mykiss* above barriers in the same watershed. This pattern suggests the ancestral genetic structure is still relatively intact above barriers, but may have been altered below barriers by stock transfers.

The genetic diversity of CV steelhead is also compromised by hatchery origin fish, which likely comprise the majority of the annual spawning runs, placing the natural population at a high risk of extinction (Lindley et al. 2007). There are four hatcheries (CNFH, FRFH, Nimbus Fish Hatchery, and Mokelumne River Fish Hatchery) in the Central Valley which combined release approximately 1.6 million yearling steelhead smolts each year. These programs are intended to mitigate for the loss of steelhead habitat caused by dam construction, but hatchery origin fish now appear to constitute a major proportion of the total abundance in the DPS. Two of these hatchery stocks (Nimbus and Mokelumne River hatcheries) originated from outside the DPS (primarily from the Eel and Mad rivers) and are not presently considered part of the DPS.

*b. Life-History Diversity*: Steelhead in the Central Valley historically consisted of both summer-run and winter-run migratory forms, based on their state of sexual maturity at the time of river entry and the duration of their time in freshwater before spawning.

*Between 1944 and 1947, annual counts of summer-run steelhead passing through the Old Folsom Dam fish ladder during May, June, and July ranged from 400 to 1,246 fish. After 1950, when the fish ladder at Old Folsom Dam was destroyed by flood flows, summer-run steelhead were no longer able to access their historic spawning areas, and perished in the warm water downstream of Old Folsom Dam(Gerstung 1971).*

Only winter-run (ocean maturing) steelhead currently are found in California Central Valley rivers and streams (Moyle 2002; McEwan and Jackson 1996). Summer-run steelhead have been extirpated due to a lack of suitable holding and staging habitat, such as cold-water pools in the headwaters of CV streams, presently located above impassible dams (Lindley et al. 2006).

Juvenile steelhead (parr) rear in freshwater for one to three years before migrating to the ocean as smolts (Moyle 2002). The time that parr spend in freshwater is inversely related to their growth rate, with faster-growing members of a cohort smolting at an earlier age but a smaller size (Peven et al. 1994, Seelbach 1993). Hallock et al. (1961) aged 100 adult steelhead caught in the Sacramento River upstream of the Feather River confluence in 1954, and found that 70 had smolted at age-2, 29 at age-1, and one at age-3. Seventeen of the adults were repeat spawners, with three fish on their third spawning migration, and one on its fifth. Age at first maturity varies among populations. In the Central Valley, most steelhead return to their natal streams as adults at a total age of two to four years (Hallock et al. 1961, McEwan and Jackson 1996).

Deer and Mill creeks were monitored from 1994 to 2010 by the CDFW using rotary screw traps to capture emigrating juvenile steelhead (Johnson and Merrick 2012). Fish in the fry stage averaged 34 and 41 mm FL in Deer and Mill, respectively, while those in the parr stage averaged 115 mm FL in both streams. Silvery parr averaged 180 and 181 mm in Deer and Mill creeks, while smolts averaged 210 mm and 204 mm. Most silvery parr and smolts were caught in the spring months from March through May, while fry and parr peaked later in the spring (May and June) and were fairly common in the fall (October through December) as well.

In contrast to the upper Sacramento River tributaries, Lower American River juvenile steelhead have been shown to smolt at a very large size (270 to 350 mm FL), and nearly all smolt at age-1 (Sogard *et al.* 2012).

(5) Summary of ESU Viability

All indications are that natural Central Valley steelhead have continued to decrease in abundance and in the proportion of natural fish over the past 25 years (Good et al. 2005; NMFS 2011); the long-term trend remains negative. Hatchery production and returns are dominant over natural fish, and one of the four hatcheries is dominated by Eel/Mad River origin steelhead stock. Continued decline in the ratio between naturally produced juvenile steelhead to hatchery juvenile steelhead in fish monitoring efforts indicates that the wild population abundance is declining. Hatchery releases (100 percent adipose fin-clipped fish since 1998) have remained relatively constant over the past decade, yet the proportion of adipose fin-clipped hatchery smolts to unclipped naturally produced smolts has steadily increased over the past several years.

Although there have been recent restoration efforts in the San Joaquin River tributaries, CCV steelhead populations in the San Joaquin Basin continue to show an overall very low abundance, and fluctuating return rates. Lindley et al. (2007) developed viability criteria for Central Valley salmonids. Using data through 2005, Lindley et al. (2007) found that data were insufficient to determine the status of any of the naturally-spawning populations of CCV steelhead, except for those spawning in rivers adjacent to hatcheries, which were likely to be at high risk of extinction due to extensive spawning of hatchery-origin fish in natural areas.

The widespread distribution of wild steelhead in the Central Valley provides the spatial structure necessary for the DPS to survive and avoid localized catastrophes. However, most wild CCV populations are very small, are not monitored, and may lack the resiliency to persist for protracted periods if subjected to additional stressors, particularly widespread stressors such as climate change (NMFS 2011). The genetic diversity of CCV steelhead has likely been impacted by low population sizes and high numbers of hatchery fish relative to wild fish. The life-history diversity of the DPS is mostly unknown, as very few studies have been published on traits such as age structure, size at age, or growth rates in CCV steelhead.

The most recent status review of the CCV steelhead DPS (NMFS 2011) found that the status of the population appears to have worsened since the 2005 status review (Good et al. 2005), when it was considered to be in danger of extinction.

## 2.2.4. Southern Distinct Population Segment of North American Green Sturgeon

### 2.2.4.1. History of Species Listing and Critical Habitat Designation

Green sturgeon are a species of ancient fish, highly adapted to benthic environments, and very marine oriented, entering freshwater mainly to spawn, but residing in bays, estuaries, and near coastal marine environments for the vast majority of their lifespan. They are known to be long lived; green sturgeon captured in Oregon have been age-estimated up to 52 years old, using a fin-spine analysis (Farr and Kern 2005). They are iteroparous, meaning they can spawn multiple times within their lifespan. The details of their biology are described in the life history section of this document, and also in various literature sources such as Moyle (2002), (Adams *et al.* 2007), (Beamesderfer *et al.* 2007), and (Israel and Klimley 2008).

Green sturgeon are broken into two distinct population segments (DPSs), a northern DPS and a southern DPS (sDPS), and while individuals from the two DPS's are visually indistinguishable and have significant geographical overlap, current information indicates that they do not interbreed, nor do they utilize the spawning areas of each other's natal rivers. In this document we are concerned primarily with sDPS green sturgeon because of its status as a listed species under the ESA. The sDPS green sturgeon include those green sturgeon that spawn south of the Eel River, specifically within the Sacramento River and Feather rivers and possibly also the Yuba River. In this document we review the life history of sDPS green sturgeon, discuss population viability parameters, identify extinction risk, discuss critical habitat features and their conservation values, and we discuss the suite of factors affecting the species. When necessary to fill in knowledge gaps, we borrow information about white sturgeon (*A. transmontanus*) and other sturgeon species, keeping the reader informed of this cross-species informational exchange.

In June of 2001, NMFS received a petition to list green sturgeon under the ESA and to designate critical habitat. After completion of a status review (Adams *et al.* 2002), NMFS found that the species was comprised of two DPS's that qualify as species under the ESA, but that neither DPS warranted listing. In 2003 this "not warranted' decision was challenged in federal court, and NMFS was asked to reconsider available information, taking into account rapidly developing new information. In April of 2005 NMFS (2005) revised its "not warranted" decision and proposed to list the sDPS as "threatened". In its 2006 final decision to list sDPS green sturgeon as threatened, NMFS cited concentration of the only known spawning population into a single river (Sacramento River), loss of historical spawning habitat, mounting threats with regard to maintenance of habitat quality and quantity in the Delta and Sacramento River, and an indication of declining abundance based upon salvage data at the State and Federal salvage facilities. Since the original 2006 listing decision, new information has become available that reinforces the original reasons for listing and reaffirms NMFS concerns that sDPS green sturgeon face substantial threats, challenging their recovery.

2.2.4.2. Critical Habitat and Primary Constituent Elements

NMFS designated critical habitat for sDPS green sturgeon on October 9, 2009 by authority of Section 4(b) of the ESA. Out of 41 habitat units considered, 14 units were excluded from designation as critical habitat because the economic benefit of exclusion outweighed the conservation benefits of designation, and these exclusions would not significantly impede the conservation of the species. Briefly, critical habitat for sDPS green sturgeon includes, (1) the Sacramento River from the I-Street Bridge to Keswick Dam, including the Sutter and Yolo Bypasses and the American River to the highway 160 bridge (2) the Feather River up to the Fish Barrier Dam, (3) the Yuba River up to Daguerre Point Dam (4) the Sacramento-San Joaquin Delta (as defined by California Water Code section 12220), but with many exclusions (see 74 FR 52300), (5) San Francisco Bay, San Pablo Bay, and Suisun Bay, but with many exclusions, and (6) coastal marine areas to the 60 fathom depth bathymetry line, from Monterey Bay, California to the Strait of Juan de Fuca, Washington (Figure 14).

Critical habitat for sDPS green sturgeon is defined as specific areas that contain the primary PCEs and physical habitat elements essential to the conservation of the species. Following are the PCEs for sDPS green sturgeon for the freshwater and estuarine systems of the Central Valley of California (74 FR 52300).

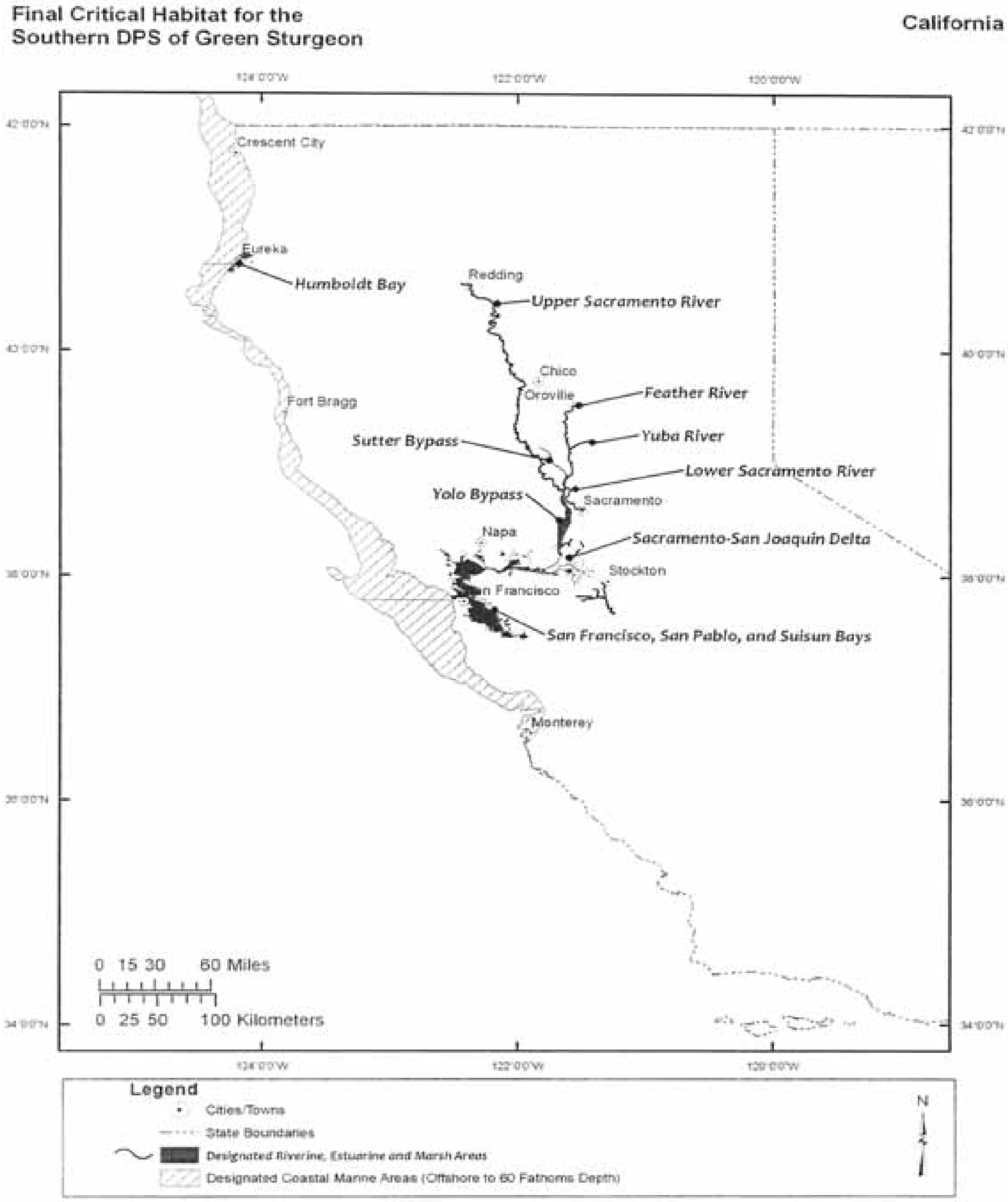



Figure 14. Green sturgeon critical habitat in California.

The specific PCEs in freshwater riverine systems include:

(1) Food Resources

Food resources are drifting and benthic invertebrates, forage fish, and fish eggs. Although specific information on food resources for green sturgeon within freshwater riverine systems is lacking, they are presumed to be generalists and opportunists that feed on similar prey as other sturgeons (Israel and Klimley 2008), such as the healthy population of white sturgeon present and coexisting with green sturgeon in the Sacramento basin. Seasonally abundant drifting and benthic invertebrates have been shown to be the major food items white sturgeon in the lower Columbia River (Muir *et al.* 2000). As sturgeons grow, they begin to feed on oligochaetes, amphipods, smaller fish, and fish eggs as represented in the diets of white sturgeon (Muir *et al.* 2000).

(2) Substrate Type or Size

Substrate type consists of pockets of sand and gravel (2.0 to 64.0 mm in size) within the crevices of larger substrate, such as cobble and boulders ((Poytress *et al.* 2011). Eggs are likely to adhere to sand and gravel after settling into crevices between larger substrates (Van Eenennaam *et al.* 2001, Deng *et al.* 2002). Larvae utilize benthic structure (Van Eenennaam *et al.* 2001, Deng *et al.* 2002, Kynard *et al.* 2005) and seek refuge within crevices, but will forage over hard surfaces (Nguyen and Crocker 2006).

(3) Water Flow

Water flow regimes consist of stable and sufficient water flow rates in spawning and rearing reaches to maintain water temperatures within the optimal range for egg, larval, and juvenile survival and development (14 – 17.5°C) (Mayfield and Cech 2004, Van Eenennaam *et al.* 2005, Allen *et al.* 2006). Sufficient flow is also needed to reduce the incidence of fungal infestations of the eggs, and to flush silt and debris from cobble, gravel, and other substrate surfaces to prevent crevices from being filled in and to maintain surfaces for feeding. Successful migration of adult green sturgeon to and from spawning grounds is also dependent on sufficient water flow. Spawning in the Sacramento River is believed to be triggered by increases in water flow to about 14,000 cfs [average daily flows during spawning months range from 6,900 – 10,800 cfs; Brown (2007)]. In Oregon's Rogue River, green sturgeon have been shown to emigrate to the ocean during the autumn and winter when water temperatures dropped below 10° C and flows increased (Erickson *et al.* 2002). On the Klamath River, the fall outmigration of green sturgeon has been shown to coincide with a significant increase in discharge resulting from the onset of the rainy season (Benson *et al.* 2007). On the Sacramento River, flow regimes are largely dependent on releases from Shasta Dam, thus the operation of this dam could have profound effects upon sDPS green sturgeon habitat.

(4) Water Quality

Adequate water quality, including temperature, salinity, oxygen content, and other chemical characteristics, is necessary for normal behavior, growth and viability of all life stages. Suitable water temperatures, salinities, and dissolved oxygen levels are discussed in detail in the life history section.

(5) Migratory Corridor

Safe and unobstructed migratory pathways are necessary for adult green sturgeon to migrate to and from spawning habitats, and for larval and juvenile green sturgeon to migrate downstream from spawning/rearing habitats within freshwater rivers to rearing habitats within the estuaries. This PCE is highly degraded compared to its historical condition due to man-made barriers and alteration of habitat. Keswick Dam, at RM 302, forms a complete barrier to any potential sturgeon migration on the Sacramento River, but downstream of this point, good spawning and rearing habitat exists, primarily in the river reach between Keswick Dam and RBDD (RM 242). The Feather River and Yuba River also offer potential green sturgeon spawning habitat, but those rivers contain their own man-made barriers to migration and are highly altered environments.

(6) Depth

Deep pools of more than five meter depth are critical for adult green sturgeon spawning and for summer holding within the Sacramento River. Summer aggregations of green sturgeon are observed in these pools in the upper Sacramento River above the Glen Colusa Irrigation District (GCID) diversion. The significance and purpose of these aggregations are unknown at the present time, but may be a behavioral characteristic of green sturgeon. Adult green sturgeon in the Klamath and Rogue rivers also occupy deep holding pools for extended periods of time, presumably for feeding, energy conservation, and/or refuge from high water temperatures (Erickson *et al.* 2002, Benson *et al.* 2007). As described above approximately 54 pools with adequate depth have been identified in the Sacramento River above the GCID location (Thomas *et al.* 2013).

(7) Sediment Quality

Sediment should be of the appropriate quality and characteristics necessary for normal behavior, growth, and viability of all life stages. This includes sediments free of contaminants [*e.g.*, elevated levels of heavy metals (*e.g.*, mercury, copper, zinc, cadmium, and chromium), PAHs, and organochlorine pesticides] that can result in negative effects on any life stage of green sturgeon or their prey. Based on studies of white sturgeon, bioaccumulation of contaminants from feeding on benthic species may negatively affect the growth, reproductive development, and reproductive success of green sturgeon.

The specific PCEs in estuarine areas include:

(1) Food Resources

Abundant food items within estuarine habitats and substrates for juvenile, subadult, and adult life stages are required for the proper functioning of this PCE for green sturgeon. Prey species for juvenile, subadult, and adult green sturgeon within bays and estuaries primarily consist of benthic invertebrates and fish, including crangonid shrimp, callianassid shrimp, burrowing thalassinidean shrimp, amphipods, isopods, clams, annelid worms, crabs, sand lances, and anchovies. These prey species are critical for the rearing, foraging, growth, and development of juvenile, subadult, and adult green sturgeon within bays and estuaries.

(2) Water Flow

Within bays and estuaries adjacent to the Sacramento River (*i.e.*, the Sacramento-San Joaquin Delta and the Suisun, San Pablo, and San Francisco bays), sufficient flow into the bay and estuary to allow adults to successfully orient to the incoming flow and migrate upstream to spawning grounds is required. Sufficient flows are needed to attract adult green sturgeon to the Sacramento River from the Bay and to initiate upstream spawning migrations.

(3) Water Quality

Adequate water quality, including temperature, salinity, oxygen content, and other chemical characteristics, is necessary for normal behavior, growth and viability of all life stages. Suitable water temperatures, salinities, and dissolved oxygen necessary for green sturgeon are discussed in detail in the life history section.

(4) Migratory Corridor

Safe and unobstructed migratory pathways are necessary for the successful and timely passage of adult, sub-adult, and juvenile fish within estuarine habitats and between estuarine and riverine or marine habitats. Fish need the ability to freely migrate from the river through the estuarine waterways of the delta and bays and eventually out into the ocean. Southern DPS green sturgeon use the Sacramento River and the Sacramento-San Joaquin Delta as a migratory corridor. Additionally, certain bays and estuaries throughout Oregon and Washington and into Canada are also utilized for rearing and holding, and these areas too must offer safe and unobstructed migratory corridors.

One of the key areas of concern is the Yolo and Sutter bypasses. These leveed floodplains are engineered to convey floodwaters of the greater Sacramento Valley and they include several concrete weir structures that allow flood flows to escape into the bypass channels. Adult sturgeon are attracted into the bypasses by these high flows. However the weirs can act as barriers and block the passage of fish. Fish can also be trapped in the bypasses as floodwaters recede (USFWS 1995, DWR 2005). Some of the weir structures have been designed with fish ladders to provide upstream adult salmon passage but these ladders have shown to be ineffective for providing upstream passage to adult sturgeon (DWR and BOR 2012). In addition there are irregularities in the splash basins at the foot of these weirs and multiple road crossings and agricultural impoundments in the bypasses that block hydraulic connectivity and can impede fish passage. As a result, sturgeon may become stranded in the bypasses and face delayed migration and lethal and sub-lethal effects from poaching, high water temperatures, low dissolved oxygen, and desiccation.

(5) Water Depth

A diversity of depths is necessary for shelter, foraging, and migration of juvenile, subadult, and adult life stages. Subadult and adult green sturgeon occupy deep (more than 5 m) holding pools within bays, estuaries, and freshwater rivers. These deep holding pools may be important for feeding and energy conservation, or may serve as thermal refugia (Benson *et al.* 2007). Tagged adults and subadults within the San Francisco Bay estuary primarily occupied waters with depths of less than 10 meters, either swimming near the surface or foraging along the bottom (Kelly *et al.* 2007). In a study of juvenile green sturgeon in the Delta, relatively large numbers of juveniles were captured primarily in shallow waters from 3 – 8 feet deep, indicating juveniles may require shallower depths for rearing and foraging (Radtke 1966).

(6) Sediment Quality

Sediment quality (*i.e.*, chemical characteristics) is necessary for normal behavior, growth, and viability of all life stages. This includes sediments free of contaminants (*e.g*., elevated levels of selenium, PAHs, and organochlorine pesticides) that can cause negative effects on all life stages of green sturgeon (see description of *sediment quality* for freshwater riverine habitat above).

The PCE's for coastal marine areas are omitted from this document as the focus here is upon the California Central Valley and the Sacramento-San Joaquin Bay Delta. A full description of all PCE's, including those for coastal marine areas, may be found in 74 FR 52300.

In summary, the current condition of critical habitat for sDPS green sturgeon is degraded over its historical condition. In particular, migratory corridor and water flow PCEs have been particularly impacted by human actions, substantially altering the historical environmental characteristics in which sDPS green sturgeon evolved.

2.2.4.3. Life History

(1) General Information

Green sturgeon are a species of ancient fish, highly adapted to benthic environments, and very marine oriented, entering freshwater mainly to spawn, but residing in bays, estuaries, and near coastal marine environments for the vast majority of their lifespan. They are known to be long lived; green sturgeon captured in Oregon have been age-estimated up to 52 years old, using a fin-spine analysis (Farr and Kern 2005). They are iteroparous, meaning they can spawn multiple times within their lifespan. The details of their biology are described in the life history section of this document, and also in various literature sources such as Moyle (2002), (Adams *et al.* 2007), (Beamesderfer *et al.* 2007), and (Israel and Klimley 2008).

A general timeline of green sturgeon development is given in Table 6. There is considerable variability across categories, such as size or age at maturity.

(2) Adult Migration and Spawning

Green sturgeon reach sexual maturity between 15–17 years of age (Beamesderfer *et al.* 2007), and they typically spawn once every 2–5 years (average is 3.75 years) (Mora unpublished data). Based on data from acoustic tags (Heublein *et al.* 2009), adult sDPS green sturgeon leave the ocean and enter San Francisco Bay between January and early May (Table 7). Migration through the bay/Delta takes about one week and progress upstream is fairly rapid to their spawning sites. Green sturgeon spawn primarily in the Sacramento with most spawning activity concentrated in the mid-April to mid-June time period (Poytress *et al.* 2013). In 2011 spawning was confirmed in the Feather River by the California Department of Water Resources (CDWR), and suggested in the Yuba River by a report released by Cramer Fish Sciences (Bergman *et al.* 2011). Table 8 shows, the vast majority of adults, and therefore spawning activity, is in the Sacramento River.

Various studies of spawning site characteristics (Poytress *et al.* 2011) agree that spawning sDPS green sturgeon typically favor deep, turbulent holes over 5 meters deep, featuring sandy, gravel, and cobble type substrates. Water depth may be negotiable, as spawning has been documented in depths as shallow as 2 meters (Poytress *et al.* 2011). However, substrate type is likely constrained as the interstices of the cobble and gravel catch and hold eggs, allowing them to incubate without being washed downstream. Flows need to be high enough to create the deep, turbulent habitat that green sturgeon favor for spawning. Successful egg development requires a water temperature range between 11° C and 19° C. Larvae and juveniles appear to have broader temperature tolerances than eggs. See Table 6 for more information and supporting references.

Table 6. General green sturgeon life history from egg to adult including length-life stage information.

| Timeline | Life stage, Length-age relationship |
|---|---|
| Fertilization of eggs (spawning) | Spawning occurs primarily in deep water (> 5m) pools[1] at very few select sites[2], predominantly in the Sacramento River, predominantly in time period mid-April to mid-June[3] |
| 144 – 192 hours (6-8 days) after fertilization of eggs | Newly hatched larvae emerge. **Larvae are 12.6 – 14.5 mm** in length[4] |
| 6 days post hatch (dph) | Nocturnal swim up, hide by day behavior observed[4] |
| 10 dph | Exogenous feeding begins around 10 dph[4]. Larvae begin to disperse downstream |
| 2 weeks old | Larvae appear in rotary screw traps at the RBDD at lengths of 24 to 31 mm. |
| 45 dph | Larval to juvenile metamorphosis complete. Begin juvenile life stage. **Juveniles are 63 – 94 mm** in length. |
| 45 days to 1.5 years | Juveniles migrate downstream and into the Delta or the estuary and rear to the sub-adult phase. **Juveniles range in size from around 70 mm to 90 cm**. Little information available about this life stage. |
| 1.5 – 4 years | Juveniles migrate to sea for the first time, thereby entering the sub-adult phase. **Subadults are 91cm to 149 cm**. |
| 1.5 years to 15-17 years | Subadults enter the ocean where they grow and develop, reaching maturity between 15-17 years of age* |
| 15-17 years* | Green sturgeon reach sexual maturity and become adults, with **males maturing around 120 cm and females maturing around 145 cm[5]** |
| 15 years to 50+ years | Green sturgeon have a lifespan that can reach 50 or more years, and can grow to a **total length of over 2 meters** |
| Sources:<br>1. Thomas *et al.* (2013) 2. Ethan Mora, UC Davis, unpublished data. 3. Poytress *et al.* (2013) 4. Deng *et al.* (2002) 5. Nakamoto *et al.* 1995 *green sturgeon in the Klamath River might reach sexual maturity as early as 13 years for females and 9 years for males. More research is needed to determine the typical age and size of sDPS green sturgeon at maturity. | |

Poytress *et al.* (2012) conducted spawning site and larval sampling in the upper Sacramento River from 2008–2012 that identified a number of spawning locations (Figure 15). Green sturgeon fecundity is approximately 50,000–80,000 eggs per adult female (Van Eenennaam *et al.* 2001). Green sturgeon have the largest egg size of any sturgeon. The outside of the eggs are mildly adhesive, and are denser than those of white sturgeon (Kynard *et al.* 2005, Van Eenennaam *et al.* 2009)

Post spawning, adults have been observed to leave the system rapidly, or to hold in deep pools and migrate downriver in winter after the first storms. Benson *et al.* (2007) conducted a study in which 49 adult green sturgeon were tagged with radio and/or sonic telemetry tags and tracked manually or with receiver arrays from 2002 to 2004. Tagged individuals exhibited four movement patterns: upstream spawning migration, spring outmigration to the ocean, or summer holding, and outmigration after summer holding. Following spawning, sDPS green sturgeon typically re-enter the ocean generally from November through January (with the onset of the first winter storms), with migration through the estuary lasting about a week.

(3) Juvenile Migration

Larval green sturgeon hatch in the late spring or summer (peak in July) and progress downstream towards the Delta rearing into juveniles. It is unknown when they enter the Delta, but typically rear for 2–3 years before entering the ocean. Ocean entry marks the transition from juvenile to sub-adults. Table 7 below gives the relative abundance of various life stages by location. Water depth may be negotiable, as spawning has been documented in depths as shallow as 2 meters (Poytress *et al.* 2011). However, substrate type is likely constrained as the interstices of the cobble and gravel catch and hold eggs, allowing them to incubate without being washed downstream.

Most green sturgeon spawning activity occurs on the mainstem Sacramento River, and although not all sites are known, just 3 sites on the Sacramento River account for over 50 percent of green sturgeon spawning (Mora unpublished data). Figure 15 shows know spawning locations on the Sacramento River.

(4) Egg and Larval Stages

Green sturgeon larvae hatch from fertilized eggs after approximately 169 hours at a water temperature of 15$^{o}$ C (59$^{o}$ F) (Van Eenennaam *et al.* 2001, Deng *et al.* 2002). Studies conducted at the University of California, Davis (UC Davis) by Van Eenennaam *et al.* (2005) indicated that an optimum range of water temperature for egg development ranged between 14$^{o}$ C (57.2$^{o}$F) and 17.5$^{o}$ C (62.6$^{o}$F). Temperatures over 23 $^{o}$C (73.4$^{o}$F) resulted in 100 percent mortality of fertilized eggs before hatching. Eggs incubated at water temperatures between 17.5$^{o}$ C (63.5$^{o}$F) and 22$^{o}$ C (71.6$^{o}$F) resulted in elevated mortalities and an increased occurrence of morphological abnormalities in those eggs that did hatch. At incubation temperatures below 14$^{o}$ C (57.2$^{o}$F), hatching mortality also increased significantly, and morphological abnormalities increased slightly, but not statistically so (Van Eenennaam *et al.* 2005). Further research is needed to identify the lower temperatures limits for eggs and larvae. Table x shows temperature tolerance by life stage for all stages of green sturgeon development.

Information about larval sDPS green sturgeon in the wild is very limited. The USFWS conducts annual sampling for eggs and larvae in the mainstem Sacramento River. Larval green sturgeon appear in USFWS rotary screw traps at the RBDD from May through August (Poytress et al. 2010) and at lengths ranging from 24 to 31 mm fork length, indicating they are approximately two weeks old (California Department of Fish and Game 2002, U.S. Fish and Wildlife Service 2002). USFWS data reveals some limited information about green sturgeon larvae, such as time and date of capture, and corresponding river conditions such as temperature and flow parameters. Information about larval sDPS green sturgeon in the wild is very limited.

Table 7. Migration timing of sDPS green sturgeon by location and life stage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Low | Medium | High | Medium | Low | | | | |
| **a) Spawning adults** | | | | | | | | | | | | |
| Location | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| Golden Gate entry, heading upstream | Low | High | High | High | Low | | | | | | | |
| Arrival at Rio Vista, heading upstream | Low | High | High | High | Low | | | | | | | |
| Arrival to spawning grounds on upper Sacramento River | | Low | High | High | Medium | Low | | | | | | |
| Sacramento River spawning period | | | | Medium | High | High | Low | | | | | |
| Sacramento River upriver presence | High | Low | High | High | High | High | High | High | High | High | High | High |
| Arrival at Rio Vista, heading downstream | High | Low | | | | | | Low | | Low | | High |
| Arrival at Golden Gate, heading seaward | High | Low | | | | | | | | Medium | | High |
| **b) Summer and fall residence of subadults and non-spawning adults in the San Francisco Bay Estuary** | | | | | | | | | | | | |
| Location | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| Golden Gate entry | | | | Medium | Medium | High | High | Medium | | | | |
| Residing in estuary | | | | Medium | High | High | High | High | High | Medium | Low | |
| Golden Gate departure | | | | Low | Low | High | Low | Medium | High | Medium | Low | |
| **c) YOY/Juveneiles** | | | | | | | | | | | | |
| Location | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| YOY at Red Bluff Diversion Dam | | | | | High | High | High | Low | Low | | | |
| YOY at GCID | | | | | Medium | High | High | Medium | Low | | | |
| Juveniles from Delta salvage (<50cmTL) | | Low | Medium | Low | Low | Low | Low | High | Low | Medium | Medium | Low |
| Juveniles residing in San Francisco Bay Estuary | High | High | High | High | High | High | High | High | High | High | High | High |

Table 8 Yearly adult green sturgeon abundance estimates in Sacramento River, Feather River, and Yuba River, Central Valley between 2010 and 2014. Data sources: Sacramento River (UC Davis/Ethan Mora, unpublished data); Feather River (Alicia Seesholtz, CDWR, unpublished data); Yuba River (Bergman et al. 2011).

| Year | Sacramento River | Feather River | Yuba River |
|---|---|---|---|
| 2010 | 164 | data unavailable | data unavailable |
| 2011 | 220 | 25 | 4 or 5 |
| 2012 | 329 | data unavailable | Presumed to be zero, but data unavailable |
| 2013 | data unavailable | data unavailable | Presumed to be zero, but data unavailable |
| 2014 | data unavailable | data unavailable | Presumed to be zero, but data unavailable |

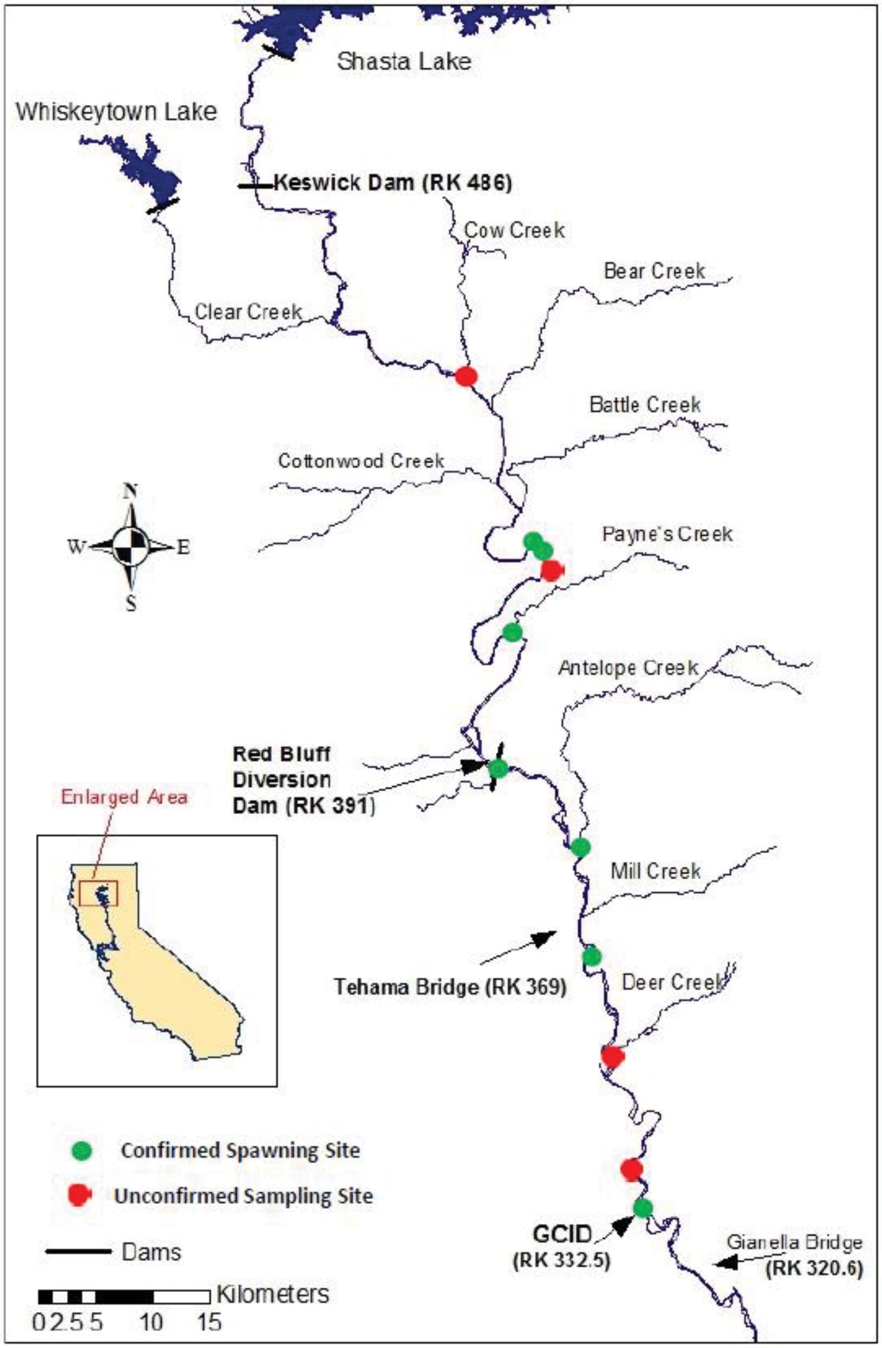



Figure 15. Green sturgeon spawning locations in the Sacramento River from 2008–2012. Unconfirmed sites indicate an area where sturgeon have been known to congregate but where evidence of spawning was not obtained in the study.

Unfortunately, there is little information on diet, distribution, travel time through the river, and estuary rearing. Laboratory studies have provided some information about this initial life stage, but the relevance to fish in their natural habitat is unknown. Probably the most significant use of the USFWS data on larval green sturgeon has been to infer larval growth rates and correlations of these growth rates to temperature and flow conditions, making comparisons with larval green sturgeon growth rates in other river systems.

Table 9. Green sturgeon temperature tolerance range by life stage

| Green Sturgeon Temperature Tolerance by Life Stage | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| temperature °C | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| temperature °F | 41.0 | 42.8 | 44.6 | 46.4 | 48.2 | 50.0 | 51.8 | 53.6 | 55.4 | 57.2 | 59.0 | 60.8 | 62.6 | 64.4 | 66.2 | 68.0 | 69.8 | 71.6 | 73.4 | 75.2 | 77.0 | 78.8 | 80.6 | 82.4 |
| egg | | | | | | | b | b | b | b | b | b | b | b | b | b | b | b | b | b | b | b | b | b |
| larvae | | | | | | | | | | | | | c | i | i | i | i | i | i | i | c,i | i | i | i |
| juvenile | | | | | | | a | a | a | a | a | a | a | a | a,d | a | a | a | a | a,d | a | a | a | a |
| sub-adult or adult, SF estuary | | | | | | | | | | h | h | h | h | h | h | h | h | | | | | | | |
| adult (>152 cm), spawning | | | | | | e | e | e,f | e,f | e,f | e,f | f | | | | | | | | | | | | |
| sub-adult or adult, ocean | | | g | g | g | g | g | g | g | g | g | | | | | | | | | | | | | |

| | |
|---|---|
| optimal temperature | a = Mayfield and Cech, 2004 |
| acceptable temperature | b = Van Eenennaam *et al*, 2005 |
| impaired fitness; avoid prolonged exposure; increasing chance of lethal effects | c = Werner *et al*, 2007 |
| likely lethal | d = Allen et al, 2006 |
| lethal | e = Poytress *et al*, 2012 |
| unknown effect upon survival and fitness | f = Poytress *et al*, 2013 |
| NOTES: a, b, c, d, i used green sturgeon sourced from the Klamath River. E and f indicate water temperature during estimated spawning period on the upper Sacramento River. G used green strugeon captured in the Rogue River. H involved tracking acoustically tagged green sturgeon captured in San Pablo Bay | g = Erickson and Hightower, 2007<br>h= Kelly *et al*, 2007<br>i = Linares-Casenave *et al*, 2013 |

NOTES on variability of individual's fitness and varibality of themal stress effects: Linares-Casenave *et al* (2013) found varying levels of temperature tolerance by broodstock collected at different times of the year when river temperatures were different. Wener *et al* (2007) found that detrimental thermal stress efects (notochord deformity and impaired swimming) were reversible in 50% of larvae returned to cool water (17° C) after 3 days exposure to 26° C. Thus it is important to note that thermal stress effects are sometimes reversible and can also affect individuals differently.

(5) Juvenile Development and Outmigration

Young green sturgeon appear to rear for the first one to two months in the Sacramento River (California Department of Fish and Game 2002). Growth is rapid as juveniles move downstream and reach up to 300 mm the first year and over 600 mm in the first 2 to 3 years (Nakamoto *et al.* 1995). Juvenile sDPS green sturgeon have been salvaged at the Federal and State pumping facilities (which are located in the southern region of the Delta), and collected in sampling studies by California Department of Fish and Wildlife (CDFW) during all months of the year (California Department of Fish and Game 2002). Salvage data have been updated through 2014 (Figure 16). The majority of juveniles that were captured in the Delta were between 200 and 500 mm indicating they were from 2 to 3 years of age, based on age/growth studies from the Klamath River (Nakamoto *et al.* 1995). The lack of any juveniles smaller than approximately 200 mm in the Delta suggests that smaller individuals rear in the Sacramento River, or its tributaries. Juvenile sDPS green sturgeon may hold in the mainstem Sacramento River for up to 10 months, as suggested by Kynard *et al.* (2005). Juvenile green sturgeon captured in the Delta by Radtke (1966) ranged in size from 200-580 mm, further supporting the hypothesis that juvenile green sturgeon enter the Delta after 10 months or at 200 mm in size. Green sturgeon juveniles tested under laboratory conditions had optimal bioenergetic performance between 15° C (59° F) and 19° C (66.2° F) (Mayfield and Cech 2004).

Radtke (1966) inspected the stomach contents of juvenile green sturgeon (range: 200-580 mm) in the Delta and found food items to include mysid shrimp (*Neomysis awatschensis)*, amphipods (*Corophium sp.)*, and other unidentified shrimp. In the northern estuaries of Willapa Bay, Grays Harbor, and the Columbia River, green sturgeon have been found to feed on a diet consisting primarily of benthic prey and fish common to the estuary. For example, burrowing thalassinid shrimp (mostly *Neotrypaea californiensis*) were important food items for green sturgeon taken in Willapa Bay, Washington (Dumbauld *et al.* 2008).

(6) Estuarine Rearing

There is a fair amount of variability (2-3 years) in the estimates of the time spent by juvenile green sturgeon in fresh or brackish water before making their first migration to sea. Nakamoto *et al.* (1995) found that green sturgeon on the Klamath River migrated to sea, on average by age three and no later than by age four. Moyle (2002) suggests juveniles migrate out to sea before the end of their second year, and perhaps as yearlings. Laboratory experiments indicate that green sturgeon juveniles may occupy fresh to brackish water at any age, but they gain the physiological ability to completely transition to saltwater at around 1.5 years of age (Allen and Cech 2007). In studying green sturgeon on the Klamath River, Allen *et al.* (2009) devised a technique to estimate the timing of transition from fresh water to brackish water to seawater by taking a bone sample from the leading edge of the pectoral fin and analyzing the strontium to calcium ratios. The results of this study indicate that green sturgeon move from freshwater to brackish water (such as the estuary) at ages 0.5–1.5 years and then move into seawater at ages 2.5-3.5 years.

(7) Ocean Rearing

Once green sturgeon juveniles make their first entry into sea, they enter the sub-adult phase and spend a number of years migrating up and down the coast. Sub-adults mature in coastal marine environments and in bays and estuaries until at least 9–17 years of age before returning to their natal freshwater river to spawn. An individual may spawn once every 3–5 years and live for 50 years or more. While they may enter river mouths and coastal bays throughout their years in the sub-adult phase, they do not return to their natal freshwater environments before they are mature.

In the summer months, multiple rivers and estuaries throughout the sDPS range are visited by dense aggregations of green sturgeon (Moser and Lindley 2007, Lindley *et al.* 2011). Genetic studies on green sturgeon stocks indicate that the green sturgeon in the San Francisco Bay ecosystem belong exclusively to the sDPS (Israel *et al.* 2009). Capture of green sturgeon as well as tag detections in tagging studies have shown that green sturgeon are present in San Pablo Bay and San Francisco Bay at all months of the year (Kelly *et al.* 2007, Heublein *et al.* 2009, Lindley *et al.* 2011). An increasing amount of information is becoming available regarding green sturgeon habitat use in estuaries and coastal ocean, and why they aggregate episodically (Lindley *et al.* 2008, Lindley *et al.* 2011).

2.2.4.4. Population Viability

We applied the VSP framework to analyzing green sturgeon viability. Although the VSP concept was developed for Pacific salmonids, the underlying parameters are general principles of conservation biology and can therefore be applied to other species.

(1) Abundance

In applying the VSP concept, abundance is examined at the population level, and therefore population size is perhaps a more appropriate term. Historically, abundance and population trends of sDPS green sturgeon has been inferred in two ways; first by analyzing salvage numbers at the State and Federal pumping facilities (see below), and second, by incidental catch of green sturgeon by the CDFW’s white sturgeon sampling/tagging program. Both methods of estimating sDPS green sturgeon abundance are problematic as biases in the data are evident. Only recently has more rigorous scientific inquiry begun with (Israel and May 2010) and (Mora unpublished data).

A decrease in sDPS green sturgeon abundance has been inferred from the amount of take observed at the south Delta pumping facilities; the Skinner Delta Fish Protection Facility (SDFPF) and the Tracy Fish Collection Facility (TFCF). This data should be interpreted with some caution; operations and practices at the facilities have changed over the decades, which may affect the salvage data shown below (Figure 16).

Despite the potential pitfalls of using salvage data to estimate an abundance trends for sDPS green sturgeon, the above chart shows what appears to be a very steep decline in abundance, and potentially great cause for concern.

Beginning in 2010, more robust estimates of sDPS green sturgeon have been generated. As part of a doctoral thesis at UC Davis, Ethan Mora has been using acoustic telemetry to locate green sturgeon in the Sacramento River, and to derive an adult spawner abundance estimate. Preliminary results of these surveys estimate an average annual spawning run of 272 fish (Mora unpublished data). This estimate does not include the number of spawning adults in the lower Feather or Yuba rivers, where green sturgeon spawning was recently confirmed.

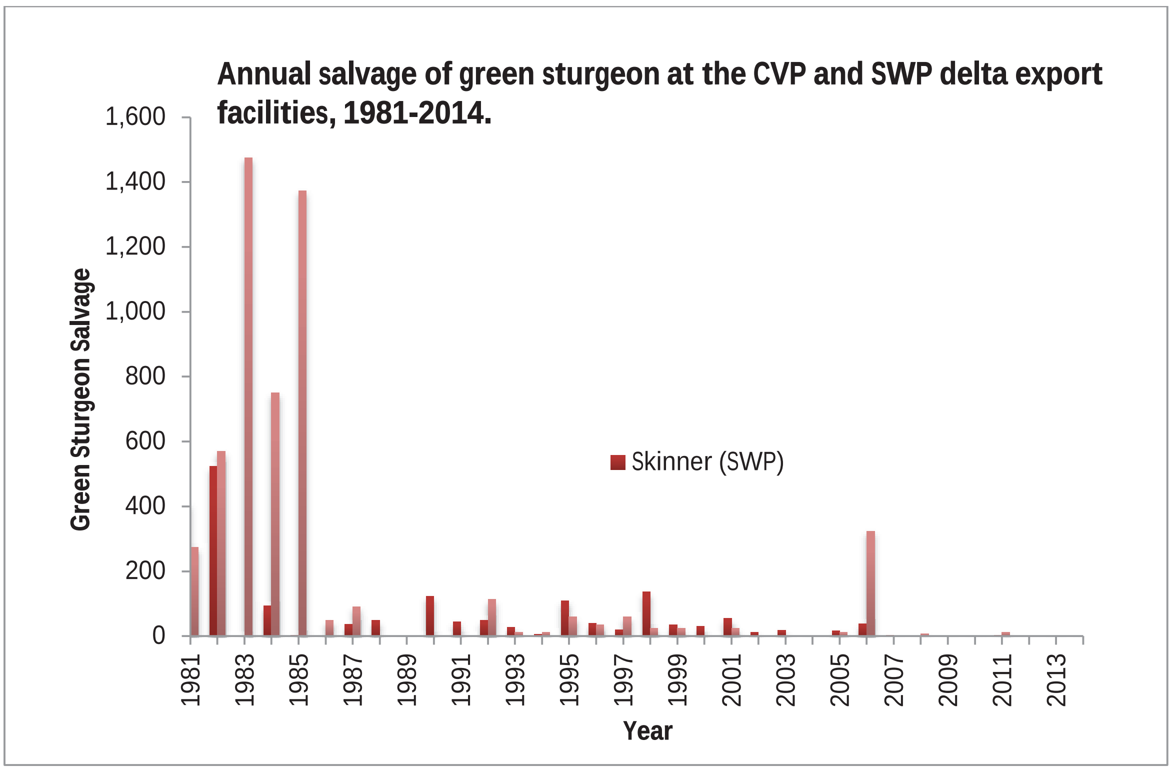



Figure 16. Annual salvage of green sturgeon for the SDFPF and the TFCF 1981–2014. Data source: ftp://ftp.delta.dfg.ca.gov/salvage

(2) Productivity

The parameters of green sturgeon population growth rate and carrying capacity in the

Sacramento Basin are poorly understood. Larval count data from rotary screw traps set seasonally near The Red Bluff and Glen Colusa Irrigation District diversions. This data shows enormous variance between years with a high count of 3,700 larval captured in 2011 (Poytress et al. 2012). In other years, larval counts were an order of magnitude lower. There is some concern that the Sacramento River may have temperature regimes too cold for optimal larval growth, or for optimal hatching success in the upper regions of the river (Poytress *et al.* 2013). In general, sDPS green sturgeon year class strength appears to be highly variable with overall abundance dependent upon a few successful spawning events (NMFS 2010b). It is unclear if the population is able to consistently replace itself or grow to greater abundance than levels currently observed. Other indicators of productivity, such as Data for cohort replacement ratios and spawner abundance trends do not exist for sDPS green sturgeon. The long lifespan of the species and long age to maturity makes trend detection dependent upon data sets spanning decades, something that is currently lacking. The acoustic telemetry work begun by Ethan Mora (UC Davis) on the Sacramento River and by Alicia Seesholtz (CDWR) on the Feather River, as well as larval and juvenile studies begun by Bill Poytress (USFWS) may eventually produce a more statistically robust analysis of productivity.

(3) Spatial Structure

Green sturgeon are known to range from Baja California to the Bering Sea along the North American continental shelf. During the late summer and early fall, subadults and non-spawning adult green sturgeon frequently can be found aggregating in estuaries along the Pacific coast (Emmett 1991, Moser and Lindley 2007). Israel *et al.* (2009) found that the green sturgeon within the Central Valley of California are sDPS green sturgeon. Likewise, acoustic tagging studies have confirmed that green sturgeon within the San Francisco Bay estuary and further inland are exclusively sDPS green sturgeon.

In waters inland from the Golden Gate Bridge in California, sDPS green sturgeon are known to range through the estuary and the delta and range up the Sacramento, Feather, and Yuba rivers. In the Yuba River, green sturgeon have been documented up to Daguerre Point Dam (Bergman *et al.* 2011). Migration past Daguerre Point Dam is not possible for green sturgeon, although potential spawning habitat upriver does exist. The same can be said about the Feather River, where green sturgeon have been observed by CDWR staff up to the Fish Barrier Dam. On the Sacramento River, Keswick Dam, located at RK (river kilometer) 486, marks the highest point on the river accessible to green sturgeon, and it might be presumed that green sturgeon would utilize habitat up to this point. However, USFWS sampled for larvae in 2012 at RK 430 and at RK 470 and no larvae were caught at these locations; habitat usage could not be confirmed any further upriver than the confluence with Ink's Creek (RK 426), which was a confirmed spawning site in 2011 (Poytress *et al.* 2012). Adams *et al.* (2007) summarizes information that suggests green sturgeon may have been distributed above the locations of present-day dams on the Sacramento and Feather rivers. (Mora *et al.* 2009) analyzed and characterized known green sturgeon habitat and used that characterization to identify potential green sturgeon habitat within the Sacramento and San Joaquin River basins that now lies behind impassable dams. This study concludes that about 9 percent of historically available habitat is now blocked by impassible dams, but more importantly, this blocked habitat was of likely high quality for spawning.

Studies done by UC Davis (Mora unpublished data) have revealed that green sturgeon spawning sites are concentrated in just a handful of locations. Mora found that in the Sacramento River, just 3 sites accounted for over 50 percent of the green sturgeon documented in June of 2010, 2011, and 2012. This is a critical point with regards to the application of the spatial structure VSP parameter, which is largely concerned with the spawning habitat spatial structure. Given a high concentration of individuals into just a few spawning sites, extinction risk due to stochastic events would be expected to be increased.

Green sturgeon were historically documented in the lower San Joaquin River; (Radtke 1966) reports catching green sturgeon at the Santa Clara Shoals (which is near the confluence to the San Joaquin River and the Sacramento River) and to a much lesser extent, west of Stockton. However, there is no known modern usage of the San Joaquin River by green sturgeon. Anglers have reported catching green sturgeon at various locations within the San Joaquin River basin; however none of these reports have been verified and no photographic evidence has surfaced. Unless stronger evidence can be shown, it is currently believed that green sturgeon do not use the San Joaquin River or its tributaries.

In summary, current scientific understanding indicates that sDPS green sturgeon is composed of a single, independent population, which principally spawns in the mainstem Sacramento River, and also breeds opportunistically in the Feather River and possibly even the Yuba River. Concentration of adults into a very few select spawning locations makes the species highly vulnerable to poaching and catastrophic events. The apparent extirpation from the San Joaquin River narrows the habitat usage by the species, offering fewer alternatives to impacts upon any portion of that habitat.

(4) Diversity

Diversity, as defined in the VSP concept in (McElhany *et al.* 2000a), includes genetic traits such as DNA sequence variation, and other traits that are influenced by both genetics and the environment, such as ocean behavior, age at maturity, and fecundity. Variation is important to the viability of a species for several reasons. First, it allows a species to utilize a wider array of environments than they could without it. Second, diversity protects a species from short term spatial and temporal changes in the environment by increasing the likelihood that at least some individuals will have traits that allow them to persist in spite of changing environmental conditions. Third, genetic diversity provides the raw material necessary for the species to have a chance to adapt to changing environmental conditions over the long term.

While it is recognized that diversity is crucial to the viability of a species in general, it is not well understood how well sDPS green sturgeon display these diversity traits and if there is sufficient diversity to buffer against long term extinction risk. In general, a larger number of populations and number of individuals within those populations should offer increased diversity, and greater chance of long term viability. The diversity of sDPS green sturgeon is probably low, given abundance estimates. Also, because human alteration of the environment is so pervasive in the California Central Valley, basic diversity principles such as run timing and behavior are likely adversely influenced through mechanisms such as diminished springtime flow rates as water is impounded behind dams, to give but one example.

(5) Summary

The viability of sDPS green sturgeon is constrained by factors such as a small population size, lack of multiple populations, and concentration of spawning sites into just a few locations. The risk of extinction is believed to be moderate because, although threats due to habitat alteration are thought to be high and indirect evidence suggests a decline in abundance, there is much uncertainty regarding the scope of threats and the viability of population abundance indices (National Marine Fisheries Service 2010a). Viability is defined as an independent population having a negligible risk of extinction due to threats from demographic variation, local environmental variation, and genetic diversity changes over a 100-year timeframe (McElhany *et al.* 2000a). The best available scientific information does not indicate that the extinction risk facing sDPS green sturgeon is negligible over a long term (~100 year) time horizon; therefore the sDPS is not believed to be viable. To support this statement, the population viability analysis (PVA) that was done for sDPS green sturgeon in relation to stranding events (Thomas *et al.* 2013) may provide some insight. While this PVA model made many assumptions that need to be verified as new information becomes available, it was alarming to note that over a 50-year time period the DPS declined under all scenarios where stranding events were recurrent over the lifespan of a green sturgeon.

Although the population structure of sDPS green sturgeon is still being refined, it is currently believed that only one population of sDPS green sturgeon exists. Lindley *et al.* (2007), in discussing winter-run Chinook salmon, states that an Evolutionarily Significant Unite (ESU) represented by a single population at moderate risk of extinction is at high risk of extinction over the long run. This concern applies to any DPS or ESU represented by a single population, and if this were to be applied to sDPS green sturgeon directly, it could be said that sDPS green sturgeon face a high extinction risk. However, the position of NMFS, upon weighing all available information (and lack of information) has stated the extinction risk to be moderate (National Marine Fisheries Service 2010a).

There is a strong need for additional information about sDPS green sturgeon, especially with regards to a robust abundance estimate, a greater understanding of their biology, and further information about their habitat needs.

## 2.3. Environmental Baseline

The "environmental baseline" includes the past and present impacts of all Federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 CFR 402.02).

The action area, encompassing the end portion of the CBD between the existing KLOG structure and about 1,000 feet downstream of the KLOG structure, provides juvenile rearing habitat and functions as a migratory corridor for adult and juvenile winter-run, spring-run, CCV steelhead, and sDPS green sturgeon. Listed species, adult salmonids in particular, may be able to pass through the radial gates in the KLOG structure and enter the CBD upstream of the KLOG. Once they enter the CBD, there is no upstream route for them to return to the Sacramento River, resulting in mortality.

The average width of the CBD in the action area is approximately 100 feet. The CBD banks downstream of the KLOG are mostly covered with RSP and lack significant riparian cover or instream woody materials.  Levee construction and bank protection can reduce floodplain connectivity, change substrate size, and decrease riparian habitat and shaded riverine aquatic cover.  The armoring and revetment of river banks with riprap significantly diminishes the natural geomorphic processes of a river that create and enhance critical habitat, such as floodplain creation, riparian vegetation recruitment, and river meander migration (Buer *et al.* 1989, Florsheim and Mount 2002, Gergel *et al.* 2002, Larsen *et al.* 2006, Fremier *et al.* 2014).

The CBD intercepts all drainage in the Colusa Basin on the west side of the Sacramento River between the communities of Colusa and Knights Landing. Runoff from agricultural activities may contain contaminants such as pesticides, sediments, and nutrients that may affect listed species, including lethal and sublethal impacts (Mayfield and Cech 2004, Dunn *et al.* 2011 and citations within, Markiewicz *et al.* 2012, Linares-Casenave *et al.* 2013, Oh *et al.* 2013 and citations within).

## 2.4. Effects of the Action

Under the ESA, "effects of the action" means the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 CFR 402.02). Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur.

The effects of the proposed project include those from two distinct phases of the proposed action: Construction and operations. The phase of construction consists of (1) placement of RSP for erosion control, (2) the construction of five new concrete wing walls, and (3) installation of four metal picket weirs. The phase of operations includes the operation and maintenance of the picket weirs after the construction is completed. Described below are the effects of both construction and operations on listed species and critical habitat.

### 2.4.1. Effects of Construction Activities on Listed Species

#### 2.4.1.1 Likelihood of Presence of Listed Species in the Action Area

Based on the life history and migration timing of listed species in the Sacramento River and the work window of the proposed action (September 1 to October 31), adult and juvenile winter-run Chinook salmon, adult spring-run, and adult green sturgeon would not be present in the Sacramento River or action area. Although juvenile spring-run, adult and juvenile steelhead, and juvenile green sturgeon might occur in the Sacramento River, they would not be present in the action area due to shallower water, poorer water quality, and higher water temperature, particularly in September and October. There will be no flowing water in the channel from the KLOG structure to the confluence of the Sacramento River during the work window, further reducing the likelihood of attraction and presence of listed species in the action area. Furthermore, fish would move away from noisy environments under ongoing activities (Hempen *et al*. 2014), adding another mechanism to eliminate the potential for their exposure to the proposed action, if there were any fish present in the action area. As discussed in section 2.4.1.3, the noise levels from the proposed action would not cause impairment to listed fish species.

2.4.1.2 Effects of Erosion Repair and Picket Weir Installation on Listed Species

Prior to repairing the eroded levee bank immediately downstream of the KLOG structure, silt fences will be installed around the extent of the in-water work area to minimize the transport of suspended sediment during the rock placement where listed species may be present. The fences will be removed after the construction work is completed.

Prior to the construction of concrete wing walls and installation of the picket weirs, a temporary water barrier will be installed on the downstream edge of the concrete apron in order to dewater the construction site where listed species may be present. The water barrier will be removed after the work is completed.

The effects of the above activities on listed species are deemed discountable as they are extremely unlikely to occur for the following reasons. In addition to those discussed in the above section 2.4.1.1, fish would move away from the noisy work area (Hempen *et al*. 2014) during the installation or removal of the temporary silt fences and the water barrier. Furthermore, the installed silt fences or water barrier will serve as a temporary barrier to prevent fish from entering the work area, eliminating or minimizing the potential effects of the rock placement or site dewatering on listed species. Lastly, relatively calm and low water in these work areas will allow the trained biological monitor to observe if there are any fish in the work area prior to the installation of the water barrier or silt fences.

2.4.1.3 Effects of Noise on Listed Species

The effects of noise on fish include (1) mortality if the noise level is greater than 228.9 dB relative to 1 micropascal reference for water (re 1 μPa), which was the peak pressure from underwater explosions; (2) damage to sensory hair cells if the noise level is greater than 180 dB (re 1 μPa); and (3) increased stress hormone levels if the noise level is greater than 153 dB (re 1 μPa) (Hempen et al. 2014). Hempen et al (2014) reported noise levels resulting from the mechanical rock grinding to remove rock pinnacles and outcroppings in the Mississippi River, which ranged from 160–172 dB (re 1 μPa @ 1 m) at frequencies ranging from 100 to 1,250 Hz (1/3-octave band). The highest noise level recorded for the sound recording session was 172 dB (re 1 μPa @ 1 m) at 1,250 Hz. Bagocius (2015) reported that the pile hammering into a lagoon bottom generated pulses with a sound exposure level of 218 dB re 1 μPa @ 1 m.

Noise may be induced from operating in-water construction machineries, placing rocks into water to repair the bank erosion, and installing and removing in-water silt fences and the temporary water barrier. There is no pile driving in the proposed action. Noise levels from these activities are expected below the noise level generated from the underwater mechanical rock grinding, and well below levels responsible for mortality or noise induced hearing damage. The impact zone for stress (increases in cortisol) might occur if listed species were present, which is not likely as discussed in section 2.4.1.1. Considering the localized impact zone and noise production during construction, listed species would not be present; or if present, they would either avoid or move out of the impact zone (Hempen *et al*. 2014). Therefore, the effect is discountable as it is extremely unlikely to occur.

### 2.4.1.4 Effects of Suspended Sediment on Listed Species

The severity of effect of suspended sediment pollution on fish increases as a function of suspended sediment concentration (SSC) and duration of exposure. For example, juvenile and adult salmonids, when exposed to 20 mg/L SSC for up to one week, would experience sublethal effects including short-term reduction in feeding rates and minor to moderate physiological stress (e.g., increase in rate of coughing and increased respiration rate). Exposure to 150 mg/L SSC would have the following sublethal effects: moderate habitat degradation, impaired homing, major physiological stress, and long-term reduction in feeding rate and feeding success (Newcombe and Jensen 1996).

In-water construction activities that may increase SSC include the installation and removal of the temporary water barrier and silt fences, and the placement of rocks to repair the eroded bank. Each of these activities is expected to last for no more than a week. These activities may increase SSC to above 20 mg/L, which could result in sublethal effects. However, these effects are deemed discountable or insignificant for reasons described below: (1) Sediment transport is very limited in the action area as there will be no flowing water in the channel from the KLOG structure to the confluence of the Sacramento River during the work window. (2) Installing silt fencing around the erosion repair area would further prevent suspended sediment from moving downstream. (3) It is unlikely for listed species to be present in the localized impact area considering migration timing, poor water quality, high water temperature, and temporarily noisy environment.

### 2.4.1.5 Effects of Other Pollutants from Spills or Leakage on Listed Species

Pollutants that may result from accidental spills or leakage from machinery or storage containers include gasoline, diesel fuel, lubricants, and hydraulic fluid. These substances can cause physiological stress and increased susceptibility of aquatic organisms to other sources of mortality such as predation through exposure to non-lethal levels, and kill aquatic organisms through exposure to lethal concentrations. Petroleum products also tend to form oily films on the water surface that can reduce DO levels available to aquatic organisms. Exposure of uncured concrete to surface water can cause localized increases in pH that can cause physiological stress in fish and other aquatic organisms. These effects will be minimized through implementation of the spill prevention, control, and counter-measure plan. Adherence to all preventative, contingency, and reporting measures in the approved plan will reduce the potential effects to listed fish species to discountable levels. The fish barrier construction site will be completely isolated from the channel and dewatered before any concrete is poured. All cured concrete will be washed and the wash water removed from the channel before channel flow is restored to the work areas. The concrete will be allowed to cure fully before being exposed to surface waters to avoid potential impacts to listed species. Therefore, the effect is discountable as it is extremely unlikely to occur.

### 2.4.2. Effects of Construction Activities on Designated Critical Habitat

The action area of the proposed project was designated as critical habitat for rearing and migration of winter-run, spring-run, steelhead, and green sturgeon. Placement of rock slope protection for erosion repair will permanently modify the area from the current physical habitat to a riprap substrate bank, resulting in changes in the essential physical feature of substrate. The physical habitat area that will be modified is estimated to be 0.07 acre. In addition, one live tree will be removed to provide equipment access, which constitutes of approximately 0.01 acre of riparian habitat, causing changes in the physical feature of riparian vegetation.

### 2.4.3. Effects of Picket Weir Operation and Maintenance on Listed Species

The installed picket weirs will be operated and maintained by the Department of Water Resources for its life time of 30 years. The main purpose of the picket weirs is to prevent adult fish from entering the CBD upstream of the KLOG structure. When the picket weirs lay flat during operation and maintenance (e.g., repairing or cleaning) activities, adult fish could enter the area behind the picket weirs and become trapped once the picket weirs are raised. To minimize this effect, the radial gates will be closed before the picket weirs are lowered and will remain closed until all maintenance activities are completed and the picket weirs are raised back into position. In the case of picket weir malfunction (such as damage of the picket weirs) and high water levels in the Sacramento River, adult fish may go through the damaged weir and swim through the open gates, getting trapped into the CBD upstream of the KLOG structure. At high water levels, adults may be able to jump up and become trapped/stranded on the picket weirs or swim through the open gates and become trapped into the CBD upstream of the KLOG structure. While it is difficult predicting the number of listed species that will be injured or killed during the operation and maintenance, the Corps expects that the maximum number of adults that could be affected over the 30-year period is a total of six adults (all ESUs and DPSs combined), or an average of one adult every 5 years. Considering the behavior of homing adult salmonids and the past observations of adult salmonids straying to the CBC, NMFS believes that the potential for injury, trapping/stranding on the picket weirs, or moving through the open gates would be higher, varying with flow conditions and the migration timing and population size of listed species. In 2012, it was estimated that about 300 adult winter-run strayed into the CBD, which is approximately 5 percent of the annual recruitment of winter-run in 2012. It is estimated that the picket weir efficiency will be 98 percent, implying that 2 percent of the adults entering from the Sacramento River to the CBD will be injured or killed by the picket weir. Assuming very conservatively that all 300 winter-run strayed into the CBD through the KLOG in 2012, integration of these two rates (straying and injury/killing) results in 0.1 percent of the annual winter-run recruitment. NMFS expects that the same percentage (0.1 percent) applies to spring-run and steelhead. The annual recruitments for winter-run or spring-run will be based on the GrandTab data reported by the Department of Fish and Wildlife. Since there are no reliable estimates for the population size of steelhead, winter-run will be used as a surrogate for steelhead. The population size of steelhead seemed relatively comparable to that of winter-run based on the monitoring data of juvenile steelhead and winter-run. Salvage data for juvenile green sturgeon and recent study results for spawning adult green sturgeon indicate a very low population size of either adult or juvenile green sturgeon, implying lower potential for injury or killing by the operation and maintenance of the picket weirs.

Since the picket weirs have 1 inch of space in between each of the bars, juvenile salmonids may move back and forth through the picket weirs. Therefore, the operation and maintenance of the picket weirs would not affect juveniles.

### 2.4.4. Effects of Picket Weir Operation and Maintenance on Designated Critical Habitat

There will be no effect from the operation and maintenance of the picket weirs to critical habitat as the operation and maintenance occur at the KLOG facility and will not alter the flow downstream of the picket weirs.

## 2.5. Cumulative Effects

"Cumulative effects" are those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR 402.02). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA. At this time, there have been are no other actions proposed within the action area, however; it is reasonable to assume that certain actions related to the *Environmental Baseline* could occur.

### 2.5.1. Agricultural Practices

Agricultural practices along the CBC may contribute to the degradation of water quality in the action area. Stormwater and irrigation runoff related to agricultural activities contain pesticides, sediments, and other contaminants that may negatively affect salmonid reproductive success and survival rates (McCarthy *et al.* 2008, Dunn *et al.* 2011, Oh *et al.* 2013).

### 2.5.2. Climate Change

It is undeniable that warming of the Earth's climate system is happening, and since the1950s, many observed changes are unprecedented over decades to millennia. The atmosphere and oceans have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of greenhouse gasses and their effects have increased. This trend continues as it is projected that the average global surface temperature may rise between 1.5°C (2.7°F) and 4.8°C (8.6°F) by the end of the 21st century (IPCC 2013). Much of that increase will manifest most noticeably in the oceans, as evidence suggests that the most dramatic changes to date have occurred in rising ocean temperatures, particularly in the Pacific (Karl *et al.* 2009).

In light of the predicted impacts of global warming, the Central Valley has been modeled to have an increase in air temperature of between 2°C and 7°C by 2100 (Dettinger and Cayan 1995, Hayhoe *et al.* 2004, VanRheenen *et al.* 2004, Cloern *et al.* 2011) , with a drier hydrology predominated by precipitation rather than snowfall. This will alter river runoff patterns and transform the tributaries that feed the Central Valley from a spring/summer snowmelt dominated system to a winter rain dominated system. It can be hypothesized that summer water temperatures and flow levels will become unsuitable for salmonid survival. The cold snowmelt that furnishes the late spring and early summer runoff will be replaced by warmer precipitation runoff. This will truncate the period of time that suitable cold-water conditions exist below existing reservoirs and dams due to the warmer inflow temperatures to the reservoir from rain runoff (Georgakakos *et al.* 2012, Hanak and Lund 2012). Without the necessary cold water pool developed from melting snow pack filling reservoirs in the spring and early summer, late summer and fall temperatures below reservoirs, such as Lake Shasta, could potentially rise above thermal tolerances for juvenile and adult salmonids (*i.e.*, Sacramento River winter-run Chinook salmon, Spring-run, CCV steelhead and Southern DPS green sturgeon) that must hold below the dam over the summer and fall periods.

Within the context of the brief period over which the proposed Project is scheduled to be constructed, near term effects of global climate change are unlikely to result in any perceptible declines to the overall health or distribution of the listed populations of anadromous fish within the action area that are the subject of this consultation. Over the long term, global climate change may have an effect on the water quality of the Sacramento River near the action area and beyond, with reduced flows or increased water temperatures - the likely outcome of increasing global temperatures.

## 2.6. Integration and Synthesis

The Integration and Synthesis section is the final step in our assessment of the risk posed to species and critical habitat as a result of implementing the proposed action. In this section, we add the effects of the action (Section 2.4) to the environmental baseline (Section 2.3) and the cumulative effects (Section 2.5), taking into account the status of the species and critical habitat (section 2.2), to formulate the agency's biological opinion as to whether the proposed action is likely to: (1) reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) reduce the value of designated critical habitat for the conservation of the species.

### 2.6.1. Summary of the Viability of Listed Species

The Status of Species and Critical Habitat section shows that past and present activities have caused substantial losses, fragmentation, and degradation of salmonid and green sturgeon habitats, and have resulted in altered flow and stream temperature regimes that exerted negative impacts to listed species. These changes have greatly reduced the quality and quantity of freshwater spawning and rearing sites and the migratory corridors within the lower valley floor reaches of the Sacramento River and the Delta for listed species. Provided below are descriptions of the viability of winter-run, spring-run, steelhead, and green sturgeon.

(1) Sacramento River Winter-run Chinook Salmon

Lindley et al. (2007) determined that the winter-run population is at a moderate extinction risk according to population viability analysis, and at a low risk according to other criteria (i.e., population size, population decline, the risk of wide ranging catastrophe, hatchery influence). Data used in Lindley et al. (2007) did not include the significant decline in escapement numbers from 2007 to 2012. Lindley et al. (2007) also states that the winter-run ESU fails the "representation and redundancy rule" because it has only one population and that population spawns outside of the eco-region in which it evolved. An ESU represented by only one spawning population at moderate risk of extinction is at a high risk of extinction (Lindley et al. 2007). NMFS concludes that the winter-run ESU remains at a high risk of extinction.

(2) Central Valley Spring-run Chinook Salmon

Lindley *et al*. (2007) posit that the spring-run populations had a low risk of extinction in Butte and Deer creeks, according to their PVA model and the other population viability criteria (*i.e.*, population size, population decline, catastrophic events, and hatchery influence). The Mill Creek population is at moderate extinction risk according to the PVA model, but appears to satisfy the other viability criteria for low-risk status. However, the spring-run ESU fails to meet the "representation and redundancy rule" (Lindley *et al*. 2007), since there is only one viable population out of the three diversity groups that historically contained them. The spring-run ESU is only represented by the group that currently occurs in the northern Sierra Nevada Diversity Group. The populations that formerly occurred in the basalt and porous-lava region (the Pit River, the Upper Sacramento River and the McCloud River) and southern Sierra Nevada region have been extirpated. The northwestern California region contains a few ephemeral populations of spring-run that are likely dependent on the Northern Sierra Diversity Group populations for their continued existence. Over the long term, these remaining populations are considered to be vulnerable to catastrophic events, such as volcanic eruptions from Mount Lassen or large forest fires due to the close proximity of their headwaters to each other. Drought is also considered to pose a significant threat to the viability of spring-run in these three watersheds due to their close proximity to each other.

(3) California Central Valley Steelhead

Lindley *et al*. (2006) indicated that prior population census estimates completed in the 1990s found the CCV steelhead spawning population above RBDD had a fairly strong negative population growth rate and small population size. Good *et al.* (2005) indicated that the decline continued as evidenced by new information (Chipps Island trawl data). CCV steelhead populations generally show a continuing decline, an overall low abundance, and fluctuating return rates. The future of CCV steelhead is uncertain due to limited data concerning their status. However, Lindley *et al.* (2007), citing evidence presented by Yoshiyama *et al.* (1996), McEwan (2001), and Lindley *et al.* (2006), concluded that there is sufficient evidence to suggest that the DPS is at moderate to high risk of extinction.

The NMFS 2011 status review of CCV steelhead describes a steelhead population that is still declining, and is in peril. The review report states that the DPS is still in danger of extinction (Williams *et al.* 2011). Analysis of catch data from the Chipps Island monitoring program suggests that natural steelhead production has continued to decline and that hatchery origin fish represent an increasing proportion of the juvenile production. Information from the Delta salvage facilities also suggests a general decline in the natural production of steelhead. Hatchery populations (Coleman NFH and Feather River Hatchery) data also suggests that hatchery populations have declined in the last several years perhaps in response to poor freshwater and ocean habitat conditions.

(4) Southern DPS of North American Green Sturgeon

Historical spawning habitat for the Southern DPS green sturgeon may have extended up into the three major branches of the upper Sacramento River above the current location of Shasta Dam; however, those habitats have been made inaccessible or altered by dams (Mora et al. 2009; Adams et al. 2007). Because historical habitat has been cut off, the Southern DPS North American green sturgeon relies on one watershed, the Sacramento River, for survival.

Lindley *et al.* (2007) pointed out that an ESU represented by a single population, which may be at moderate risk, is actually at a high risk of extinction over the long term in the case where isolation occurs. Additional threats to this species that could put the species at higher risk for extinction include: reduction/loss of spawning areas, insufficient freshwater flow rates in spawning areas, contaminants (e.g., pesticides), harvest by-catch, poaching, entrainment by water projects, influence of exotic species, small population size, impassable barriers, and elevated water temperatures (Adams et al. 2007). The most recent status review update concluded the southern DPS of north American green sturgeon is likely to become endangered in the foreseeable (NMFS 2005); a principal factor in NMFS' conclusion was the reduction of potential spawning habitat to a single area in the Sacramento River due to migration barriers (e.g., dams).

### 2.6.2. Summary of Environmental Baseline and Cumulative Effects

The action area of the proposed project encompasses the end portion of the CBD between the existing KLOG structure and about 1,000 feet downstream of the KLOG structure. There is no fish screen at the existing gates in the KLOG structure. Listed species, adult salmonids in particular, may be able to pass through the gates and enter the CBD upstream of the KLOG. There is no upstream route for them to return from the CBD to the Sacramento River, resulting in mortality. The CBD banks downstream of the KLOG are mostly covered with RSP and lack significant riparian or instream woody cover. Levee construction and bank protection can reduce floodplain connectivity, change substrate size, and decrease riparian habitat and shaded riverine aquatic cover. The CBD intercepts all drainage in the Colusa Basin. Runoff from agricultural activities may contain contaminants such as pesticides, sediments, and nutrients that may affect listed species, including lethal and sublethal impacts.

### 2.6.3. Summary of Effects on Listed Species

#### (1) Construction Activities

The proposed project work window for erosion repair and fish barrier construction activities is from September 1 through October 31. The potential negative effects of construction activities on listed species include elevated levels of noise, SSC, or contaminants. However, it is unlikely that these construction activities will result in adverse effects to the listed species for reasons described below. (1) The potential negative impacts on listed species have been addressed and will be minimized through the conservation measures of the proposed action. (2) It is unlikely that adult and juvenile winter-run, adult spring-run, and adult green sturgeon are present in the Sacramento River and action area during the work window. (3) Adult and juvenile steelhead, juvenile spring-run, and juvenile green sturgeon may be present in the Sacramento River, but it is unlikely that they would be present in the action area due to shallower water, poorer water quality, and higher water temperature, particularly in September and October. (4) There will be no flowing water in the channel from the KLOG structure to the confluence of the Sacramento River during the work window, further reducing the likelihood of attraction and presence of listed species in the action area. (5) Fish would move away from noisy environments under ongoing construction activities.

#### (2) Operation and Maintenance of the Picket Weirs

For the lifetime of 30 years, the operation and maintenance of the picket weirs may result in injury or mortality of adult winter-run, adult spring-run, adult steelhead, and adult and juvenile green sturgeon. However, take of these species is expected to represent a very small proportion (less than 1%) of the overall population as the fish barrier is designed and will be operated according to NMFS criteria (NMFS 2008).

NMFS has considered these potential effects of the proposed action on listed winter-run, spring-run, steelhead, and green sturgeon, combined with other ongoing activities within the action area, and determined that the proposed action is not expected to appreciably reduce the likelihood of survival and recovery of winter-run, spring-run, steelhead, and green sturgeon in the wild by reducing their spatial structure, diversity, abundance, and productivity. This conclusion is also due to the fact that the overall project effect will be beneficial to the listed species by reducing the risk of becoming trapped into the CBD.

#### 2.6.4. Summary of Effects on Critical Habitat

The critical habitat for winter-run, spring-run, steelhead, and green sturgeon is considered to have a high conservation value necessary for the recovery of the listed species, although the current condition of the critical habitat is degraded. Placement of rock slope protection for erosion repair will permanently modify the area from the current physical habitat to a riprap substrate. The physical habitat area that will be modified is estimated to be 0.07 acre. In addition, one live tree will be removed to provide equipment access, constituting of approximately 0.01 acre of riparian habitat. As a conservation measure, the project proponent will purchase 0.01 acre of riparian habitat credit through the Wildlands River Ranch Mitigation Bank and 0.07 acre of aquatic habitat credit from the National Fish and Wildlife Foundation's Sacramento District in-lieu fee program. This conservation measure will serve as a mitigation measure for offsetting the loss of essential fish habitat (see section 3.2).

Based on the analysis of available evidence, the proposed action is likely to adversely affect the critical habitat, but is not likely to appreciably reduce the conservation value of designated critical habitat for winter-run, spring-run, steelhead, and green sturgeon.

### 2.7. Conclusion

After reviewing and analyzing the current status of the listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, any effects of interrelated and interdependent activities, and cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of Sacramento River winter-run Chinook salmon, Central Valley spring-run, California Central Valley steelhead, North American green sturgeon or destroy or adversely modify their designated critical habitats.

### 2.8. Incidental Take Statement

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is further defined by regulation to include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering (50 CFR 222.102). "Incidental take" is defined by regulation as takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 CFR 402.02). Section 7(b)(4) and section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of this incidental take statement.

### 2.8.1. Amount or Extent of Take

NMFS anticipants incidental take of adult winter-run, adult spring-run, adult steelhead, or adult or juvenile green sturgeon in the form of injury or killing through the operation and maintenance of the picket weirs during their expected lifetime of 30 years. NMFS anticipates that take of the listed species will be difficult to quantify for the following reasons: (1) there are no monitoring data that indicate the annual number of individuals straying into the CBD through the KLOG; (2) some of the adult salmonids trapped/stranded on the picket weirs may move through the open gates; (3) the behavior of homing adult salmonids varies with species; (4) some of the individuals injured by the picket weirs may return to the Sacramento River; and (5) the number of take for each species is likely to vary, depending on flow conditions in the Sacramento River and the CBD, migration timing, and population size of listed species. For these reasons, NMFS is estimating the level of take as the percentage of the population size of a listed species. The level of take for winter-run or spring-run will be 0.1 percent of the geometric mean of the annual recruitments of the previous three consecutive years. In 2012, it was estimated that about 300 adult winter-run strayed into the CBD, which is approximately 5 percent of the annual recruitment of winter-run in 2012. It is estimated that the picket weir efficiency will be 98 percent, implying that 2 percent of the adults entering from the Sacramento River to the CBD will be injured or killed by the picket weir. Assuming very conservatively that all 300 winter-run strayed into the CBD through the KLOG in 2012, integration of these two rates (straying and injury/killing) results in 0.1 percent of the annual winter-run recruitment. NMFS expects that the same percentage (0.1 percent) applies to spring-run and steelhead. The annual recruitments for winter-run or spring-run will be based on the GrandTab data reported by the Department of Fish and Wildlife. Since there are no reliable estimates for the population size of steelhead, the quantification of the amount of incidental take of winter-run will be used as a surrogate for the amount of incidental take of steelhead. The population size of steelhead seemed relatively comparable to that of winter run based on the monitoring data of juvenile steelhead and winter-run. Salvage data for juvenile green sturgeon and recent study results for spawning adult green sturgeon indicate a very low population size of either adult or juvenile green sturgeon. NMFS anticipates the level of take for green sturgeon through the operation maintenance of the picket weirs will be lower than those for salmonids; the level of take will be one green sturgeon adult or juvenile, per year for 30 years. The injured or killed individual fish resulting from the operation and maintenance of the picket weirs will be monitored and reported by following the procedures specified in section 2.8.3 and 2.8.4.

### 2.8.2. Effect of the Take

In the accompanying formal biological opinion, NMFS determined that the amount of the anticipated take, coupled with other effects of the proposed action, is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

### 2.8.3. Reasonable and Prudent Measures

"Reasonable and prudent measures" are nondiscretionary measures that are necessary or appropriate to minimize the impact of the amount or extent of incidental take (50 CFR 402.02).

NMFS believes the following reasonable and prudent measures are necessary and appropriate to minimize the take of winter-run, spring-run, steelhead, and green sturgeon.

(1) The Corps and applicant, in coordination with the picket weir operator, shall develop a protocol for operating and maintaining the picket weirs to minimize the incidental take.

(2) The Corps and applicant, in coordination with the picket weir operator, shall develop a protocol for monitoring and/or rescuing incidental take of winter-run, spring-run, steelhead, and green sturgeon, associated with the operation and maintenance of the picket weirs.

(3) The Corps shall submit to NMFS an annual report for the incidental take resulting from the operation and maintenance of the picket weirs to document the effects of the operation and maintenance on listed Chinook salmon, steelhead, and green sturgeon. Any such reports shall be filed not later than October 1 of each year, starting 2017, covering the time period from September 1 of the preceding year to August 31 of the following year.

### 2.8.4. Terms and Conditions

The terms and conditions described below are non-discretionary, and the Corps and the applicant must comply with them in order to implement the reasonable and prudent measures (50 CFR 402.14). The Corps and the applicant have a continuing duty to monitor the impacts of incidental take and must report the progress of the action and its impact on the species as specified in this incidental take statement (50 CFR 402.14). If the entity to whom a term and condition is directed does not comply with the following terms and conditions, protective coverage for the proposed action would likely lapse.

(1) The following terms and conditions implement reasonable and prudent measure 1:

The Corps shall submit to NMFS, not later than February 1, 2016, a protocol for operating and maintaining the picket weirs. The picket weirs shall be operated and maintained by following the specific criteria and guidelines for picket barriers described in the NMFS Anadromous Salmonid Passage Facility Design document (National Marine Fisheries Service 2008)

(2) The following terms and conditions implement reasonable and prudent measure 2:

The Corps shall submit to NMFS, not later than February 1, 2016, a protocol for monitoring, rescuing, and reporting incidental take of winter-run, spring-run, steelhead, and green sturgeon.

(3) The following terms and conditions implement reasonable and prudent measure 3:

In the case that the take exceeds the identified incidental take level, consultation shall be reinitiated immediately.

## 2.9. Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Specifically, conservation recommendations are suggestions regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information (50 CFR 402.02).

(1) Monitor Listed Species Within In-water Work Areas

The Corps and applicant should retain a qualified biologist to monitor if listed anadromous fish species are present in the work area. If the biologist observes listed species, erosion repair or construction activities should be avoided until they move away from the work area.

(2) Minimize the Impact of Suspended Sediment

The Corps and applicant should minimize the transport of suspended sediment resulting from erosion repair or construction activities by implementing best management practices including installing silt fencing.

(3) Prevent Spills and Leakage of Contaminants into the Action Area

The applicant should develop and implement a spill prevention, control, and counter-measure plan to minimize the potential for and effects from spills or leakage of hazardous, toxic, or petroleum substances during repair and construction activities.

(4) Minimize the impact of the RSP on listed juvenile salmonids

To minimize large voids that could be used by predator fish species, which may cause mortality of juvenile salmonids, the Corps and applicant should consider the following guidelines for construction of a riprap bank:

(a) The maximum diameter of riprap rocks should be no more than 18 inches.
(b) Rocks should be graded to < 10 inches of d50 below water surface.
(c) The mixture ratio of rock to soil should be 7:3 above water surface.
(d) The Corps should require the revetted area to be vegetated with riparian vegetation.

## 2.10. Reinitiation of Consultation

This concludes formal consultation for the Knights Landing Outfall Gates Project.

As 50 CFR 402.16 states, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained or is authorized by law and if: (1) the amount or extent of incidental taking specified in the incidental take statement is exceeded, (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this Opinion, (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this Opinion, or (4) a new species is listed or critical habitat designated that may be affected by the action.

# 3. MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT ESSENTIAL FISH HABITAT CONSULTATION

Section 305(b) of the MSA directs Federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect EFH. The MSA (section 3) defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Adverse effect means any impact that reduces quality or quantity of EFH, and may include direct or indirect physical, chemical, or biological alteration of the waters or substrate and loss of (or injury to) benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects on EFH may result from actions occurring within EFH or outside of it and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) also requires NMFS to recommend measures that can be taken by the action agency to conserve EFH.

This analysis is based, in part, on the EFH assessment provided by the Corps and descriptions of EFH for Pacific coast salmon (Pacific Fishery Management Council 1999) contained in the fishery management plans developed by the Pacific Fishery Management Council and approved by the Secretary of Commerce.

## 3.1. Essential Fish Habitat Affected by the Project

The Corps and the applicant have determined that the proposed action may adversely affect essential fish habitat for Pacific coast salmon including winter-, spring-, fall-, and late fall-run Chinook salmon. EFH in the action area consists of adult migration habitat and juvenile rearing and migration habitat for the four salmon runs. There are no habitat areas of particular concern (HAPCs) in the action area.

## 3.2. Adverse Effects on Essential Fish Habitat

Placement of rock slope protection for erosion control would result in adverse effects on Pacific coast salmon EFH due to losses of riparian habitat and natural substrate. The natural substrate that will be modified is estimated to be 0.07 acre. In addition, one live tree will be removed to provide equipment access, which constitutes of about 0.01 acre of riparian habitat.

To mitigate these effects, the project proponent Reclamation District 108 has proposed to compensate for the habitat loss by purchasing 0.01 acre of riparian habitat credit through the Wildlands River Ranch Mitigation Bank and 0.07 acre of aquatic habitat credit from the National Fish and Wildlife Foundation's Sacramento District in-lieu fee program.

## 3.3. Essential Fish Habitat Conservation Recommendations

To mitigate these effects associated with the placement of RSP, NMFS makes the following recommendations.

1. The applicant compensates for the loss of riparian habitat by purchasing 0.01 acre of

riparian habitat credit through the Wildlands River Ranch Mitigation Bank and for the loss of natural substrate by purchasing 0.07 acre of aquatic habitat credit from the National Fish and Wildlife Foundation's Sacramento District in-lieu fee program.

2. To minimize large voids that could be used by predator fish species, which may cause mortality of juvenile salmonids, the Corps and applicant should consider the following guidelines for a riprap bank: (1) the maximum diameter of riprap rocks should be no more than 18 inches; (2) rocks should be graded to < 10 inches of d50 below water surface; and (3) the mixture ratio of rock to soil should be 7:3 above water surface.

Fully implementing the above EFH conservation recommendations would protect, by avoiding or minimizing the adverse effects described in section 3.2, above, approximately 0.07 acre of designated EFH for Pacific coast salmon.

### 3.4. Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, The Corps must provide a detailed response in writing to NMFS within 30 days after receiving an EFH Conservation Recommendation. Such a response must be provided at least 10 days prior to final approval of the action if the response is inconsistent with any of NMFS' EFH Conservation Recommendations unless NMFS and the Federal agency have agreed to use alternative time frames for the Federal agency response. The response must include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with the Conservation Recommendations, the Federal agency must explain its reasons for not following the recommendations, including the scientific justification for any disagreements with NMFS over the anticipated effects of the action and the measures needed to avoid, minimize, mitigate, or offset such effects (50 CFR 600.920(k)(1)).

In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, we ask that in your statutory reply to the EFH portion of this consultation, you clearly identify the number of conservation recommendations accepted.

### 3.5. Supplemental Consultation

The Corps must reinitiate EFH consultation with NMFS if the proposed action is substantially revised in a way that may adversely affect EFH, or if new information becomes available that affects the basis for NMFS' EFH Conservation Recommendations (50 CFR 600.920(l)).

## 4. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

The Data Quality Act (DQA) specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the Opinion addresses these DQA components, documents compliance with the DQA, and certifies that this Opinion has undergone pre-dissemination review.

## 4.1. Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended users of this Opinion are the Corps and Reclamation. Other interested users could include the applicant (Reclamation District 108, the facility operator (Department of Water Resources), California Department of Fish and Wildlife, and U.S. Fish and Wildlife Service. Individual copies of this Opinion were provided to the Corps and Reclamation. This Opinion will be posted on the Public Consultation Tracking System web site (https://pcts.nmfs.noaa.gov/pcts-web/homepage.pcts ). The format and naming adheres to conventional standards for style.

## 4.2. Integrity

This consultation was completed on a computer system managed by NMFS in accordance with relevant information technology security policies and standards set out in Appendix III, 'Security of Automated Information Resources,' Office of Management and Budget Circular A-130; the Computer Security Act; and the Government Information Security Reform Act.

## 4.3. Objectivity

Information Product Category: Natural Resource Plan

***Standards:*** This consultation and supporting documents are clear, concise, complete, and unbiased; and were developed using commonly accepted scientific research methods. They adhere to published standards including the NMFS ESA Consultation Handbook, ESA regulations, 50 CFR 402.01 *et seq*., and the MSA implementing regulations regarding EFH, 50 CFR 600.

***Best Available Information:*** This consultation and supporting documents use the best available information, as referenced in the References section. The analyses in this Opinion and EFH consultation contain more background on information sources and quality.

***Referencing:*** All supporting materials, information, data and analyses are properly referenced, consistent with standard scientific referencing style.

***Review Process:*** This consultation was drafted by NMFS staff with training in ESA and MSA implementation, and reviewed in accordance with West Coast Region ESA quality control and assurance processes.

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Appendix G

# State Historic Preservation Officer Consultation Letter

**OFFICE OF HISTORIC PRESERVATION**
**DEPARTMENT OF PARKS AND RECREATION**
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August 18, 2015 In Reply Refer To: COE_2015_0715_001

Alicia Kirchner
Chief, Planning Division
Environmental Resources Branch
U.S. Army Corps of Engineers, Sacramento
1325 J Street
Sacramento, CA 95814-2922

Re: Section 106 Consultation for the Knights Landing Outfall Gates Positive Fish Barrier and Riprap Project in Yolo County, California.

Dear Ms. Kirchner:

Thank you for your letter dated July 31, 2015 and the e-mail that William Welsh of your staff provided on July 31, 2015 continuing consultation on the above referenced project to comply with Section 106 of the National Historic Preservation Act (NHPA) of 1966 (as amended) and its implementing regulation at 36 CFR Part 800. The Army Corps of Engineers (COE) is seeking my comments on their finding of effect for the Knights Landing Outfall Gates Positive Fish Barrier and Riprap Project in Yolo County, California.

Reclamation District 108 (RD108), in coordination with the Central Valley Flood Protection Board (CVFPB) is seeking a permit from the COE under section 14 of the Rivers and Harbors Act of 1899 (33 USC 408) to construct a positive fish barrier on the downstream side of the existing Knights Landing Outfall Gates (KLOG) and to place riprap downstream of the KLOG structure. The original KLOG structure and works were constructed by RD 108 and other local districts as part of the Central Valley Flood Protection Project (CVFPP) on the Colusa Basin Drain, approximately ¼ mile from its confluence with the Sacramento River. The purpose of the proposed undertaking is to prevent entry of adult salmon into the Colusa Basin Drain. The U.S. Bureau of Reclamation (USBR) is funding the proposed undertaking, but the COE is lead federal agency for the purposes of Section 106 of the NHPA.

The APE for the undertaking is split into the Archaeological APE and the Architectural APE. The Archaeological APE includes the maximum possible area of direct impacts resulting from the proposed undertaking, including all construction, repairs, easements, and staging areas. The Architectural APE is limited to the KLOG structure and a small portion of the Colusa Basin Drain (CBD) canal/levee. The KLOG structure will be modified as part of this undertaking and work along the CBD canal/levee is limited to the placement of riprap along the east side of the levee. Along with their letter, the COE submitted the following document to support their finding of effect:

- *Cultural Resources Inventory Evaluation for Knight's Landing Outfall Gates Project, Yolo County, California* (ICF July 2015)

A records search was conducted by ICF (consultant) on April 30, 2015 that included the project area and a 0.25-mile buffer. As a result, two cultural resources were identified within the APE, segments of the CBD Canal (P-57-000705/CA-YOL-240H) and the Knights Landing Outfall Gate Structure. A pedestrian survey was completed on May 13, 2015 and one prehistoric archaeological site was identified and given the temporary field-designation of ICF-CUL-01. An ICF Architectural Historian surveyed the APE on this day as well and visually examined the KLOG structure and the CBD canal/levee segments. Additional survey of new APE sections was conducted on May 27, 2015 and on June 4 and 5, 2015, ICF conducted 21 surface scrapes around the location of ICF-CUL-01 to determine the site boundaries. Though the original APE included a staging area in the location of ICF-CUL-01, RD 108 decided to move the staging areas to the east side of the CBD canal and remove ICF-CUL-01 from the APE, thereby avoiding effects to the site. The COE has determined that the KLOG structure and the CBD canal/levee (P-57-000705/CA-YOL-240H) are not eligible for listing on the NRHP under any criteria.

The Native American Heritage Commission (NAHC) was contacted by the applicant's consultant in April, 2015 and follow up e-mails were sent in May, 2015 with no response. Letters were sent by ICF to the Native American contacts based on a list previously provided by the NAHC for a different project in Yolo County on May 19, 2015 and no responses were received. The COE sent letters to these contacts again on July 17, 2015 and have not received any responses to date.

The COE has concluded that issuing a 408 permit would have no adverse effect on historic properties. The COE has requested my review and comment on their determination of eligibility and finding of effect for the proposed undertaking. After reviewing your letter and supporting documentation, I have the following comment:

- I concur that the KLOG and the CBD Canal and levee ((P-57-000705/CA-YOL-240H) are not eligible for listing on the NRHP under any criteria.
- The proposed finding of *no adverse effect* pursuant to 36 CFR 800.5(b) does not appear to be applicable to this undertaking, as there have been no historic properties identified within the APE. However, I concur with a finding of *no historic properties affected* pursuant to 36 CFR 800.4(d)(1).

Thank you for seeking my comments and for considering historic properties in planning your project. Be advised that under certain circumstances, such as unanticipated discovery or a change in project description, the COE may have additional future responsibilities for this undertaking under 36 CFR Part 800. If you require further information, please contact Archaeologist Jessica Tudor of my staff at phone 916-445-7016 or email jessica.tudor@parks.ca.gov or Historian Kathleen Forrest of my staff at 916-445-7022 or email Kathleen.forrest@parks.ca.gov.

Sincerely,

Julianne Polanco
State Historic Preservation Officer