# Appendix C: Biological Opinion from the National Marine Fisheries Service

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

FEB 24 2017 **Refer to NMFS No:** ***WCR-2016-5553***

David E. Hyatt
Resources Management Division Chief
South-Central California Area Office
Bureau of Reclamation
1243 N Street
Fresno, California 93721-1812

Re: Endangered Species Act Section 7(a)(2) Biological Opinion, and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response, for the Central Valley Project Interim Renewal Contracts for Panoche Water District and San Luis Water District 2017 – 2019

Dear Mr. Hyatt:

Thank you for your letter of August 26, 2016, requesting initiation of consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 et seq.) for the Central Valley Project Interim Renewal Contracts for Panoche Water District and San Luis Water District 2017 – 2019.

Based on the reviewed information, this biological opinion concludes that the 2017 – 2019 Panoche and San Luis Water Districts Interim Renewal Contracts, as presented by the U.S. Bureau of Reclamation, may adversely affect the listed species and habitats in question but, these actions are not likely to jeopardize their continued existence, or destroy or adversely modify their designated critical habitats. The ESA-listed species and their designated critical habitats evaluated in this biological opinion include: endangered Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*), threatened Southern distinct population segment of North American green sturgeon (*Acipenser medirostris*), threatened Central Valley spring-run Chinook salmon (*O. tshawytscha*), and threatened California Central Valley steelhead (*O. mykiss*). NMFS also included an incidental take statement, with reasonable and prudent measures and non-discretionary terms and conditions, for actions that are otherwise lawful. These stipulations and measures are necessary and appropriate to avoid, minimize, or monitor the impacts of the proposed action on ESA-listed salmonids and green sturgeon associated with this project, or any incidental take that may occur.

Thank you, also, for your request for consultation pursuant to the essential fish habitat (EFH) provisions in Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1855(b)) for this action. NMFS reviewed the likely effects of the proposed action on EFH and concluded that the action would adversely affect the EFH of Pacific Coast Salmon. NMFS suggests adopting certain terms and conditions presented in the ESA incidental take statement as the EFH conservation recommendations to avoid further impacts. Reclamation has a statutory requirement under section 305(b)(4)(B) of the MSA to submit a written response back to NMFS within 30 days of receipt of these EFH conservation recommendations, and that the response should include a description of the conservation recommendations adopted and measures proposed or underway to avoid, minimize, or offset negative impacts of project activities on Pacific Coast Salmon EFH (50 CFR 600.920(k)).

Please contact Katherine Schmidt, Fisheries Biologist in the California Central Valley Office at (916) 930-3685, or at katherine.schmidt@noaa.gov, if you have any questions concerning this consultation, or if you require additional information.

Sincerely,

Maria Rea
for Barry A. Thom
Regional Administrator

Enclosure

Cc : California Central Valley Office
Division Chron File: *151422-WCR2016-SA00277*

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UNITED STATES DEPARTMENT OF COMMERCE
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**Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response**

Central Valley Project Interim Renewal Contracts for Panoche Water District
and San Luis Water District 2017 – 2019
NMFS Consultation Number: **WCR-2016-5553**

Action Agency: Bureau of Reclamation

Affected Species and NMFS' Determinations:

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

| Fishery Management Plan That Identifies 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 ~~Barry~~ A. Thom
Regional Administrator

**Date:** FEB 24 2017

Acronyms and shorthand terms list

| | |
|---|---|
| 3rd Use Agreement | The agreement between the United States and the San Luis & Delta-Mendota Water Authority for continued use of the San Luis Drain, January 1, 2010 through December 31, 2019 |
| BA | biological assessment |
| Bay-Delta | the San Francisco Bay and Sacramento-San Joaquin River Delta system |
| CCV | California Central Valley |
| CR | conservation recommendation |
| CVP | Central Valley Project |
| Delta | Sacramento-San Joaquin River Delta |
| DDT | dichlorodiphenyltrichloroethane |
| DPS | distinct population segment |
| EFH | essential fish habitat |
| EIS | environmental impact statement |
| ENSO | El Niño-Southern Oscillation |
| EPA | Environmental Protection Agency |
| ESA | Endangered Species Act |
| ESU | evolutionarily significant unit |
| FR | Federal Registrar |
| FWS | Fish and Wildlife Service |
| GBP | Grassland Bypass Project |
| HAPCs | Habitat Areas of Particular Concern |
| ITS | incidental take statement |
| $K_d$ | the ratio of the particulate concentration divided by the in-water concentration of a contaminate |
| MSA | Magnuson-Stevens Fishery Conservation and Management Act |
| NMFS | National Marine Fisheries Service |
| Northerly Districts | collectively, the Pacheco, Panoche, and San Luis Water Districts |
| opinion | biological opinion |
| PBF | physical or biological features |
| PCE | primary constituent elements |
| PDO | Pacific Decadal Oscillation |
| PFMC | Pacific Fishery Management Council |
| PWD | Panoche Water District |
| ppb | parts-per-billion |
| Reclamation | Bureau of Reclamation |
| RPA | reasonable and prudent alternative |
| RPM | reasonable and prudent measure |
| sDPS | southern Distinct Population Segment |
| SJRIP | San Joaquin River Water Quality Improvement Project |
| SJRRP | San Joaquin River Restoration Program |
| SLWD | San Luis Water District |
| SWP | State Water Project |
| TFF | trophic transfer factor |
| µg/ L | micrograms per liter |

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# 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

This opinion is the latest in a series in which we, the National Marine Fisheries Service (NMFS), reviewed the effects of the renewal and execution of the terms of interim water contracts between the Bureau of Reclamation (Reclamation) and the Panoche Water District (PWD) and the San Luis Water District (SLWD). Since 2009, Reclamation has been required to submit annual monitoring reports on water quality conditions and biological assessments (BA) of the effects associated with the renewal of these two-year water contracts to ensure the water districts and the drainage produced from use of the delivered water remains below previously established water quality thresholds for downstream water bodies, so that these actions are not greatly harming ESA-protected anadromous fishes.

Execution of this action depends on the Central Valley Project (CVP) and the State Water Project (SWP) to supply water for the deliveries. Central Valley Project and SWP water is usually sourced from the Sacramento River basin (Figure 1) and may be diverted, stored, and rerouted many times before being delivered to water districts south of the Sacramento-San Joaquin River Delta (Delta). All water deliveries will be enabled through pre-existing CVP and SWP facilities and infrastructure, and the BA did not include any proposals to construct new facilities, install new structures, or modify existing infrastructure. Water deliveries will occur via the shared San Luis and Delta-Mendota canals (Figure 2), and delivered water must be used beneficially within authorized places of use approved for CVP water south of the Delta. The water delivered in these contracts is primarily used for irrigation and agriculture within the water district's boundaries (NMFS, 2009a). The ecological effects and NMFS's determination regarding the federal actions of the CVP and SWP have been reviewed separately, and the conclusions associated with that consultation may be found in the biological and conference opinion on the long-term operations of the Central Valley Project and State Water Project (2008/09022), (NMFS, 2009*a*).

NMFS prepared the biological opinion (opinion) and incidental take statement (ITS) portions of this document in accordance with section 7(b) of the Endangered Species Act (ESA) of 1973 (16 USC 1531 et seq.), and implementing regulations at 50 CFR 402.
action, in accordance with section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management

We 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 [https://pcts.nmfs.noaa.gov, tracking number: **WCR-2016-5553**]. A complete record of this consultation is on file at California Central Valley Office, Sacramento (file: *151422-WCR2016-SA00277*).

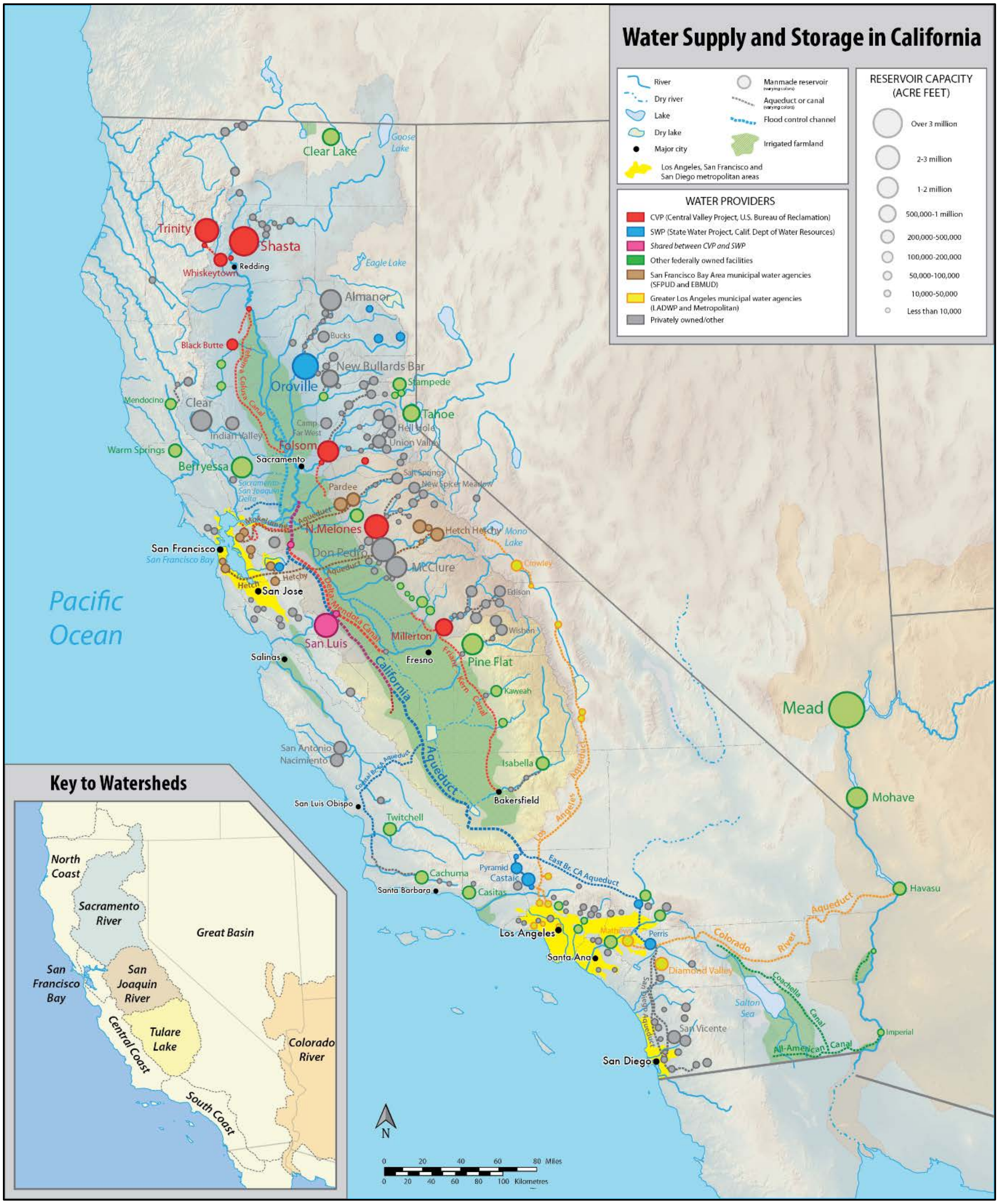


Figure 1. Map of water storage and delivery facilities in the state of California, as well as major rivers and cities. Central Valley Project systems are in red, State Water Project in blue, and shared facilities in magenta. The San Luis reservoir is the storage facility most likely to be used as the source for the water in these water contracts (Wikimedia Commons, 2013).

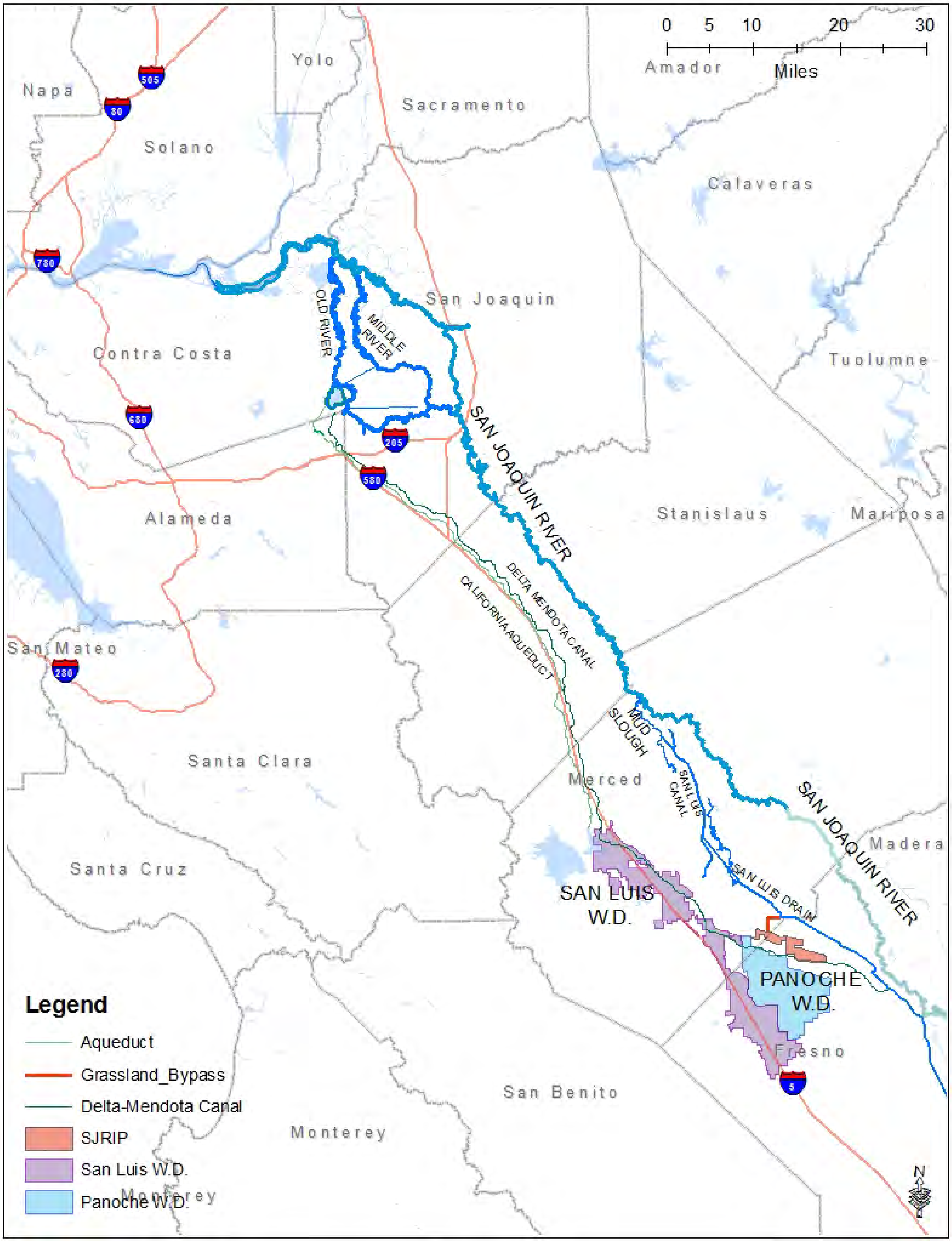


Figure 2. Map provided by Reclamation for project, including the drainage routes from the service areas (San Luis and Panoche Water Districts), the San Joaquin River Water Quality Improvement Project (SJRIP), the San Luis Drain discharge point from the Grassland Bypass Project at Mud Slough North into the San Joaquin River, and downstream, including to the Sacramento-San Joaquin River Delta and Old and Middle Rivers (Reclamation, 2016a).

## 1.2 Consultation History

On December 29, 2008, NMFS provided a no jeopardy/no adverse modification Opinion for the San Luis Water District (SLWD) and Panoche Water District (PWD) Interim Renewal Contracts (2008/04445) (SLWD and PWD Interim Renewal Contracts 2009-2011 Opinion) to the Bureau of Reclamation (Reclamation), which covered the time period from January 1, 2009 through February 28, 2011.

On February 23, 2011, NMFS provided a no jeopardy/no adverse modification Opinion for the San Luis Water District and Panoche Water District Interim Renewal Contracts (2010/04827) (SLWD and PWD Interim Renewal Contracts 2011-2013 Opinion) to Reclamation, which covered the time period from March 1, 2011 through February 28, 2013.

On February 11, 2013, NMFS provided a no jeopardy/no adverse modification Opinion for the San Luis Water District and Panoche Water District Interim Renewal Contracts (2012/05021) (SLWD and PWD Interim Renewal Contracts 2013-2015 Opinion) to Reclamation, which covered the time period from March 1, 2013 through February 28, 2015.

On January 20, 2015, NMFS provided a no jeopardy/no adverse modification Opinion for the San Luis Water District and Panoche Water District Interim Renewal Contracts (2014/01480) (SLWD and PWD Interim Renewal Contracts 2015-2017 Opinion) to Reclamation, which covered the time period from March 1, 2015 through February 28, 2017.

On August 26, 2016, NMFS received a formal request and accompanying BA from Reclamation, to initiate formal consultation under section 7 of the ESA for the San Luis Water District and Panoche Water District Interim Renewal Contracts for the period of 2017-2019.

On September 20, 2016, NMFS sent Reclamation notice that the submitted BA and initiation package were considered complete and that the consultation had been initiated.

Various emails were exchanged between Reclamation’s point-of-contact, Dr. Jennifer Lewis, and NMFS’s point-of-contact, Katherine Schmidt, between September 26, 2016 and the conclusion of this opinion.

Other related NMFS opinions that were important resources in conducting this consultation include those stated above, the Central Valley Project (NMFS, 2009a), and the Grasslands Bypass Project (NMFS, 2009b).

## 1.3 Proposed Federal 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). Reclamation proposes to fulfill their obligation to deliver water to the Panoche and San Luis Water Districts over a period of 24 months, from March 1, 2017 to February 28, 2019 (Reclamation, 2016a). This action includes annual water delivery of up to 94,000 acre-feet of water to the PWD and 125,000 acre-feet of water to the SLWD, though Reclamation may deliver less water to each district in any given year there is not sufficient water available. Regardless of water availability, NMFS is considering the effects of this federal action as if the contracts were implemented in full, though the likelihood of full delivery occurring is small.

“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). The Grasslands Bypass Project (GBP) is an interrelated action which has been in operation since 1996, with the purpose of reducing the volume of agricultural drainage water discharged from the Grassland Drainage Area, thereby significantly reducing the selenium contamination in local wetland water supply channels and the San Joaquin River (NMFS, 2008, 2009b). The GBP is a joint effort of area farmers, and water and drainage agencies, and is supported by Reclamation and regulatory agencies to reduce selenium and salt loading from the Grassland Drainage Area to wetland channels and other downstream water bodies, such as the Sacramento-San Joaquin Delta. The PWD and SLWD, and the lands they irrigate, are situated in the Grassland Drainage Area (Reclamation, 2016a, 2016b). The Grassland Drainage Area formed as a regional drainage entity to implement the GBP and manage on-going drainage activities, and is considered part of the Westside Regional Drainage Plan (incorporated by reference into the 2017-2019 Reclamation BA). In whole, the Westside Regional Drainage Plan is a group of water and drainage agencies that manage subsurface drain water and stormwater runoff from irrigated lands though source control, groundwater management, re-use, and treatment and disposal of salts as part of the long-term plan to provide drainage service to lands in the Grassland Drainage Area. As part of the Grassland Drainage Area, the Panoche and San Luis Water Districts also participate in the Westside Regional Drainage Plan. All drainage water resulting from the irrigation of lands in the Grassland Drainage Area is conveyed via the Grassland Bypass Channel to the San Luis Drain, and then into Mud Slough North. This removes drainage water from the Grassland Drainage Area and prevents drain water from entering wetland water supply channels as it did historically. In an analysis of potential adverse effects from the use of the GBP to convey water used by the PWD and SLWD to the San Joaquin River, NMFS determined that allowing Grassland Drainage Area water to be conveyed through the GBP was a reasonable and prudent measure (RPM) necessary and appropriate to minimize the incidental take of ESA-listed fishes. As the water used by PWD and SLWD originates in whole or in part from the CVP, and delivery is implemented by these interim water contracts, the GBP is interrelated to NMFS’s opinion conclusion regarding this set of renewal contracts as well.

The GBP currently operates under terms in the 2009 Agreement for Continued Use of the San Luis Drain, otherwise known as the 3rd Use Agreement (Reclamation, 2009) between the San Luis and Delta-Mendota Water Authority and the United States through Reclamation. The 3rd Use Agreement is regulated under waste discharge requirements issued by the Central Valley Region of the California Water Quality Control Board. As such, all drainage water originating from the Grassland Drainage Area must enter the GBP so it can be retained or treated. Then the water may be discharged through the San Luis Drain into Mud Slough North, and finally into the San Joaquin River. Once in the San Joaquin River system, drain water has the potential to enter and affect the Sacramento-San Joaquin River Delta (Delta) ecosystem. To curb negative effects, the water leaving the GBP is subject to allowable discharge load requirements based on water-year type, including monitoring throughout the discharge pathway, and has an ultimate goal of "zero-discharge" or a selenium concentration of 2 parts-per-billion (ppb), or 2 µg/L, or less in the San Joaquin River. However, it should be noted that the GBP is one management tool used by the Westside Regional Drainage Plan, but, the term "Grassland Bypass Project" is more commonly used to include the conveyance and all other strategies used to meet contractual and regulatory requirements stipulated in the 3rd Use Agreement. The effects of the GBP have been reviewed separately, and the conclusions associated with that consultation may be found here: Informal Consultation for the Grasslands Bypass Project (2009/04097), (NMFS, 2009b).

# 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, each Federal agency must ensure that its 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 habitats. If incidental take is reasonably certain to occur, section 7(b)(4) requires NMFS to provide an ITS that specifies the impact of any incidental taking and includes non-discretionary reasonable and prudent measures (RPMs) and terms and conditions to minimize such impacts.

## 2.1 Analytical Approach

This biological opinion includes both a jeopardy analysis and/or 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.

This biological opinion relies on the definition of "destruction or adverse modification," which "means a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features" (81 FR 7214).

The designations of critical habitat for ESA listed species uses the term primary constituent elements (PCE) or essential features. The new critical habitat regulations (81 FR 7414) replace this term with physical or biological features (PBFs). The shift in terminology does not change the approach used in conducting a ''destruction or adverse modification'' analysis, which is the same regardless of whether the original designation identified PCEs, PBFs, or essential features. In this biological opinion, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

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

- Identify the range wide status of the species and critical habitat expected to be adversely affected by the proposed action.
- Describe the environmental baseline in the action area.
- Analyze the effects of the proposed action on both species and their habitat using an "exposure-response-risk" approach.

- Describe any cumulative effects in the action area.
- Integrate and synthesize the above factors by: (1) Reviewing the status of the species and critical habitat; and (2) adding the effects of the action, the environmental baseline, and cumulative effects to assess the risk that the proposed action poses to species and critical habitat.
- If unable to estimate the number of individuals that will be harmed by the action, establish a criteria for use of a reasonable ecological surrogate.
- Reach a conclusion about whether species are jeopardized or critical habitat is adversely modified.
- If necessary, suggest a Reasonable and Prudent Alternative to the proposed action.

In writing this section, major information sources included:

- Recovery Plan for the Evolutionarily Significant Units of Sacramento River winter-run Chinook salmon, and Central Valley spring-run Chinook salmon, and the Distinct Population Segment of California Central Valley steelhead (NMFS, 2014)

- 5-year review: Summary and evaluation of Sacramento River winter-run Chinook salmon ESU (NMFS, 2011)

- 5-year review: Summary and evaluation of Central Valley spring-run Chinook salmon Evolutionarily Significant Unit (NMFS, 2016b)

- GrandTab spreadsheet of adult Chinook salmon escapement for 2015 in the Central Valley (CDFW, 2016)

- 5-year review: Summary and evaluation of California Central Valley steelhead Distinct Population Segment (NMFS, 2016a)

- DRAFT Recovery Plan for the southern Distinct Population Segment of the North American green sturgeon (*Acipenser medirostris*) (NMFS, 2016c)

- 5-year review: Summary and evaluation of southern Distinct Population Segment of North American green sturgeon (*Acipenser medirostris*) (NMFS, 2015)

- Biological Assessment for National Marine Fisheries Service Central Valley Project interim renewal contracts for Panoche Water District and San Luis Water District 2017-2019 (Reclamation, 2016a)

- The 3rd Use Agreement (Reclamation, 2009)

- The Northerly Agreement, DRAFT (Reclamation, 2016b)

- Grassland Bypass Project Monthly Report (Reclamation, 2015)

## 2.2 Rangewide Status of the 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 ESA requires critical habitat to be designated for any species listed; 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 PBFs that help to form that conservation value. Critical habitat is defined as specific areas within the geographical area occupied by the species at the time of listing that contain specific physical or biological features essential to the species' conservation, or any features that may require special management considerations or protection. Also, specific areas outside of the areas currently occupied by the species may be included if the listing agency determines that those areas are essential for conservation of the species. Critical habitat designations usually include: 1) space for individual and population growth and normal behavior, 2) sites for breeding and rearing of offspring, and 3) habitats protected from human disturbance or those that are representative of the historical geography and ecological distribution of the species.

### 2.2.1 Sacramento River winter-run Chinook salmon, evolutionarily significant unit

- First listed as threatened (August 4, 1989, 54 FR 32085), reclassified as endangered (January 4, 1994, 59 FR 440), reaffirmed endangered (June 28, 2005, 70 FR 37160 and August 15, 2011, 76 FR 50447)

Sacramento River winter-run Chinook salmon, *Oncorhynchus tshawytscha*, evolutionarily significant unit (ESU) were first listed as "threatened" under the Endangered Species Act in 1989, under an emergency rule (NMFS, 2011) but, in 1994, this ESU was reclassified as an endangered species. While NMFS proposed to de-classify the ESU down to a threatened species status in 2004, the final determination in 2005 concluded that the ESU remained in danger of extinction and therefore has remained unchanged (NMFS, 2011). This ESU includes all winter-run Chinook salmon naturally spawned in the Sacramento River and its tributaries, and fish propagated at the Livingston Stone National Fish Hatchery (Figure 3).

NMFS issued guidelines for assigning recovery priorities following a species listing under the ESA. A recovery priority number is used to assess a species priority for recovery plan development, implementation and resource allocation. Priority numbers are based on three criteria: 1) the magnitude of the overall threat the species faces, 2) its recovery potential, and 3) existing conflicts between its recovery and human activities such as construction and development. Recovery priority numbers range from 1 (highest priority) to 12 (lowest priority). The recovery priority number given to the Sacramento River winter-run Chinook salmon ESU is three. This ESU considered an endangered species and has been assigned a high recovery priority number because it 1) has showed continued decline and increased variability in its run

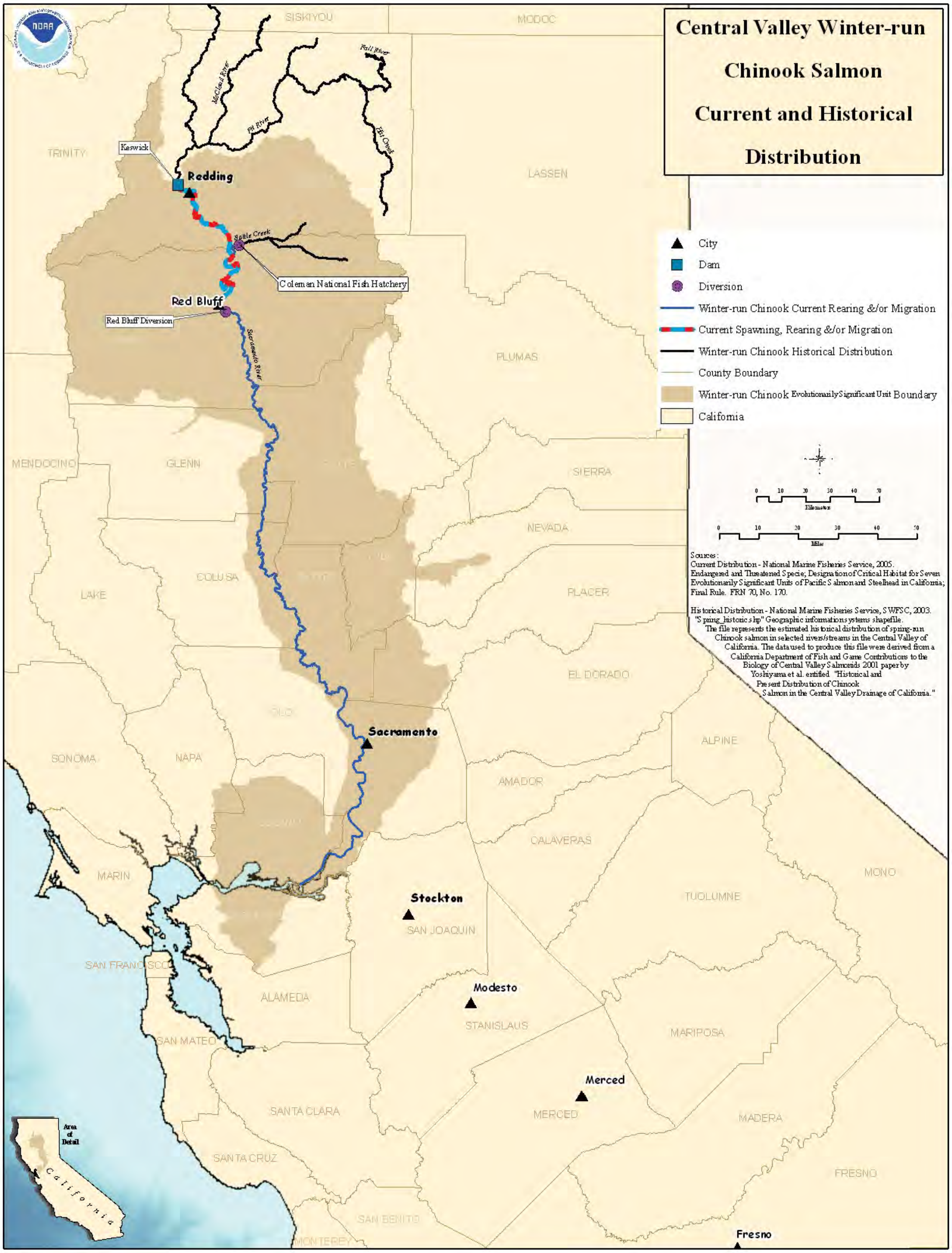


Figure 3. Current and historical Sacramento River winter-run Chinook salmon ESU range (NMFS, 2014).

size since listing in 1989, 2) has limited genetic diversity and spatial structure, and 3) faces persisting threats (NMFS, 2011).

One significant, continuing threat to this ESU's recovery is that it consists of only one population, though historically it likely was supported by four independent populations (NMFS, 2014). Furthermore, this remaining population is small and has declined from an escapement of 100,000 adults in the 1960s down to about 200 adults in the early 1990s (Good, Waples, & Adams, 2005). The most recent estimates from the 2014 - 2015 spawning cycle places the total adult spawning population at 3,440 individuals (CDFW, 2016). Over the last several years, the population has dropped to very low levels of abundance and hatchery contributions have been increasing but are still considered relatively small (Figure 4).

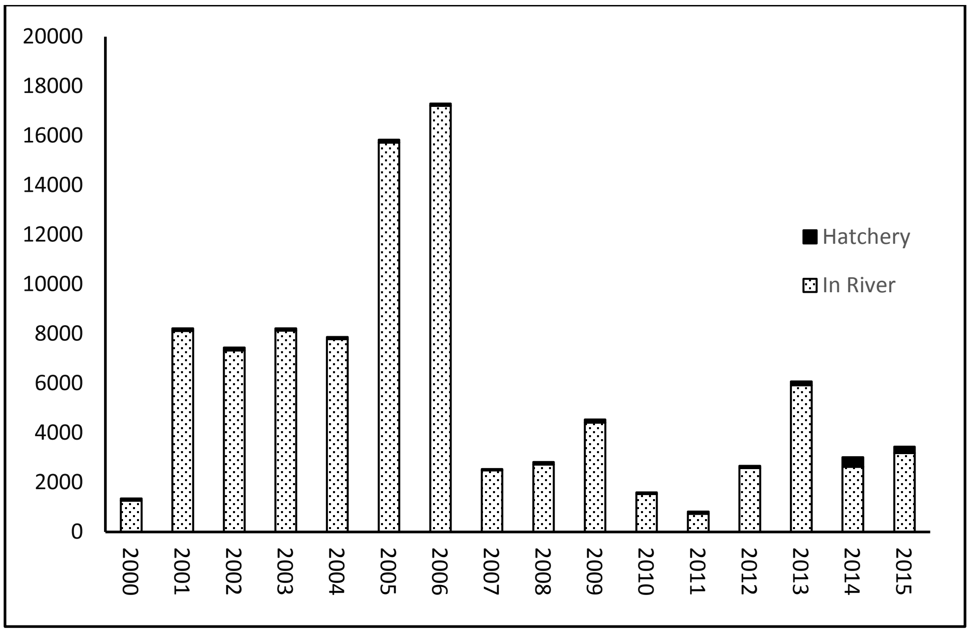


Figure 4. Sacramento River winter-run Chinook salmon adult escapement estimates 2000-2015, from observed in-river and hatchery fish, data from (CDFW, 2016).

Chinook salmon, also referred to as king salmon, are the largest of the Pacific salmon. Chinook salmon are the most important commercially and recreationally harvested anadromous fish in California (NMFS, 2014). Chinook salmon have evolved a broad array of life history patterns that allow the species to take advantage of the variable riverine conditions throughout the year and different runs of adults returning to spawn take turns to avoid intra-species competition for limited space in the freshwater habitats. Spawning runs are named for the timing of adult upstream migration: fall-run, late fall-run, winter-run, and spring-run. The Sacramento River supports all four runs of Chinook salmon, and many other major California rivers, provides habitat for one or more of these runs. Each run has adopted slightly different life history tactics to successfully use rivers while minimizing competition with the other runs, and despite whatever water conditions are available during their particular spawning times. These life history differences and adaptations have influenced the genetic profiles of each run.

Adult winter-run Chinook salmon typically start their migration from the Pacific Ocean to their freshwater spawning grounds starting December through July, with a peak in activity from January through April (NMFS, 2014). However, when winter-run fish arrive in freshwater, they are sexually immature and historically would hold in the Delta and in areas of the lower Sacramento River for several months while developing and transitioning into their freshwater forms. But because water temperatures are no longer sufficiently cold in these areas (59º to 60º F), now these areas are only used as a migration corridor and instead the fish hold above the Red Bluff Diversion Dam in suitably cold cool, deep, well-oxygenated pools (NMFS, 2014).

Another the notable biological change associated with salmonid transition from the ocean to freshwater forms is a cessation in feeding (Quinn, 2005). The exact point at which migrating adults stop feeding is not well defined and can vary due to several factors including the run type's biology and the season that they leave the ocean. Some individuals from certain runs may spend several months in estuarine or lower river areas, and may continue to feed to some extent during the transition process. However, in (Groot, L. Margolis, & W. C. Clarke, 1995), Chinook salmon sampled while entering rivers after their transition in estuarine areas below the Kamchatka and the Fraser rivers did not contain any evidence of prey in their stomachs. Recreational anglers of the Bay-Delta occasionally catch silvery, or 'chrome', Chinook salmon that have not made the saltwater to freshwater transition in the San Francisco Bay. These individuals also have immature gonads, suggesting they may be either a spring-run or winter-run Chinook, as being immature at that stage of the migration is typical for those runs. 'Chrome' fish with little external signs of progress towards the freshwater transition or secondary sexually dimorphic characteristics of their 'running' forms likely have a higher probability of feeding in estuarine areas than fish further along (Joe Heublein, NMFS Central Valley Office, personal communication, November 2016).

For spawning, Chinook salmon require clean loose gravel and cobble in swift, relatively shallow riffles, or along the margins of deeper river reaches, that also have suitable water temperatures, depths, and velocities (NMFS, 2014). Females dig out nests in the gravel, called redds, and deposit eggs to be fertilized by males. Winter-run Chinook salmon spawn during summer months, May through August, when air temperatures typically approach their yearly maximum. Historically, snow melt coming down from high mountains provided freshwater that was sufficiently cold to protect embryos and juveniles from the summer air temperatures that would otherwise be lethal. Currently, dams and reservoirs detain and warm snowmelt water while blocking access to higher reaches, so spawning now occurs between the Keswick Dam and the Red Bluff Diversion Dam [Figure 3, (NMFS, 2014)]. The adults die soon after spawning, though males may fertilize more than one redd before death (Quinn, 2005).

Once the eggs are fertilized, incubation occurs April through October. With appropriate water temperatures, the development to the hatching stage normally takes 40 to 60 days (NMFS, 2014). Newly hatched fish, called alevins, remain in the gravel for an additional four to six weeks until the yolk sac is absorbed. Then, after emerging from the gravel, Chinook salmon fry swim or are displaced downstream at varying rates. Some fry may start moving downstream mid-July with peaks in September, but others may spend almost a year in the river before beginning their emigration to downstream, with movement downstream sometimes stretching into the following March in dry years. While moving downstream, the fry and juveniles seek streamside areas that contain in-water or overhanging riparian vegetation and other complex substrates and structures that provides prey items, predator avoidance cover and slower water velocities for resting (otherwise known as rearing habitat).

After some growth while traveling downstream, Chinook salmon begin the smoltification process. Smoltification is growth and physiological preparation to cope with the increased salinities faced in environments like the Delta, and can be triggered when rearing in areas where salinity is 1.5 to 2.5 parts per thousand (NMFS, 2014). In the Delta, juvenile Chinook salmon will forage in shallow areas with cover and feed on a variety of aquatic and terrestrial invertebrate prey. Juvenile Chinook salmon smolts may stay in the Delta for about 40 days before migrating out to the Pacific Ocean. Sacramento River winter-run Chinook salmon typically utilized the Delta for rearing November through May, and will remain in the area until they reach a fork length of about 118 millimeters and are about five to ten months in age. Emigration out to the ocean may occur during this time period.

After migration out to sea, Central Valley Chinook salmon juveniles are known to use the Gulf of the Farallones, as well as open or mid-water oceanic areas along the continental shelf for feeding and growth. Typically, they will feed voraciously in the marine environment for about three to four years before returning to San Francisco Bay to begin their life cycle again (NMFS, 2014), though small percentage of male Chinook salmon may mature precociously in freshwater without migrating to the sea (Groot & Margolis, 1991), within one or two years of age.

The key reasons this ESU became endangered are 1) man-made blockages keeping them from accessing their historical spawning and rearing habitats (Shasta and Keswick dams, Figure 3); 2) warm water releases from those dams that have led to decreased juvenile survivorship; 3) adult and juveniles passage constraints downstream in addition to major dam obstruction; 4) water exports in the southern Delta; 5) additional loss of rearing habitat downstream of major dams from cumulative human activities and alterations; 6) heavy metal contamination; and 7) entrainment of adults and juveniles in water diversions (NMFS, 2014). Additionally, not only have rim dams like Shasta Dam have blocked access to a majority of winter-run historic spawning habitat and artificially raised water temperatures downstream, but they also detain the recruitment of suitably-sized spawning gravel to the lower river reaches by trapping it behind their retaining walls. Other gravel recruitment sources, like river banks and floodplains, that would naturally release gravel during erosion events have been altered by levee and bank protection measures and currently retain their sediments. But, the existence of Shasta Reservoir has in part aided in the ESU’s persistence, due to managed cold-water releases that are generally sufficiently cold to enable somewhat successful spawning between Keswick and the Red Bluff Diversion dams.

This population remains at high risk of extinction, due to the fact that the sole population of winter-run occupies a limited area for spawning and rearing, and so has an increased risk of extinction that could come with any local catastrophe or adverse environmental change that may occur. If such an event persisted for four years or more, the entire ESU could fall into extinction. For example, the severe 2011 - 2016 California drought put this ESU in serious peril after Shasta Reservoir was unable to provide sufficiently cold water to support successful egg development, resulting in an approximate 95% failure for a series of years (Garwin Yip, NMFS Central Valley Office, personal communication, November 2016). Only through contentious water management decisions and allocations in 2016 was NMFS able to secure enough cold water for this population to avoid their extinction.

Layered over all human activities, whether they result in the degradation or restoration of the habitat, are the natural variations in the environment and climate. These natural changes in the freshwater and marine environments play a major role in salmonid abundance and their recovery. Recent evidence suggests that marine survival among salmonids fluctuates in response to 20 to 30 year cycles of climatic conditions and ocean productivity (Hare, Mantua, & Francis, 1999; Mantua & Hare, 2002). These long period cyclic oceanic conditions, called the Pacific Decadal Oscillation (PDO), alter the upper level atmospheric winds. Shifts in the PDO phase can have significant implications for global climate, hurricane activity, global land temperatures, the productivity of marine ecosystems, and, the intensity and length of droughts and flooding around the Pacific basin. In addition, large-scale but shorter-term climatic regime shifts called the El Niño Southern Oscillation (ENSO) influence nearshore productivity levels off California by increasing or decreasing the strength and duration of northerly winds that cause upwelling of nutrient-rich deep water via nearshore water displacement. Periods of weak coastal winds, poor water column mixing, and overall warm, nutrient-poor ocean water, which ultimately results in conditions largely unfavorable to nearshore productivity are termed El Niños, while the opposite (strong coastal winds, strong water column mixing, cold, nutrient-rich water that enables high nearshore productivity) are called La Niñas. The PDO can intensify or diminish the impacts of the ENSO phase, for example if the PDO and ENSO are in the same phase, any El Niño or La Niña impacts may be magnified, but if they are out of phase they may offset each other, effectively canceling each other out.

Poor oceanic conditions or adverse changes are often cited as a cause for declines in abundance of West Coast salmonids (Northwest Fisheries Science Center, 2017). Principal ecosystem alterations include decreased primary and secondary productivity in affected regions and changes in prey and predator species distributions. Cold-water species are displaced towards higher latitudes or move into deeper, cooler water, and their habitat niches are occupied by species tolerant of warmer water that move upwards from the lower latitudes with the warm water tongue. Another key factor affecting many West Coast stocks has been a general 30-year decline in ocean productivity. The mechanism whereby stocks are affected is not well understood, partially because the pattern of response to these changing ocean conditions has differed among stocks, presumably due to differences in their ocean timing and distribution. It is presumed that survival in the ocean is driven largely by events occurring between ocean entry and recruitment to a sub-adult life stage. Healthy populations typically recover from temporary adverse condition within a few generations, however compromised populations may be unable to recover from a particular severe event (NMFS, 2014).

The PDO and ENSO cycles can also cause fluctuations between drought and wet conditions in the basins of the American west. During the first part of the 1990s, much of the Pacific Coast and California was subject to a series of very dry years, which reduced inflows to watersheds up and down the west coast. Starting in 2010, the Southern United States faced an extreme drought that brought record-breaking heat waves. These conditions expanded to include most of North America in 2012 – 2013, and in most measures (crop destruction, water supply, low snowfall, and summer temperatures) the recent drought has exceeded the 1988-1989 drought. California has been experiencing the most recent drought since at least 2011 which lasted until 2016, and placed many fish species at increased risk. Many areas were classified as in an exceptional drought, or the driest California had been since record-keeping had begun (Wikipedia, 2016a, 2016b). Impending climate change is generally expected to cause more frequent extreme weather than what was previously expected for each season (Williams et al., 2016), and the 2016 - 2017 winter rainy season that has brought California out of the recent historic drought does not seem to deviate from this expectation.

## Sacramento River winter-run Chinook salmon designated critical habitat

- Critical habitat designated (June 16, 1993, 58 FR 33212)

Critical habitat was designated for the Sacramento River winter-run Chinook salmon ESU in 1993 (NMFS, 2011), and the PBFs include a migratory pathway for access from the Pacific Ocean to appropriate spawning areas in the upper Sacramento River; available gravel areas for spawning activities; river areas with adequate flows that support successful spawning, egg incubation, fry development and emergence, and downstream transport of juveniles; water temperatures between 42.5$^{o}$ to 57.5$^{o}$ F; riparian habitat which provides for successful juvenile development and survival; and access to downstream from spawning areas to the Delta, San Francisco Bay, and the Pacific Ocean for juveniles and smolts (Figure 5). The designated boundary that encompasses these needs includes areas where winter-run may be found, such as the Sacramento River from Keswick Dam to Chipps Island, Chipps Island west to Carquinez Bridge, all waters of San Pablo Bay west of Carquinez Bridge, and all waters of San Francisco Bay to the Golden Gate Bridge. It remains crucial to the existence and recovery of this ESU to maintain or improve the current extent and quality of the designated critical habitat until access for all life stages of winter-run can be re-established to historic habitats upstream of Shasta Dam and to Battle Creek (NMFS, 2014).

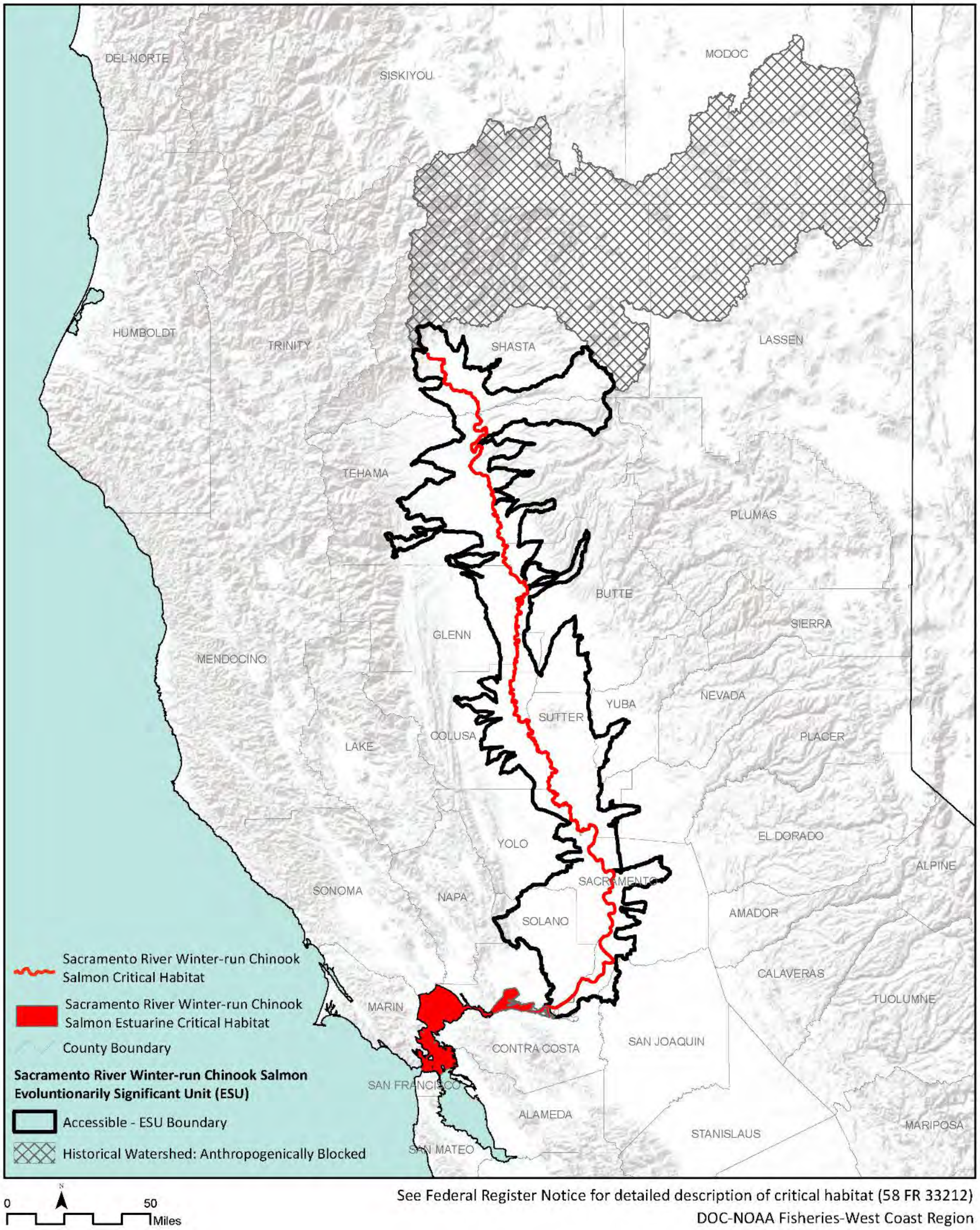

Figure 5. Sacramento River winter-run Chinook salmon designated critical habitat, and current and historical ranges (NMFS, 2016f).

### 2.2.2 North American green sturgeon, southern Distinct Population Segment

- Listed as threatened (April 7, 2006, 71 FR 17757)

The southern Distinct Population Segment (sDPS) of North American green sturgeon, (*Acipenser medirostris*), was listed as threatened in 2006, and the latest status review determined a change in listing status was not warranted (NMFS, 2015). The sDPS includes all North American green sturgeon populations in coastal environments south of the Eel River and within major rivers of the California Central Valley, with Sacramento River as a main spawning river (Figure 6). A northern Distinct Population Segment also exists, consisting of North American green sturgeon in, and northward of, the Eel River. However the northern DPS is not listed under the ESA at this time, but is considered a species of concern by NMFS's Proactive Conservation Program (NMFS, 2016g). Genetic analysis (Israel, Bando, Anderson, & May, 2009) confirmed the population segment division at the Eel River previously established based on known spawning rivers. Additional studies that used telemetry and other techniques confirmed the structure of the DPS as those currently described by the ESA listings (NMFS, 2015). While the individuals from the two DPSs may co-occur in marine environments, they do not appear to enter each other's natal rivers (Lindley et al., 2011). Southern DPS green sturgeon were given a recovery priority number of five, which indicates this population faces a moderate level of extinction in some regions and may be in conflict with some economic and resource use interests, but has a high recovery potential in many regions (NMFS, 2015).

Preliminary results of recent adult population surveys suggest the sDPS may be increasing in number, but the estimates of adults in the Sacramento River indicate the sDPS may only be half as abundant compared to the northern DPS (NMFS, 2015). Currently, the overall sDPS spawning adult abundance is estimated at 1,990 with a 95% confidence interval range of 1,172 to 2,808 adult individuals in the upper Sacramento, [Figure 7, (NMFS, 2015, 2016c)], however this estimate does not include green sturgeon adults that may be in the Feather River. Another estimate which includes subadults in the estimate figures 10,450 individuals in the entire sDPS (95% CI: 6,155-14,745) (NMFS, 2016c). A large successful spawning event occurred in the near the Red Bluff Diversion Dam, where an unprecedented number of larval green sturgeon and eggs were recovered from rotary screw traps in the summer of 2016 (Joe Heublein, personal communication, NMFS Central Valley Office, 2016). While the magnitude of this reproductive event is promising, it will not guarantee a population increase until offspring from the event survive to maturity and are counted as effective population members that contribute to the sDPS's stability and replacement capacity.

North American green sturgeon are long-lived [54 years, (Nakamoto, Kisanuki, & Goldsmith, 1995)], and reach maturity in about 15 years or at a total length of 150 – 155 centimeters for sDPS individuals (NMFS, 2015). Once mature, sDPS individuals typically spawn every three to four years, with a range of two to six years. Spawning activity in the California Central Valley has been confirmed to occur in the Sacramento River and the Feather River (Figure 6). To reach the spawn grounds, adults enter San Francisco Bay in late winter through early spring, and travel upstream to cool sections in the main stem of these rivers from April through early July depending on water flow cues and water temperatures.


Figure 6. Map of the distribution of southern Distinct Population Segment North American green sturgeon in the California Central Valley (NMFS, 2016c).

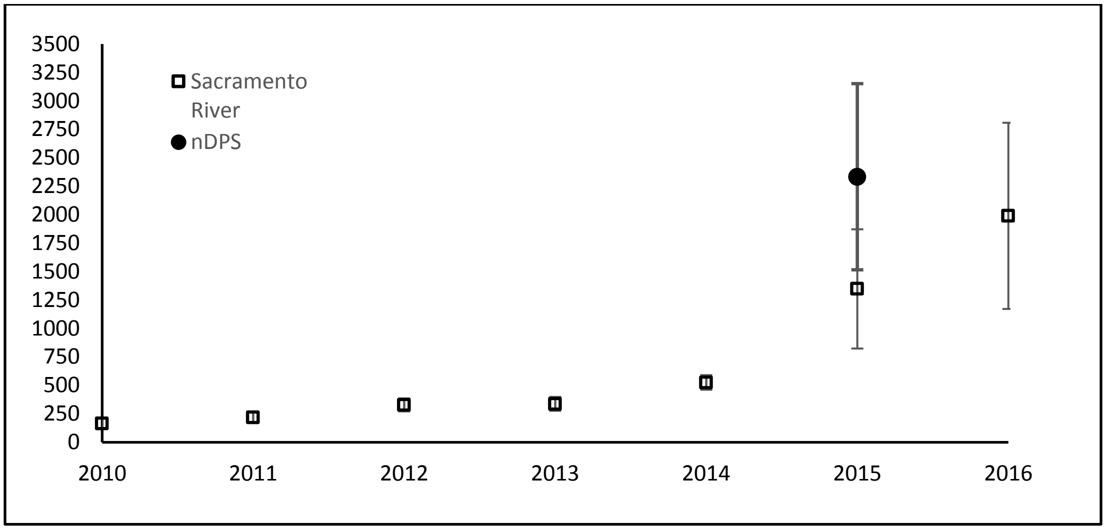


Figure 7. Adult North American green sturgeon abundance estimates (NMFS, 2016c).

Green sturgeon also prefer clearer water than white sturgeon for spawning [< 10 NTU (Gruber, Jackson, & Van Eenennaam, 2012)], a preference that may be preventing them from spawning in the San Joaquin River system as conditions exist currently [average turbidity 22 NTU, (Gruber, 2012)]. They exhibit spawning site fidelity to their natal streams (Poytress, Gruber, & Van Eenennaam, 2011), which may also explain the lack of green sturgeon spawning activity observed outside of the Sacramento River basin. Typically after spawning, adults move out quickly (2-10 days) or may hold for several months before leaving the estuary (NMFS, 2015).

Sturgeon eggs have adhesive qualities and stick to gravel or cobble and incubate up to nine days before hatching (NMFS, 2015). Eggs take 144 to 192 hours to hatch in 15.7 °C water (Deng, et al., 2002). After hatching, larvae may remain near the area for 18 to 35 days (Poytress et al., 2011). In a laboratory setting, the metamorphosis from a larvae to a juvenile Northern DPS green sturgeon occurred about 45 days post-hatching (Deng et al., 2002). Juveniles are highly tolerant of salinity changes and can make the physiological transition to seawater at 1.5 years of age (Allen et al., 2011). Based on extrapolated ages from lengths of juvenile green sturgeon captured in the Delta, sDPS green sturgeon are estimated to start the migration downsteam toward the estuaries between 6 months and 2 years of age (NMFS, 2015). Little is known about juveniles rearing and foraging in the Delta and San Francisco Bay, but they likely spend several months to at least a year in freshwater environments (NMFS, 2016c). Juveniles and sub-adults of the northern DPS make extensive use of bays and estuaries (WDFW and ODFW 2012), and the typical size at which subadults are encountered in the ocean (>600 millimeters total length) suggests ocean entry occurs at an age greater than 1 year old (Thomas & Klimley, 2015). Adults and subadults migrate seasonally along the coasts and tend to congregate at specific locations when not spawning. Unlike Chinook salmon, adult green sturgeon are not known to cease feeding while moving between fresh, brackish, or saltwater, whether migrating upstream to spawning aggregations or making use of an area for other reasons (NMFS, 2016c). Green sturgeon tend to feed opportunistically and consume a variety of benthic prey items when available, including shrimp, amphipods, isopods, clams, annelid worms, crabs, and fish as juveniles in the Delta, and lamprey ammocoetes, crayfish, shrimp, clams, and benthic fish as subadults and subadults (NMFS, 2016c).

A primary ongoing threat to the sDPS green sturgeon population and its recovery is that the spawning area currently in use is quite small. The primary spawning area is in the main stem of the Sacramento River, though the Feather River and perhaps the Yuba River may also be used to some degree. Similar to Chinook salmon, many high dams form impassable barriers to green sturgeon attempting to migrate further upstream to suitable spawning habitat that may have been historically used (NMFS, 2015), however green sturgeon are less maneuverable than Chinook salmon and smaller structures act as barriers to them that are not effective barriers to Chinook salmon. Some recent management decisions have led to increased green sturgeon accessibility, like the decommissioning of the Red Bluff Diversion Dam and the breach of Shanghai Bench that made movement conditions more favorable. Overall the suitability of any accessible spawning habitat is dependent on sufficient water flow and temperatures. Also, altered hydrologic conditions have been a persistent threat since the construction of major dams and water storage for the CVP. Low temperature compliance points in the Sacramento River are making progress in the direction of recovery when sufficient cold water is available for release. Recent drought conditions have made it difficult to impossible to maintain compliance and river connectivity in some areas, however. As such, the inadequacy of existing regulations and mechanism surrounding improving or preserving sDPS green sturgeon spawning habitat is regarded as another important remaining threat (NMFS, 2015), while threats from commercial and recreational fishery harvest have diminished following retention restrictions throughout the contiguous western states and Canada. The threat of unscreened river diversions, or diversions with screens designed to avoid entraining salmonids but not considering green sturgeon juveniles physiology may result in selective entrainment, are a remaining threat of unclear importance. Pollution, such as the insecticide carbaryl or facsimiles, used in the California Central Valley agricultural industry may also pose a threat to green sturgeon populations by eradicating their invertebrate forage base, as well as selenium and methylmercury contamination in the Delta San Francisco, San Pablo, and Suisun Bays that may directly or indirectly affect green sturgeon individuals (NMFS, 2015). A possible new threat may be kinetic energy installations in areas used by green sturgeon, but more information and study is necessary before a determination on such installations can be made.

While some threats have been addressed, many remain though there is a high degree of uncertainty to whether high-ranking threats could cause substantial impacts on the species (NMFS, 2015). Also, no new evidence examined in the 2016 Recovery Plan suggested a decline in sDPS abundance. However, the limited area within which spawning occurs places the sDPS at increased extinction risk due to stochastic and uncontrollable events such as severe droughts, floods, or chemical spills. The sDPS also faces increased extinction risk due to climate change as environmental changes may act synergistically in favor of already introduced invasive species and alter their forage base.

#### North American green sturgeon sDPS designated critical habitat

- Critical habitat designated October 9, 2009 (74 FR 52300)

On October 9, 2009, NMFS established designated critical habitat for the sDPS green sturgeon (74 FR 52300) pursuant to 50 CFR 424.12(b), which took effect November 9, 2009. The


Figure 8. Map of designated critical habitat for southern Distinct Population Segment North American Green Sturgeon (NMFS, 2016c).

freshwater portion of the critical habitat designated includes the accessible portions of the mainstem of the Sacramento River, Feather River, Yuba River, American River, and the Sacramento-San Joaquin Delta (Figure 8). Important coastal bays and estuaries in California were also designated, including the San Francisco, San Pablo, Suisun, and Humboldt Bays. Marine coastal waters within the 60 fathom isobaths were also included, from the Monterey Bay north to the U.S. – Canada Border.

The PBFs protected by this designation include those important to the continued existence of the sDPS North American green sturgeon in freshwater and estuarine areas, like food resources, substrates suitable for egg deposition and development, water quality and freshwater flow regimes that supports normal behavior, growth, and survival of all life stages, migratory corridors necessary for the safe and timely passage of all life stages between riverine and estuarine habitats, sufficiently deep holding pools for adults and subadults, and sediment quality necessary for normal behaviors, growth, and viability of all life stages. Additional spawning areas likely existed and were used by green sturgeon in parts of the San Joaquin, lower Feather, American, and Yuba Rivers, all of which are currently inaccessible due to barriers, or unusable due to current hydrologic condition or quality caused by water management decisions and infrastructure (NMFS, 2016c). For nearshore marine areas, important characteristics are safe and open migration pathways for all life stages, adequate water quality characteristics including acceptably low levels of containments that have the potential to disrupt normal behavior, growth, or viability, and abundant prey resources, for subadult and adult green sturgeon.

Several initiatives directed at benefiting salmonids also benefit sDPS green sturgeon, such as habitat restorations, water allocation for wildlife uses, and fish screening projects. However, the current condition of the accessible portions of the designated critical habitat is not ideal, though successful spawning has been observed in some limited areas. In addition, volitional passage has not been obtained through major corridors such as the Yolo and Sutter bypasses. Water quality is degraded throughout the system and chemical contamination is beyond acceptable levels for many harmful compounds throughout the Bay-Delta, and may be affecting green sturgeon use, behavior, and reproductive success (NMFS, 2016c).

### 2.2.3 Central Valley spring-run Chinook salmon, evolutionarily significant unit

- First listed as threatened (September 16, 1999, 64 FR 50394), reaffirmed threatened (June 28, 2005, 70 FR 37204)

The Central Valley spring-run Chinook salmon (*O. tshawytscha*) ESU was listed as threatened in 1999 and that status has not changed despite two reviews (NMFS, 2010, 2016b). The most recent status review, (NMFS, 2016b) found that most Central Valley spring-run populations have remained stable or have slightly increased in abundance, improving the degree of the population's viability since the 2010/2011 review cycle. During the 2016 status re-evaluation, the Central Valley spring-run Chinook salmon ESU's recovery priority number changed from seven to a five, to reflect their increased recovery potential. The current range for this ESU includes all naturally spawned populations of Central Valley spring-run Chinook salmon in the Sacramento River Basin downstream of impassible barriers of the Sacramento River, and its tributaries, down to the Delta (Figure 9). In addition, this ESU also includes the Feather River Fish Hatchery spring-run Chinook salmon stock (NMFS, 2016b). In the near future, a modification to the ESU boundary may be necessary when spring-run Chinook salmon are successfully reintroduced into the restored San Joaquin River and begin spawning naturally without intervention [see Central Valley spring-run Chinook salmon, nonessential experimental population section below (NMFS, 2012, 2016b)].

Historically there may have been 18 to 19 independent populations of Central Valley spring-run Chinook from four diversity groups (Lindley, 2004). Of these, only three populations are extant in Mill, Deer, and Butte creeks, representative of the Northern Sierra diversity group only. These remaining populations experienced low abundances before moderately increasing in the 1990s. All other independent diversity groups have been extirpated from their ranges, and a few populations dependent on the Mill, Deer, and Butte creek populations persist in the Northwestern California group (NMFS, 2016b). Total escapement had been increasing until 2014, and in 2015 continued to drop dramatically [Figure 10, (NMFS, 2016b)]. In addition to the main creeks, spring-run Chinook have been naturally repopulating Battle Creek following increased flows. That area that had been extirpated for many decades and once supported the Basalt and Porous Lava diversity group. Central Valley spring-run returns in Clear Creek had also been increasing before 2015. All other returns in nearby dependent populations have remain at or near zero in recent years (NMFS, 2016b). The population on the lower Yuba River may meet the abundance criteria for a low extinction rate, but is largely influenced by hatchery fish, so it remains at a high extinction risk (NMFS, 2016b). The Feather River population is in the same situation, having high returns heavily influenced by the Feather River Fish Hatchery stock. Aerial surveys in September suggest that a small population of Central Valley spring-run Chinook may be spawning in the Sacramento River, though their origins are unknown and the occurrence and number of redds counted in the surveys are highly variable. Also of note, there have been recent observations of springtime running Chinook salmon returning to San Joaquin River tributaries but there is insufficient information to determine their origins and whether they should be included in the ESU (i.e. if they are straying into this basin from the Sacramento River Basin or if they are returning to natal streams in the San Joaquin River basin, (NMFS, 2016b)). They exhibit typical spring run life history characteristics (Franks, 2014) and 7 were observed without adipose fins (FISHBIO, 2015).

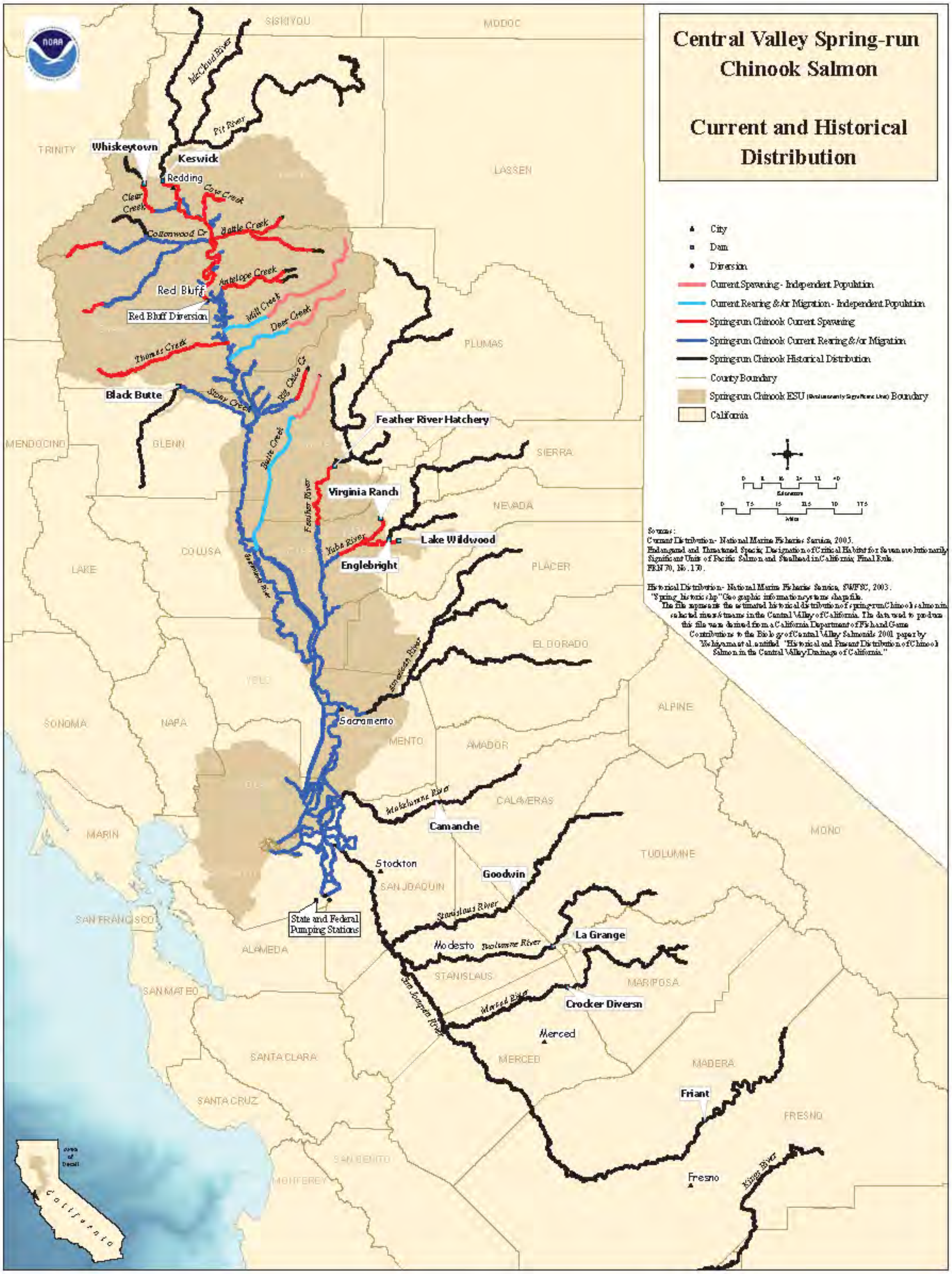


Figure 9. Central Valley spring-run Chinook salmon ESU range, and current and historical distribution (NMFS, 2014).

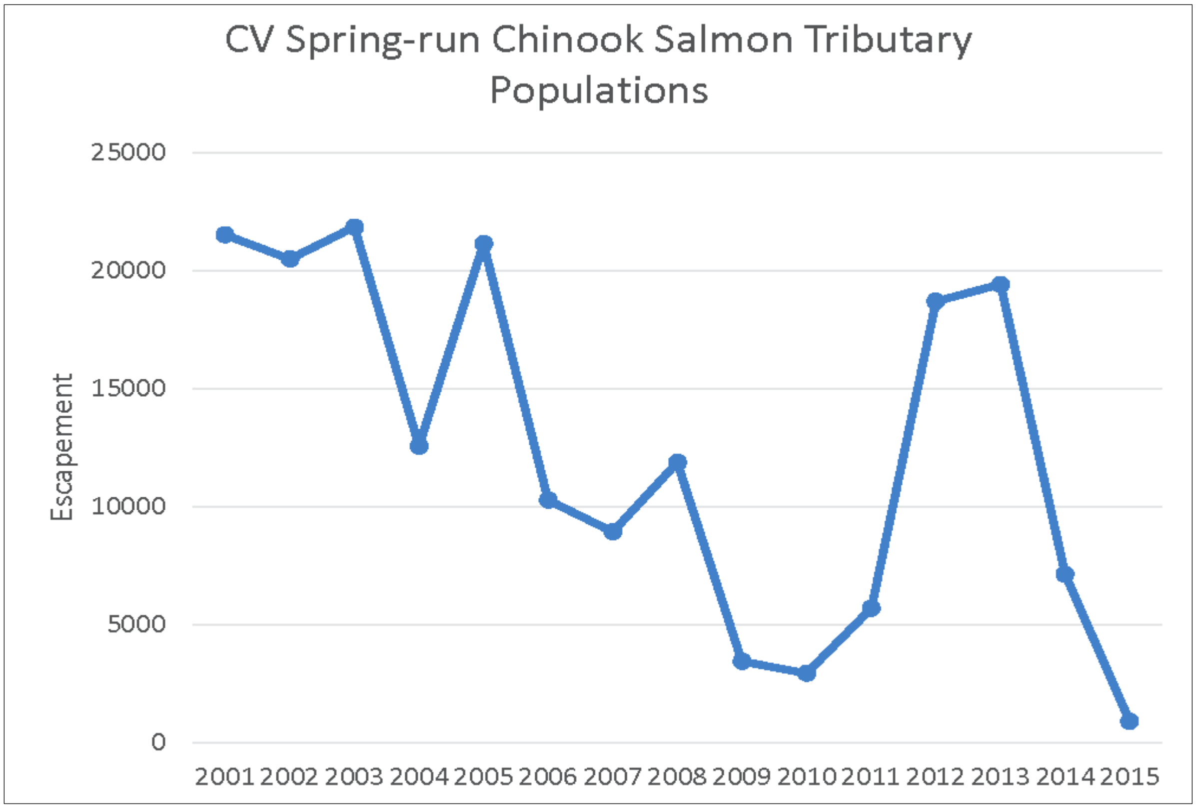


Figure 10. Combined escapement for Central Valley spring-run Chinook salmon in the Sacramento River Basin (tributaries: Butte, Mill, Deer, Battle, and Clear creeks), since 2001 (NMFS, 2016b).

Central Valley spring-run Chinook salmon follow the same general life history patterns as those described above for Sacramento River winter-run Chinook salmon, with some slight deviations. Central Valley spring-run Chinook usually enter the main stem of the Sacramento River as early as March or as late as September to travel to their stream of origin (NMFS, 2014). Adults travel from the ocean through the Bay-Delta to reach the main stem of the Sacramento River and ultimately, their natal tributaries. Typically Chinook salmon morph from a silvery ocean form to dark body colors with external secondary features, particularly males, following the physiological transition necessary to survive in freshwater (Quinn, 2005). At this point, these fish are technically immature and over summer months, in cold-water holding pools, they make another transition into mature, ripe adults (NMFS, 2014, 2016b). Spring-run Chinook usually begin making redds and spawning between mid-August and early October, with a peak in activity in September (Moyle, 2002). Like other Chinook salmon runs, the adults die soon after spawning.

Eggs incubate between 40 and 60 days, and after hatching as alevins, the offspring stay in the redd four to six more weeks before emerging as fry (Moyle, 2002). Fry emergence occurs November through March (Moyle, 2002). While some spring-run fry may migrate to the ocean within eight months of hatching as young-of-the-year, a majority of the spring-run offspring are described as stream-type (Groot & Margolis, 1991). These individuals be freshwater residents for over a year. Therefore, depending on the out-migration tactic used, spring-run Chinook salmon may then spend a brief or an extensive time feeding in the floodplain and saltmarsh aquatic habitats of the Delta before smolting and heading to the ocean through San Francisco Bay (NMFS, 2014).

The main reasons behind this ESU's population decline and initial ESA listing are the same as other Central Valley salmonids: loss of freshwater and estuarine habitats from water storage development, detrimental water management and hatchery practices. To avoid continuing declines and the spring-run ESU becoming endangered, NMFS issued several recovery actions that would likely lead to the recovery of these fish. Some of the high priority actions to are the restoration of access to high elevation habitat beyond high dams in the Yuba and Sacramento Rivers, continued implementation of the Salmon and Steelhead Restoration Project to improve fish passage over natural barriers, continued implementation of the San Joaquin River Restoration Program (SJRRP) including reintroduction of spring-run Chinook in their historic range of the southern Central Valley, modernization of fish passage facilities on the major rivers currently containing naturally spawning populations including increased flows during critical periods, reduction in the abundance of non-native predatory fishes, reduction of the amount of CV spring-run Chinook salmon harvested in fisheries, and restoring Bay-Delta habitat and flow characteristics to those more suitable for salmonid rearing and migration (NMFS, 2016b). Continuing threats that are depressing the ESU's recovery include: 1) exclusion from a majority of their historic spawning and holding habitat; 2) degradation or modification of remaining accessible spawning and rearing habitat; 3) modification of water quality and hydrologic characteristics suitable for salmonid migration, holding, spawning, and rearing (including increased water temperatures, decreased dissolved oxygen, and decreased flow or changed flow patterns) brought about by water management, diversion, or storage for human uses; 4) increased mortality from increased exposure and risk of succumbing to diseases caused by increased water temperatures from releasing insufficient amounts of reservoir water or releasing insufficiently cold reservoir water; 5) increased risk of predation from introduced and native species that prey on out-migrating juveniles due to increased presence of manmade structures, altered waterways, and environmental changes that favor the life histories of predatory non-native species; and 6) introgression of genetics between Feather River spring-run and fall-run Chinook salmon in the Feather River Fish Hatchery stock, and between of naturally spawning spring-run Chinook and FRFH produced spring-run (NMFS, 2014, 2016b).

In addition to the persistent threats described above, less controllable obstacles that may derail population recovery in the foreseeable future include: a severe drought of more than two years in duration or the continuation of the current severe drought, poor ocean conditions, and climate change (NMFS, 2016b). Though this ESU's extinction risk may have decreased somewhat, it is still facing a significant extinction risk that is likely to increase as the full effects of the 2012 – 2015 North American drought are realized (Williams et al., 2016). Central Valley spring-run Chinook are especially vulnerable to the warmer freshwater temperatures climate change may bring with less melting snowpack because they need to over-summer in streams before the autumn spawning (Thompson et al., 2011). Currently, due to rim dams and water diversions, most populations of these fish are extirpated from the elevated reaches of their tributaries and the cold water refugia those reaches offer; climate change is likely to negate any remaining cold-water refugia in most, if not all, areas. The ESU is also in danger of being wiped out in a single catastrophic event due to the limited area in which it currently holds, spawns, and rears (NMFS, 2014, 2016b).

Central Valley spring-run Chinook salmon designated critical habitat

- Critical Habitat designated September 2, 2005 (70 FR 52488)

NMFS designated critical habitat for CV spring-run Chinook salmon in a final ruling in 2005 (70 FR 52488). The PBFs contained in the designated area included 1) freshwater spawning sites accessible at the time of the ruling that also have sufficient water quantity and quality suitable to support spawning, incubation, and larval development; 2) freshwater rearing sites with sufficient water quantity and floodplain connectivity that form and maintain physical habitat conditions that support juvenile growth and mobility, water quality and forage that also supports their development, and contains other natural features like overhanging shade, submerged large woody debris, aquatic vegetation, large rocks, side channels, and undercut banks; 3) freshwater migration corridors free of obstruction and excessive predation risk, with water quantity and quality conditions, as well as natural cover, that supports juvenile and adult mobility and survival; and 4) estuarine areas free from obstruction and excessive predation risk, with water quantity and quality and salinity conditions that support juveniles and adults during their physiological transitions between fresh-and-saltwater, including natural cover and both juvenile and adult forage species (NMFS, 2014).

To encompass these elements necessary to Central Valley spring-run Chinook salmon, the designated critical habitat extends approximately from estuarine areas the northern Delta to below the major rims dams of the Sacramento River and its primary tributaries (Figure 11), especially Mill, Deer, and Butte creeks (NMFS, 2014, 2016b). The runs on these creeks are self-sustaining, have low hybridization rates with strays from the Feather River Fish Hatchery, and contain two genetically distinct subpopulations (NMFS, 2014), so the preservation of these spawning areas was essential to improve overall abundance and genetic diversity in this ESU. Additionally, large dams have eliminated access to almost all other historical habitat (Lindley, 2007) and native spring-run have been entirely extirpated from the all tributaries in the San Joaquin River, which at one time produced over half of the spring-run population in California (NMFS, 2014). Any remaining suitable spawning and rearing habitat protected by designated critical habitat areas are therefore of high conservation value to the ESU.

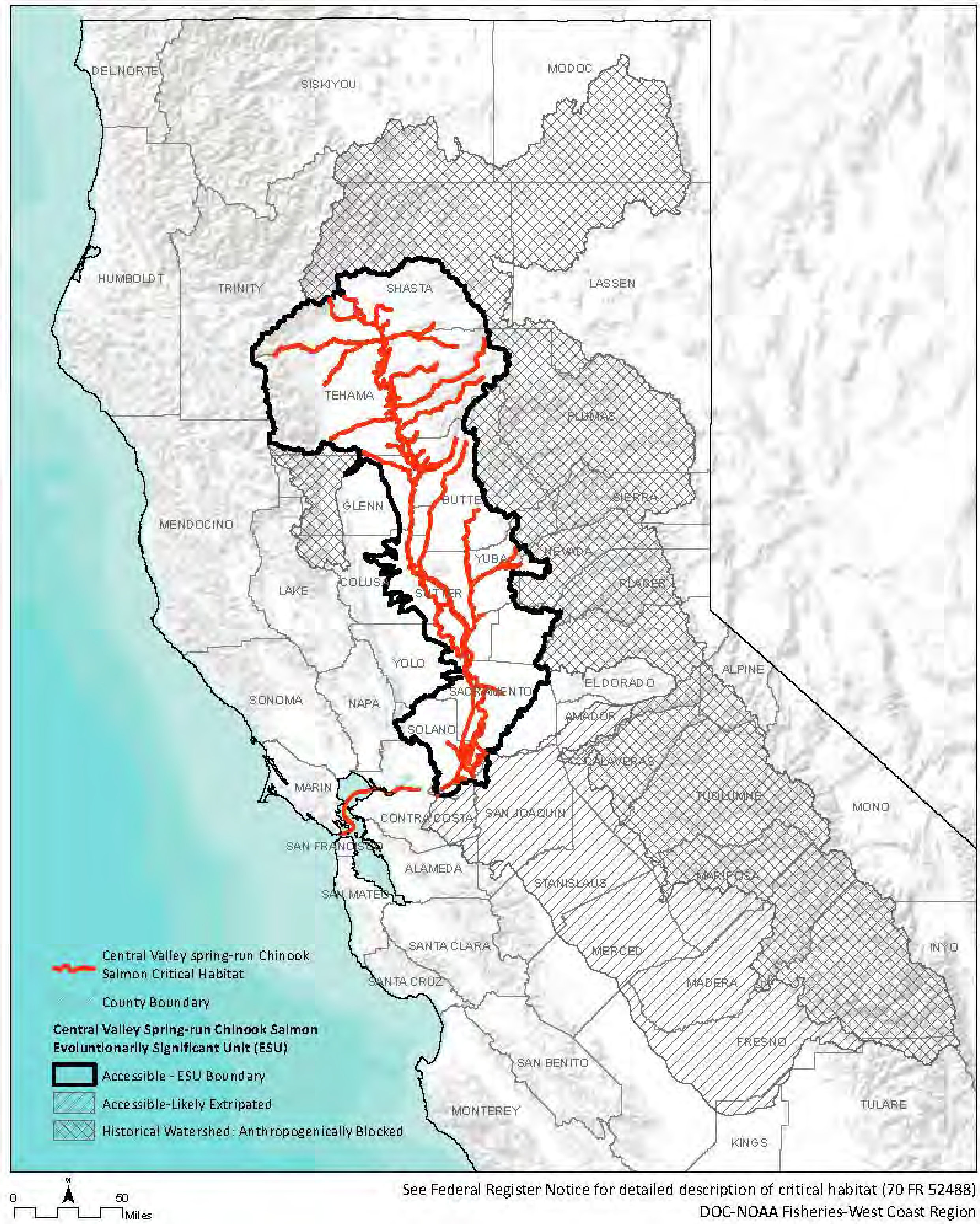


Figure 11. Central Valley spring-run Chinook salmon designated critical habitat map (NMFS, 2016e).

Central Valley spring-run ESU, Chinook salmon, nonessential experimental population

- To be considered as threatened as of December 31, 2013 (78 FR 79622)
- No critical habitat

In 2013, additional 4(d) take exceptions were issued in designating a 10(j) nonessential experimental population of spring-run Chinook salmon (67 FR 1116) as part of the reintroduction component of the San Joaquin River Restoration Program [SJRRP, (NMFS, 2012, 2016b)]. Until this population spawns naturally in the San Joaquin River Basin and has access to volitional movement, this nonessential experimental population is not included in the Central Valley spring-run Chinook salmon ESU (Figure 9), though it should still be treated as a threatened species when individuals are outside of the defined 10(j) nonessential experimental population boundary in the San Joaquin River (78 FR 79622). In 2014 the SJRRP began reintroduction of these fish and managed to imprint Central Valley spring-run juveniles to the mainstem of the upper San Joaquin River, however they did not observe any returns in following years. Repopulation of the Southern Sierra Nevada diversity group is an important recovery priority that will increase overall ESU abundance, genetic diversity, and spatial distribution. If ongoing efforts are successful, reintroduced spring-run may naturally stray into San Joaquin River tributaries and begin the repopulation of the basin (NMFS, 2014, 2016b).

### 2.2.4 California Central Valley steelhead, distinct population segment

- First listed as threatened (March 19, 1998, 63 FR 13347), reaffirmed threatened (January 5, 2006, 71 FR 834)

The California Central Valley steelhead DPS is a unique statutory division necessary to distinguish between the two forms of a single species, *O. mykiss*. A DPS is considered an appropriate taxonomic unit for a population when it is substantially reproductively isolated from other con-specific populations and represents an important component of the evolutionary legacy of the species (NMFS, 2016a). Steelhead and rainbow trout may be the same species but the term steelhead refers to the anadromous form of the species and rainbow trout refers to resident forms. NMFS applied the DPS policy to this species because the resident and anadromous life forms are "markedly separated" as a consequence of physical, ecological and behavioral factors, and therefore warrant delineation as a separate DPS from rainbow trout (NMFS, 2014).

The California Central Valley (CCV) steelhead DPS was originally ESA-listed as threatened in 1998 (NMFS, 2016a). This listing was re-evaluated in 2006, and while the status remained the same, the determination concluded that the Coleman National Fish Hatchery and Feather River Hatchery CCV steelhead artificial propagation programs should be included as part of this DPS as they were derived from native wild stock from appropriate local basins and have seen no more genetically change or drift than the degree observed in the local naturally spawning populations (NMFS, 2016a). In addition, the 2016 CCV steelhead status review recommends that fish from the Mokelumne River Hatchery artificial propagation program also be included to the CCV steelhead DPS because of the past practice of importing eggs from the Feather River Hatchery, which is part of the DPS and native CCV stock (NMFS, 2016a). The recovery priority number issued for this species was changed from a seven to a five in 2015, to reflect the increased recovery potential of this DPS (NMFS, 2016a).

There are at least 81 historic independent steelhead populations in the CCV steelhead DPS (Lindley, 2006), and include any steelhead that occur throughout the Sacramento and San Joaquin River systems of the Central Valley [Figure 12, (NMFS, 2014)]. The CCV steelhead DPS does not include populations in the Suisun Bay tributaries, the Central Western diversity group, or populations of the southern Sierra Nevada diversity group that are south of the upper San Joaquin River (NMFS, 2014). Management, assessment, and recovery of the CCV steelhead DPS suffers from an overall lack of robust information about the wild populations. Mean population size averaged from the estimated from the run sizes of the most recent three years exist for the American River (n=157), Clear Creek (n=254), Coleman National Fish Hatchery (n=2820), Feather River Hatchery (n=1373), Mokelumne Hatchery (n=133), and Nimbus Hatchery populations (n=1351). Overall, it appears that the abundance of the DPS has remained about the same since 2011 (NMFS, 2016a). Several Central Valley hatcheries have seen increased returns in recent years, however a large percentage of the returns are hatchery fish (Figure 13), and the percentage of wild returns to the hatchery are slightly decreasing (NMFS, 2016a). There has been a small increase in the percent of wild steelhead seen in surveys in the Delta but wild fish still contributes less than 5 percent of the total catch (NMFS, 2016a), indicating the natural production of steelhead in the Central Valley remains at a very low level.

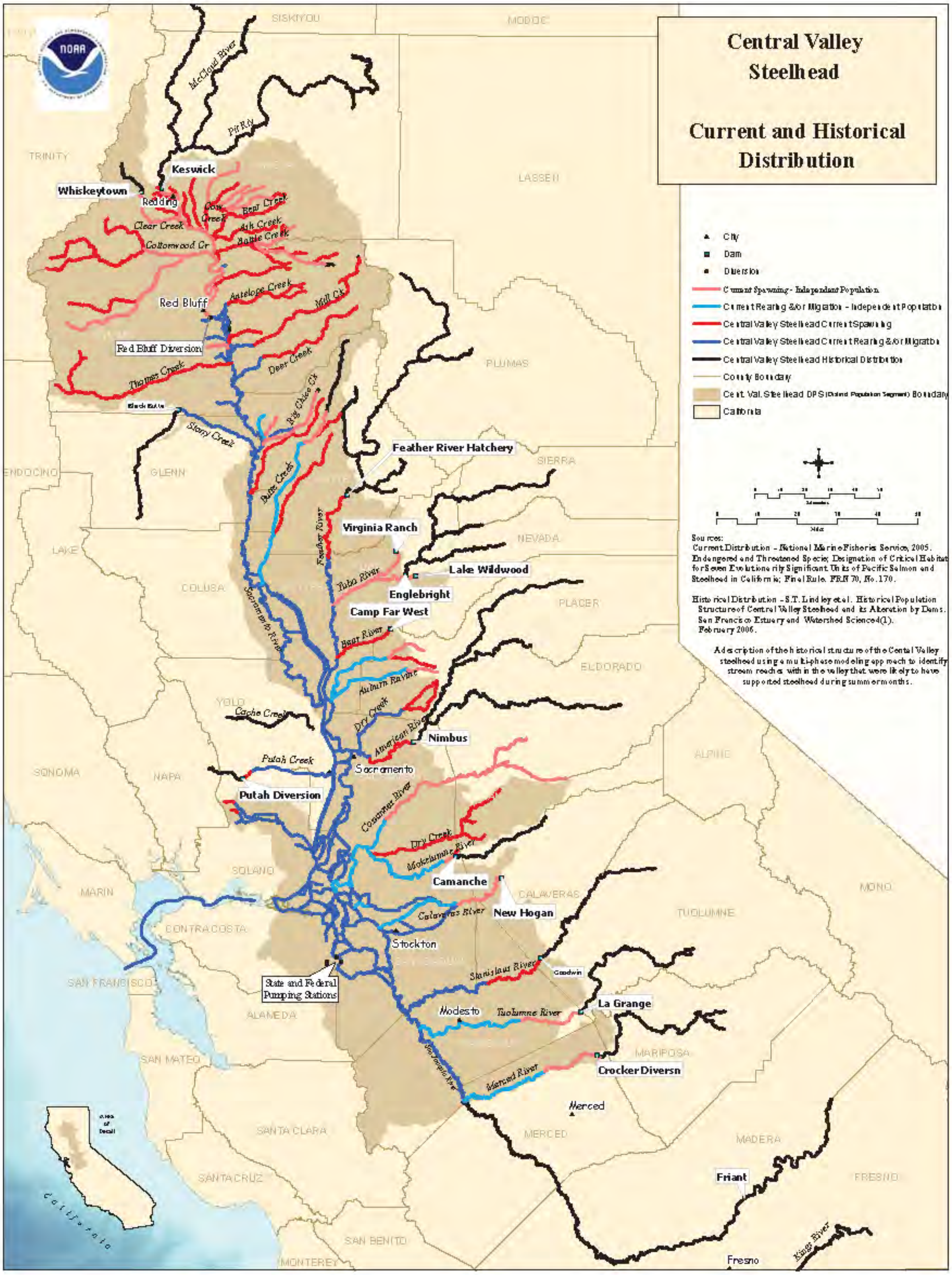


Figure 12. California Central Valley steelhead Distinct Population Segment range, with the historical and current distribution (NMFS, 2014).

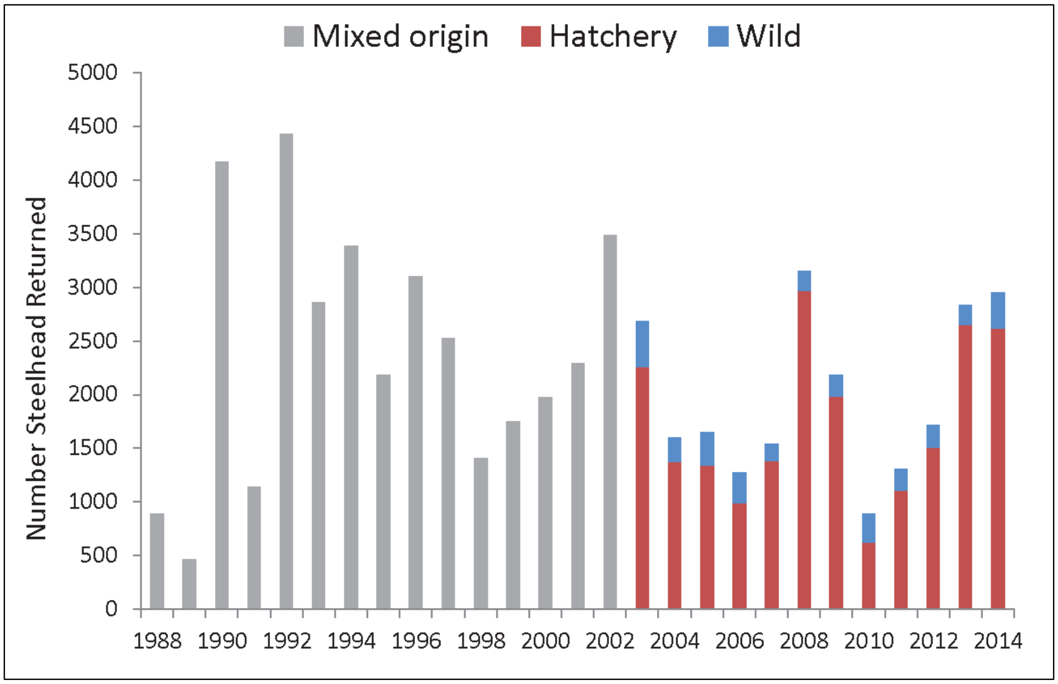

Figure 13. Steelhead returns at Coleman National Fish Hatchery 1988 – 2014. Starting in 2001, fish were distinguished as wild (unclipped adipose fin) or hatchery produced (clipped adipose fin), (NMFS, 2016a).

*O. mykiss* have a complex and diverse life history compared to other Pacific salmonids, though they may share many basic needs. Central Valley steelhead are considered “ocean-maturing”, meaning they enter freshwater with well-developed gonads and spawn shortly after (NMFS, 2014). Steelhead return to streams to spawn after two or three years in the ocean as four or five year old adults (NMFS, 2014). In the Central Valley, steelhead typically enter freshwater August through April and hold until flows are sufficient to enter tributaries (Moyle, 2002). Spawning occurs December through April with peak activity January through March. All life-stages of CCV steelhead require cool, well-oxygenated water year round (NMFS, 2014). Unlike other Pacific salmon, steelhead are able to spawn more than once, however it is rare for steelhead to spawn more than twice before dying. Most individuals that display this limited iteroparity are females (Moyle, 2002).

The incubation through fry emergency life stages occur in a pattern similar to other Pacific salmonids. In the Sacramento River, juveniles generally start migrating to the ocean in the spring and summer between one to three years after hatching and at a size 10 to 25 centimeters fork length (Reynolds, Mills, Benthin, & Low, 1993). The timing of their downstream migration can be variable throughout the year, but the peak period occurs in the spring with a secondary peak in the fall (NMFS, 2014). Once in the ocean, they feed and grow rapidly.

The degree of anadromy in a population can vary from zero to 100%, and varies by age and sex of the individuals. Smolt survival rates and size is important to each individual’s “decision” to be an anadromous or resident adult (Satterthwaite et al., 2010). Both forms of the species are protected because rainbow trout can produce anadromous smolts and vice versa in the Central Valley (Zimmerman, Edwards, & Perry, 2008). Steelhead tend to reach a larger size than resident rainbow trout, and will migrate to marine waters after spending one to two years rearing in freshwater.

The key reasons behind the CCV steelhead population decline and ESA listing were widespread habitat degradation and destruction, blockage from a large portion of upstream freshwater habitat, and negative water management decision impacts on otherwise suitable habitat (NMFS, 2014). About 80% of the habitat that was historically available is behind impassable dams, and steelhead may have been extirpated from their entire historical range in the San Joaquin Valley, though resident rainbow trout may still persist. Spawning habitats that are accessible have been drastically altered and degraded from their natural states (NMFS, 2014). Adverse changes include water development, inadequate instream flows, rapid flow fluctuations, high summer water temperatures below reservoirs, diversion dams that block access, unscreened or poorly screen water diversions, poor land use practices by the agricultural and forestry sectors, and urbanization (McEwan, 2001). Past hatchery management practices also have negatively influenced the genetic integrity of the CCV steelhead DPS (NMFS, 2014). Genetic diversity was diminished by the increased proportion of hatchery fish relative to naturally produced fish, the practice of using out-of-basin individuals as stock for hatchery production, and straying of hatchery fish leading to interbreeding with naturally producing fish (NMFS, 2014).

#### California Central Valley steelhead designated critical habitat

- Critical habitat designated September 2, 2005 (70 FR 52488)

A final rule published in 2005 established designated critical habitat for the CCV steelhead DPS, which includes all accessible river reaches in the Sacramento and San Joaquin Rivers and their tributaries, river reaches and estuarine areas of the Sacramento-San Joaquin River Delta, from Chipps Island to the Carquinez Bridge, all waters of San Pablo Bay westward to the bridge, and all waters of the San Francisco Bay north of the Bay Bridge to the Golden Gate Bridge [Figure 14, (NMFS, 2014)]. The PBFs these areas required by CCV steelhead are: 1) freshwater spawning sites with sufficient water quality and quantity and substrates that support spawning, egg incubation, and larval development; 2) freshwater rearing sites with sufficient water quantity and floodplain connectivity to form and maintain habitat conditions that support juvenile growth and mobility, sufficient water quality and forage to support juvenile development, and that provide sufficient natural cover as shade, submerged and overhanging large wood debris, log jams, beaver dam, or aquatic vegetation, large rocks and boulders, side channels, and undercut banks; 3) freshwater migration corridors free from obstruction and excessive predation with sufficient water quantity and quality, and natural cover as described above, that supports juvenile and adult mobility and survival; and 4) estuarine areas free from obstruction and excessive predation with sufficient water quality, quantity, and salinity conditions to support juvenile and adult physiological transitions, natural cover as described above, with juvenile and adult forage including aquatic invertebrates and fish for growth and maturation (NMFS, 2014). Remaining accessible habitat containing features that benefit CCV steelhead, such as that contained in its designated critical habitat are important to the recovery of this DPS because the main threat to its existence is habitat loss and habitat degradation (NMFS, 2014).

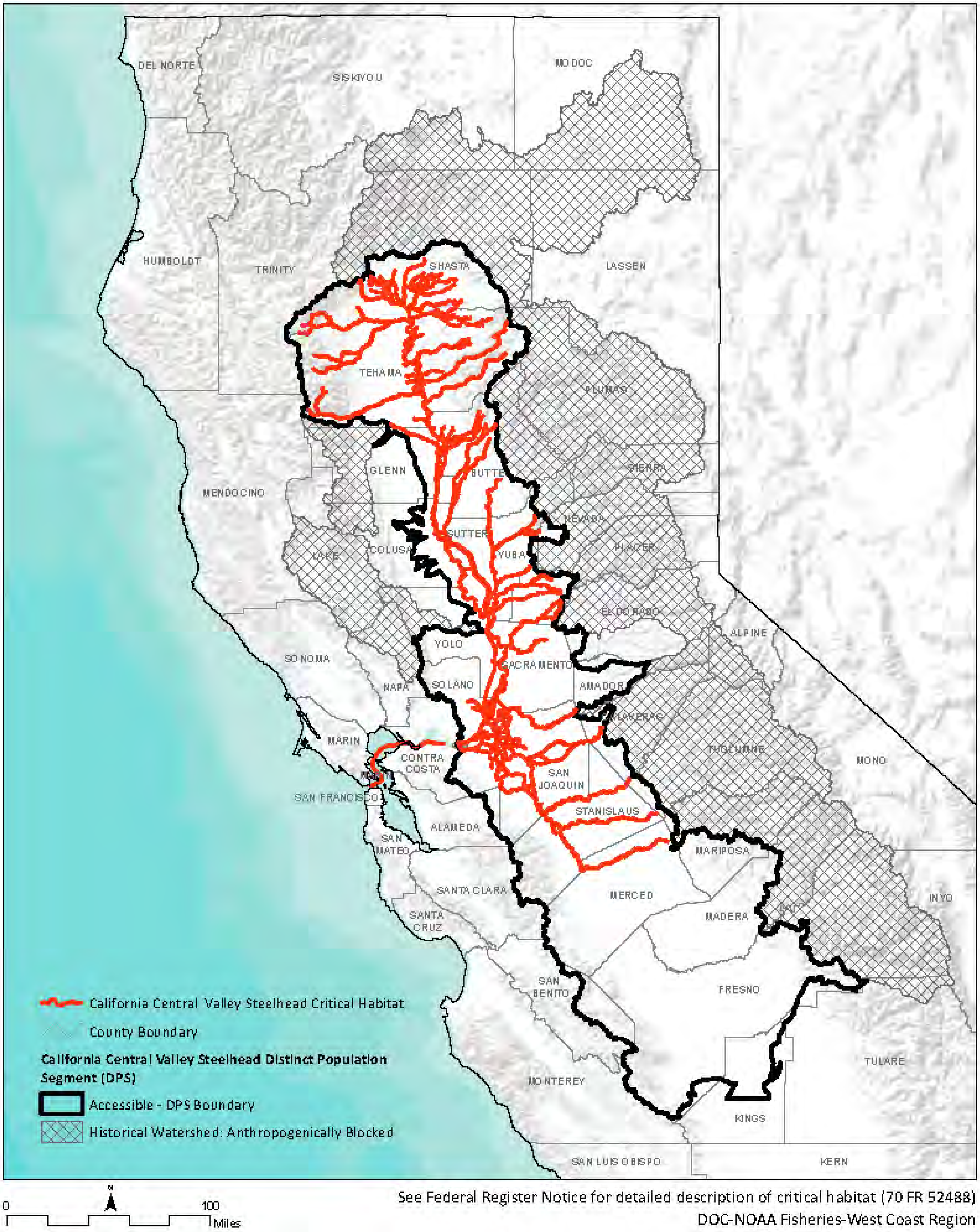


Figure 14. California Central Valley steelhead distinct population segment designated critical habitat map (NMFS, 2016d).

## 2.3 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). This opinion considers the action area as the Panoche and San Luis Water Districts and all the acreage they encompass (Figure 2, approximately 38,000 acres in the Panoche Water District and 65,000 in the San Luis Water District), including the CVP and SWP infrastructure used to deliver the water to the districts (the San Luis and Delta-Mendota Canals). Also, after the water is applied to the agricultural lands within the PWD and the SLWD, and results in drainage water containing a composition of compounds introduced from its use, it is directed to the Grassland Bypass Project and associated channels, the San Joaquin River Water Quality Improvement Project, or other programs and tools included in the term ‘Grasslands Bypass Project’ to reuse, retain, or treat the drainage water, all areas of which are also included in the action area. Ultimately, drainage water is directed into the San Luis Drain and then Mud Slough North to be discharged into the San Joaquin River. The drainage water discharged from the San Luis Drain has been shown to contain and introduce toxic levels of selenium to downstream areas even after treatment and reuse (Reclamation, 2016a), due to the extreme toxicity of selenium even at low levels (Hamilton 2004). Therefore, to encompass all areas that may be directly or indirectly impacted by this action, the San Luis Drain and all natural waterways down to, and including, the Delta are also considered part of the action area. By name, these natural waterways include Mud Slough North starting from the discharge point, the main stem of the San Joaquin River receiving water from this action, down to the southern Delta, including Old River and Middle River, and the southern Delta, ending where the Delta joins with the San Francisco Bay (Figure 2).

## 2.4 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).

<u>Historical baseline</u>

The California Central Valley ecosystem once contained numerous streams and rivers that supported notable salmon runs (NMFS, 2014). Such streams drained the Sierra Nevada, Cascade and Coast Range mountains and, in many cases, their large watersheds and regular yearly snowpack provided year-round stream flows in large rivers (NMFS, 2014). The valley floor also had large expanses of floodplain and estuarine habitat suitable for juvenile rearing (Figure 15) and no doubt contributed to the robust recruitment of young to the population. The southern part of the Central Valley and the San Joaquin River supported approximately half of the estimated Chinook salmon abundance, consisting largely of spring-run, at least 250,000 adults strong (NMFS, 2014). These natural conditions produced substantial runs of Chinook salmon, and Native Americans depended on these fish for a variety of purposes (Yoshiyama, Fisher, & Moyle, 1998). Native American harvest of California Chinook salmon is estimated to have reached 8.5 million pounds or more, annually (Yoshiyama et al., 1998).


Figure 15. Historical map (1873) of the water attributes of the California Central Valley prior the most large-scale human alterations (US Army Corps of Engineers, 1873). Grey hatched areas indicate 'overflow' regions (i.e. floodplains).

With the advent of the California gold rush in the mid-1800s, Euro-Americans began to settle California and a commercial fishery for Chinook salmon developed in San Francisco Bay and the Sacramento-San Joaquin Delta (NMFS, 2014). These fisheries extracted an estimated 4 to 10 million pounds of Chinook annually. Eventually, in the early 1900s, interest shifted from the Delta region to commercial marine salmon fishing off the coast of California. This form of fishing eventually dominated the commercial market (NMFS, 2014). However, since settlement of the Central Valley, native salmon populations have declined dramatically, (NMFS, 2014) including within the action area. Starting in the late-1800s, salmonid population decline was displayed in the trends of the commercial catches through the early-1900s, from 11 million pounds in 1880 to less than 3 million pounds by 1939 (Lufkin, 1996).

Despite early commercial fishery development, the salmonid population decline has been attributed primarily to habitat degradation throughout California and to the fact that access to a majority of the historical spawning reaches has been blocked (NMFS, 2014). Beginning in the 1850s, the first major source of habitat degradation and destruction was hydraulic gold mining. Thousands of miles of spawning and rearing habitat were converted into flumes, or water in those areas was diverted into canals for the hydraulic cannons (NMFS, 2014). Hydraulic cannons regularly leveled hillsides and such practices deposited approximately 1.5 billion cubic yards of debris into Central Valley waterways in the miner's search for gold (Lufkin, 1996). Hydraulic mining became prohibited in 1894, but other practices that degraded salmonid habitat continued. The construction of levees and other infrastructure for urban and agricultural purposes formed barriers to migration, and resulted in the modification of natural hydrologic flows by dams and water diversions, elevated water temperatures, and increased water pollution. Such factors contributed to the sustained declines in the salmonid populations throughout the Central Valley system (Lufkin, 1996). However, the rate at which the populations were declining accelerated following the completion and operation of major water project facilities (NMFS, 2014).

The Central Valley Project and State Water Project

An extensive network of reservoirs and aqueducts was developed throughout California to provide water to major urban and agricultural areas (Figure 1). The two largest water projects were the federal Central Valley Project (CVP) which began in 1933, and the State Water Project (SWP) which began in 1960. These projects reroute many million acre feet of water each year for human use (NMFS, 2014). The major rim dam on the San Joaquin River, Friant Dam, began construction in 1937 and was completed by 1942. Overall, approximately half of all freshwater streams historically used by Chinook salmon have been lost in the process of constructing and operating the CVP and SWP. Lower reaches of the San Joaquin and Sacramento rivers were likely used as rearing habitat, but human alterations and water use has made these areas less suitable to juvenile survival. When spawning and adult holding habitats are solely considered, at least 72% of the total area historically used for these purposes has been made inaccessible by high terminal dams (Yoshiyama, et al. 2001). Considering that steelhead have superior maneuverability and can survive in much smaller streams compared to Chinook salmon, it is likely they were more widely distributed and likely lost a substantially higher percentage of spawning and holding habitat than Chinook salmon suffered. Anadromous fish also experienced a loss in functionality of much of the habitat in the Delta, which was historically comprised of about 700 miles of river channels and sloughs (NMFS, 2014).

Drainage issues

Starting in 1950, water deliveries from the CVP to the Delta Mendota Service Area began. Soon after, in 1960, the San Luis Unit was formed and agriculture in the area increased with the accessibility of irrigation water. However, subsurface saturation of salty water, or drainage issues, intrinsic to these areas due to a high water table had been local knowledge since at least the 1870s (Kelley & Nye, 1984) and almost immediately there was a call for a federal solution to the drainage problem. The San Luis Act of 1960 authorized the San Luis Unit to construct facilities necessary to drain and remove salt-laden water from irrigated agricultural lands and start working towards the minimum salt and water balance that would result in sustained crop growth and yields (Reclamation, 2016b). Plans were made throughout the 1960s to construct a master drain that would remove the drainage waste water from the San Joaquin Valley and transport it out of the area, eventually into the Pacific Ocean via the Bay-Delta. Central Valley Project water deliveries to the San Luis Unit began in 1968, as did construction of the San Luis Drain for use by the water districts, which was to stretch from Kettleman City to the Delta (Kelley & Nye, 1984).

The San Luis Unit consists of the Westlands Water District, and also the Pacheco, Panoche, and San Luis Water Districts (the Northerly Districts), and eventually all of the water districts were discharging drained water into the San Luis Drain. In 1970, the Kesterson Reservoir was designated as the regulating reservoir receiving San Luis Drain water and was deemed a federal Fish and Wildlife Service (FWS) National Wildlife Refuge. By 1975, the San Luis Drain was 85 miles long and collected drainage water from 120 associated miles of irrigation drains, and Kesterson Reservoir was 1,200 acres in size. Also in 1975, the construction of the San Luis Drain was halted due to Federal budget restrictions and increasing environmental concerns regarding the discharged wastewater, which otherwise would have completed the stretch necessary to discharge directly into the Delta.

At the time, Reclamation recommended competing the San Luis Drain all the way to the Delta and authorized studies on issues related to its completion of the San Luis Drain. Reclamation also inquired into the legal requirements to discharge waste from the US Environmental Protection Agency. In 1981, Reclamation began the process of obtaining permits to discharge the drainage water into the Bay-Delta at Chipps Island while in the meantime San Luis Drain water flowed into Kesterson Reservoir and National Wildlife Refuge.

Kesterson Reservoir ecological disaster

In 1983, the FWS informed Reclamation that they had begun to find embryonic deformities and observed mortalities in birds at the Kesterson National Wildlife Refuge. The FWS and the US Department of Geological Survey linked the environmental and biological damage to elevated levels of selenium observed in the waters, sediments, and animals found in the refuge. The Department of the Interior and the governor of California then established the Federal-State San Joaquin Valley Drainage Program to determine the magnitude and source of the selenium problem, to study the effects of selenium on wildlife, and to identify actions necessary to resolve the issue. The Department of the Interior issued cessation orders in 1985 that halted discharges from agricultural drainages into the Kesterson Reservoir. The State Water Resources Control

Board also issued orders to regulate the discharge of agricultural drainage into the San Joaquin River, and Reclamation closed the San Luis Drain soon after. A 1986 Federal Court Order, called the Barcellos Judgement, settled a lawsuit among Westlands, Reclamation, and various other landowners and water users, and directed Reclamation to develop, adopt, and submit to Westlands a plan for drainage service by the end of 1991 (Reclamation, 2007). Through the late 1980s, there were many calls for drainage plans, service facilities, and clean-up measures that did not come to large-scale fruition. Many proposed drainage plans looked to build infrastructure that would move the drainage out of the Central Valley and discharge it into the Pacific Ocean using various pathways, but opposition to such plans from communities that would be affected by them ultimately lead to the accepted reality that the solution to the drainage-selenium problem must be kept to in-valley options. Soon after this realization, the state of California ordered Reclamation to fill and grade parts of the Kesterson Reservoir as part of the necessary clean-up. Litigations over the lack of drainage service and associated issues began.

Reclamation submitted a Draft Environmental Impact Statement (EIS) for the San Luis Unit Drainage Program, which acknowledged that there remained unacceptable social and environmental realities associated with completing the San Luis Drain as originally envisioned, which precluded any plan being approved or implemented before the date stipulated in the Barcellos Judgement. In 1992, federal laws called for water allocations to protect fish and wildlife uses, and that seleniferous land in the San Joaquin Valley should be retired from agriculture and irrigation. However, other interest groups pushed against these laws and recommendations. These interest groups petitioned the US House of Representatives to allow the reuse of a portion of the San Luis Drain by Grassland Area farmers, however at the same time conservation-minded petitions were also submitted regarding unacceptable bird loss from the operation of privately owned evaporation ponds that were used to collect and store drainage from irrigated seleniferous lands. The US District Court then decided to send drainage water north and required dischargers that wished to discharge into the Delta via the San Luis Drain to obtain the appropriate permits (Wanger Decision 1994); however this decision was appealed soon after environmental groups intervened.

After the Wanger decision was appealed in 1995, the U.S. District Court of the Eastern District of California then returned a partial judgement that the federal government's statutory obligation to provide drainage to the San Luis Unit had not been excused or rendered impossible, regardless of the conclusions of the EIS they had drafted. In an effort to continue irrigating their lands but lessen impacts downstream of discharge points, growers in the Grassland area contracted with Reclamation to use part of the San Luis Drain to route the selenium-laden drainage around wildlife refuges and wetlands areas, an effort called the Grassland Bypass Project (GBP). While the Department of Water Resources began updating the Drainage Management Plan in 1997, since Reclamation had not yet started planning for alternative drainage service options since the 1995 decisions, but the Drainage Management Plan was ultimately declared unsuccessful by 1999. As such, in 2000, the 9$^{th}$ Circuit Court of Appeals upheld the District Court finding that Reclamation has a statutory duty to provide drainage service to lands in the San Luis Unit, but to accomplish drainage service Reclamation was not required to build a drain to discharge into the Bay-Delta. Therefore, Reclamation initiated a process to provide drainage service to the San Luis Unit, including producing another EIS called the San Luis Drainage Feature Re-evaluation (Reclamation, 2007) and an EIS on the renewal of long-term San Luis Unit water contracts, finalized in 2006 and 2007. The long-term water contracts for the CVP deliveries would expire at the end of 2008 (Reclamation, 2016a), and to continue water deliveries to the Panoche and San Luis water districts Reclamation entered into interim service contracts as directed by the Central Valley Project Improvement Act.

Like the water contracts and deliveries currently under review, these interim contracts would contain no changes to the contract amounts, the service areas, sources of the water, diversion amounts, amount of water used for specific purposes, or water allocated for fish and wildlife. As such, since 2009 and every two years after, interim water contracts to these areas have been submitted and approved of by regulating agencies. The existing Coordinated Long-term Operation of the CVP and SWP, and their effects on ESA-listed species and their critical habitats have been analyzed in the 2009 NMFS CVP Operations opinion (NMFS, 2009a). In 2007, Reclamation signed a Record of Decision selecting a drainage plan for the San Luis Unit (Reclamation, 2007). Since 2010, Reclamation has been implementing the plan on a portion of the Westlands and within the Panoche Drainage District on a court-ordered schedule. In 2011 and 2012, individual property owners of Westlands, and the Westlands Water District itself, filed complaints and lawsuits against the United States alleging the government's failure to provide drainage service.

<u>Grassland Bypass Project performance</u>

According to the 3rd Use Agreement, the Grasslands Bypass Project and its allowable selenium and salt discharges are on a strict schedule according to the water year type [Appendix B, from the 3rd Use Agreement (Reclamation, 2009)]. For example, by year 10 of the agreement (the last year of interim water contract renewals and the point at which selenium discharge should be 'zero'), allowable selenium discharges may range between 150 pounds if 2019 is a critically dry water year, to 600 pounds if it is a wet water year (Figure 16). Progress towards these standards is measured by in-water selenium concentrations throughout the system in ppb and estimated total pounds of selenium discharged per year from the San Luis Drain into Mud Slough North and the San Joaquin River.

For reference, 1 ppb of a compound in water is equal to 1 microgram per liter (µg/L), and 1 pound of dissolved selenium in 1 acre-foot of water should result in an approximate reading of 368 µg/L, which would be extremely toxic in terms of chronic aquatic exposure (EPA, 2016; Hamilton, 2004). The Grasslands Bypass Project has been producing less than 5 ppb on a 4-day average (5 ppb selenium in water would be representative of less than 6.2 grams of selenium dissolved in 1 acre-foot of water) therefore, meeting their discharge and water quality objectives regarding selenium concentrations in the San Joaquin River below the confluence with the Merced River. Above the Merced River confluence, the monthly mean 15 ppb selenium performance objective and the 5 ppb 4-day selenium water quality average objective both have been met, ahead of the mandate of December 31, 2019 (Reclamation, 2016a). Agricultural drainage water not discharged out the GBP through the San Luis Drain is reused on the closed collection system of the 6,000-acre San Joaquin River Water Quality Improvement Project (Reclamation, 2016a). Reclamation continues to monitor, assess, and report selenium loads and concentrations within the waters, sediments, fish, invertebrates, and plants that may be affected by this project and the GBP.

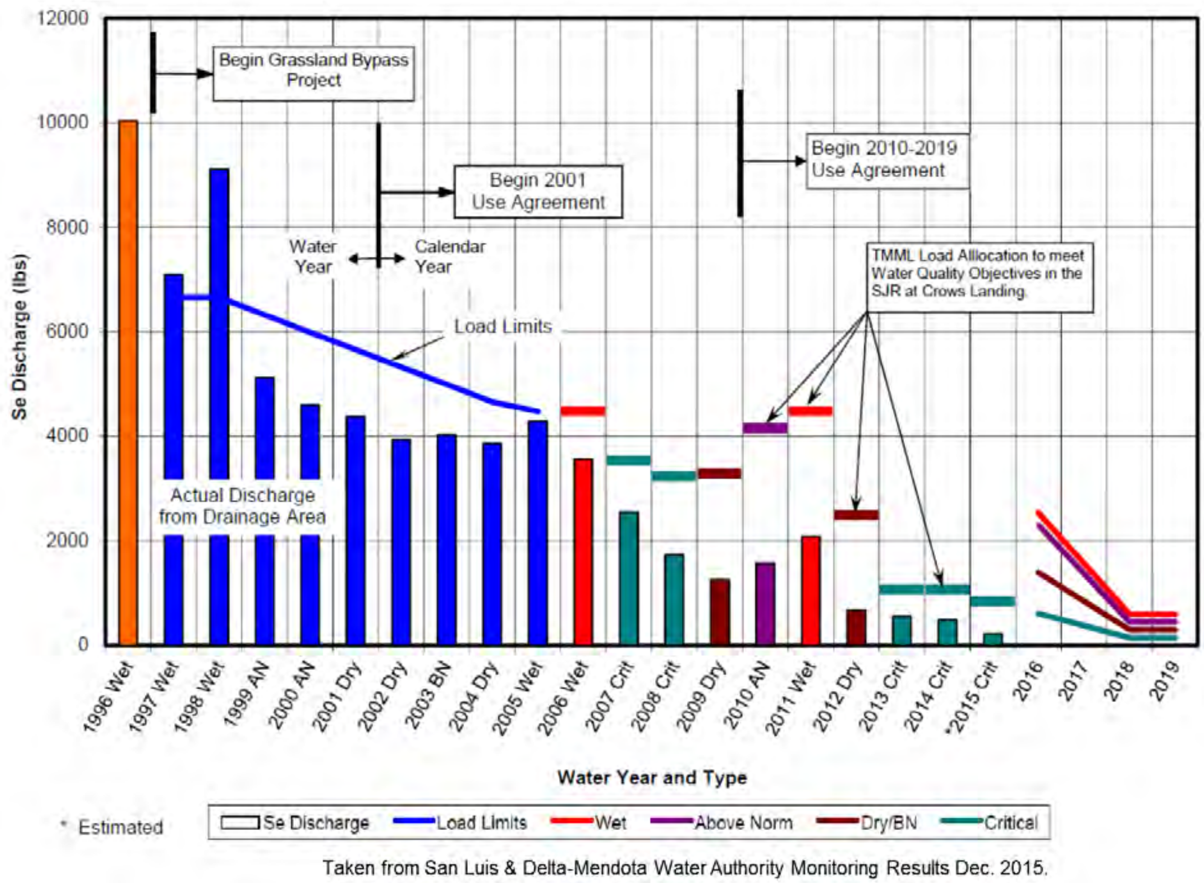


Figure 16. Grassland Drainage Area targets and actual selenium (Se) discharge in pounds (lbs), by water year type (Reclamation, 2016a).

Selenium levels monitored in the San Joaquin River below the discharge point normally remain below 2 ppb (Figure 17), and in 2015 a period of zero discharge was briefly achieved. However these periods corresponded to dry seasons in critically dry water year types. Instances where selenium concentrations reached or exceeded 2 ppb have occurred, and correspond to storm events and stormwater flows (Figure 17), situations which are exempt from targets. Total selenium load discharged by the Grassland Drainage Area has been within allowable levels stipulated in the 3rd Use Agreement for the appropriate water year type (Table 1, Figure 16), and reductions in selenium loads of up to 97% have been achieved. This reduction has been accomplished by farmers reducing the volume of drainage water reaching Mud Slough North through on-farm water conservation, efficient irrigation practices, and displacing drainage water by reuse through irrigating salt tolerant crops, including reuse on the San Joaquin River Water Quality Improvement Project acreage (Table 2). However, while objectives have largely been achieved, 83,176 pounds of selenium attributable to agricultural activities have been discharged in total since 1995, (the beginning of the Grasslands Bypass Project). The concentration of the total discharged selenium compared to the discharged wastewater in 2015 is estimated to be 21.42 ppb, based on the provided numbers [(354 pounds, or $1.61 \times 10^{11}$ µg ,of selenium divided by 6,079 acre-feet, or $7.50 \times 10^{09}$ L, of discharge water (Reclamation, 2016a)], which would be higher than the monthly average allowable for the San Joaquin River.

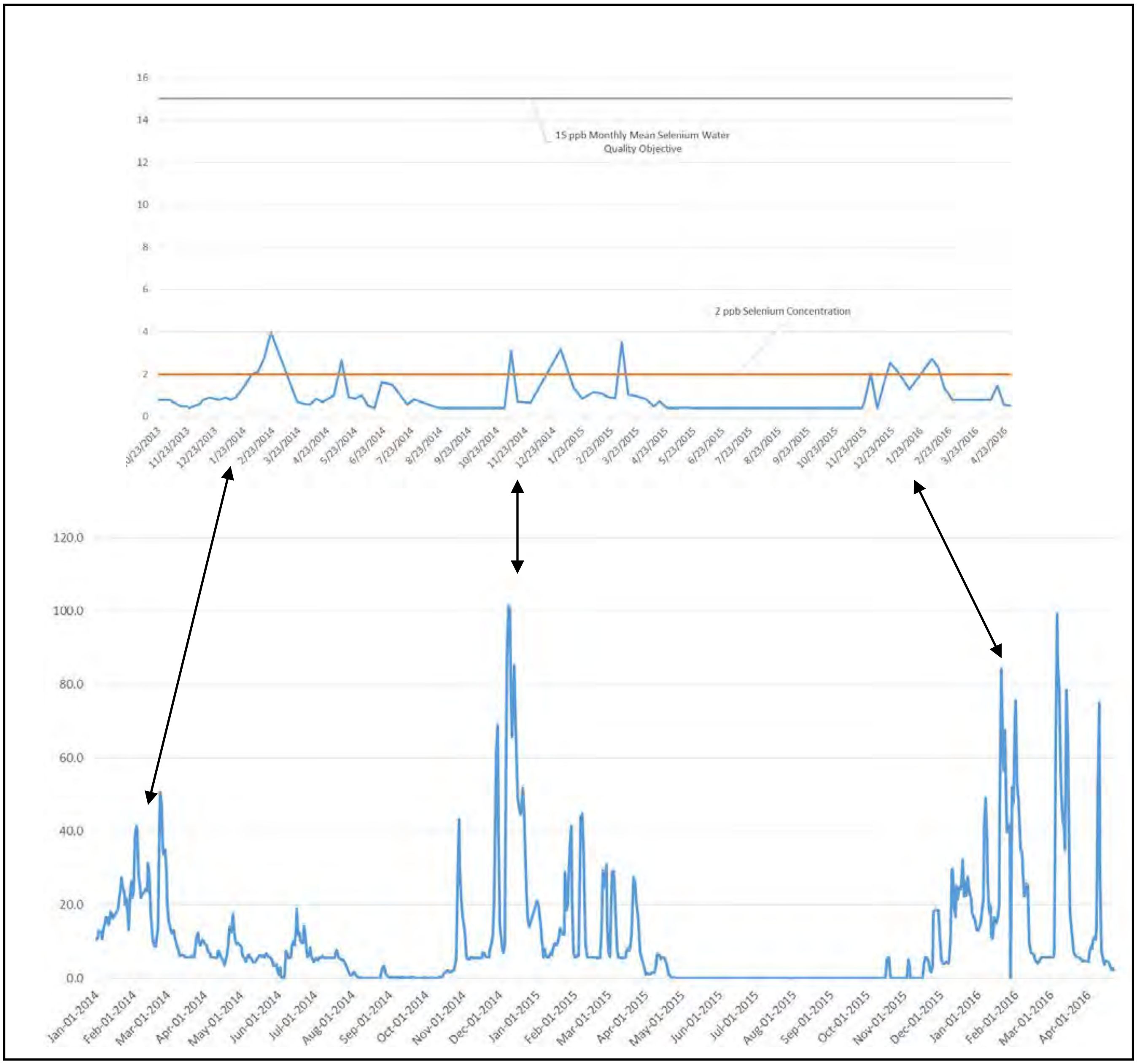


Figure 17. Weekly selenium (ppb) in the San Joaquin River below the discharge point (upper graph) and daily flow in the San Joaquin River just below the discharge point (low graph). Black arrows correlate peaks in in-water selenium concentrations to high flow storm events 2014 – 2016 (Reclamation, 2016a).

Table 1. Discharge of selenium and salts from the Grassland Drainage Area by water year, from 1996 through 2014 (Reclamation, 2016a).

| Water Year | Discharge (Acre Feet) | Selenium Load (Lbs) | Boron Load (Lbs) | Salt Load (Tons) |
|---|---|---|---|---|
| 1995 | 57,600 | 11,875 | 868,000 | 237,530 |
| 1996 | 53,000 | 10,036 | 830,700 | 197,500 |
| 1997 | 39,900 | 7,096 | 682,300 | 172,600 |
| 1998 | 49,300 | 9,118 | 967,200 | 213,500 |
| 1999 | 32,300 | 5,124 | 630,200 | 149,100 |
| 2000 | 31,300 | 4,603 | 606,700 | 135,000 |
| 2001 | 28,300 | 4,377 | 423,300 | 120,000 |
| 2002 | 28,400 | 3,939 | 550,500 | 116,100 |
| 2003 | 27,300 | 4,029 | 575,000 | 118,152 |
| 2004 | 27,700 | 3,871 | 536,000 | 120,200 |
| 2005 | 30,000 | 4,288 | 585,000 | 138,900 |
| 2006 | 26,000 | 3,563 | 538,000 | 119,646 |
| 2007 | 18,500 | 2,554 | 278,000 | 79,094 |
| 2008 | 15,700 | 1,737 | 280,000 | 66,459 |
| 2009 | 13,200 | 1,262 | 236,000 | 55,556 |
| 2010 | 14,500 | 1,570 | 320,000 | 67,661 |
| 2011 | 18,500 | 2,085 | 419,000 | 87,537 |
| 2012 | 10,500 | 740 | 245,000 | 38,398 |
| 2013 | 10,300 | 637 | 282,000 | 54,674 |
| 2014 | 7,125 | 317 | 244,000 | 44,834 |
| 2015 | 6,079 | 354 | 212,000 | 40,779 |
| % Reduction 95-12 | 82% | 94% | 72% | 84% |
| % Reduction 95-13 | 82% | 95% | 77% | 68% |
| % Reduction 95-15 | 89% | 97% | 76% | 83% |
| Taken from San Luis & Delta-Mendota Water Authority 2015. | | | | |

Table 2. Drain water and pounds of selenium displaced by drainage water reuse on the San Joaquin River Water Quality Improvement Project (SJIRP) by water year, 2001 to 2015 (Reclamation, 2016a).

| Water Year | Reused Drain Water (Acre Feet) | Displaced Selenium (Pounds) | Displaced Boron (Pounds) | Displaced Salt (Tons) |
|---|---|---|---|---|
| 1998¥ | 1,211 | 329 | NA | 4,608 |
| 1999¥ | 2,612 | 321 | NA | 10,230 |
| 2000¥ | 2,020 | 423 | NA | 7,699 |
| 2001 | 2,850 | 1,025 | 61,847 | 14,491 |
| 2002 | 3,711 | 1,119 | 77,134 | 17,715 |
| 2003 | 5,376 | 1,626 | 141,299 | 27,728 |
| 2004 | 7,890 | 2,417 | 193,956 | 41,444 |
| 2005 | 8,143 | 2,150 | 210,627 | 40,492 |
| 2006 | 9,139 | 2,825 | 184,289 | 51,882 |
| 2007 | 11,233 | 3,441 | 210,582 | 61,412 |
| 2008 | 14,955 | 3,844 | 238,435 | 80,900 |
| 2009 | 11,595 | 2,807 | 198,362 | 60,502 |
| 2010 | 13,119 | 3,298 | 370,752 | 75,362 |
| 2011 | 21,623 | 4,394 | 454,675 | 102,417 |
| 2012 | 23,735 | 3,293 | 545,180 | 118,445 |
| 2013 | 26,170 | 3,527 | 568,907 | 118,883 |
| 2014 | 30,870 | 3,711 | 879,800 | 179,560 |
| 2015 | 36,698 | 2,667 | 1,084,483 | 200,178 |

Taken from San Luis & Delta-Mendota Water Authority 2015
NA = Not Available
¥ Drainage reuse project prior to SJRIP

<u>After the 3rd Use Agreement expires</u>

Over the short term, Reclamation intends to deliver water to the PWD and SLWD up to the amounts stipulated in their contracts over the next two years. However, this renewal will be the last of a series of two-year interim water contract renewals that began in 2009, concurrent with the 3rd Use Agreement for continued use of the San Luis Drain between Reclamation and the San Luis and Delta-Mendota Water Authority, as implemented by the Central Valley Project, over the period of January 1, 2010 through December 31, 2019 (Reclamation, 2009). Existing waste discharge requirements issued by the Regional State Water Board include prohibitions of discharge, financial incentives to reduce discharges to zero as quickly as possible [Appendix A, fee schedule from 3rd Use Agreement (Reclamation, 2009)], and potential financial liability for non-compliance during the current term of the 3rd Use Agreement; as well as, demonstration that any significant environmental impacts associated with continued operation of the Grassland Bypass Project, including use of the San Luis Drain after December 31, 2019, have been analyzed and are in compliance with the Endangered Species Act. Currently, there are no plans to renew the 3rd Use Agreement or continue discharge through the San Luis Drain (Reclamation, 2016b), and all districts plan to cease discharging by December 19, 2019, except for stormwater events which are exempt, as previously discussed.

## The Northerly Agreement

A new act, drafted on July 8, 2016, called the Northerly Districts Drainage Agreement (Reclamation, 2016b), would effectively terminate the federal government's obligation (through Reclamation) to provide drainage service to landowners within the boundaries of the Northerly Districts, and instead places such responsibilities on the Northerly Districts. The Northerly District Drainage Agreement would be considered an amendment to the San Luis Act of 1960, and considers the Northerly Districts to be composed of the Pacheco, Panoche, and San Luis Water Districts. Under this act, the Northerly Districts would assume responsibility for the management of drainage and discharged waters within their respective boundaries, including providing drainage service in accordance with all other legal requirements of state and federal laws, and assuming the titles of drainage facilities previously owned by the United States. The agreement also gives the Northerly Districts the ability to receive funds that will assist them in drainage solution implementation and eliminates their repayment responsibilities for any previously implemented drainage solutions or infrastructure, including all CVP construction charges still owed to the United States. In turn, the Act would indemnify the United States against any damages landowners claimed arose from failure to provide drainage services; including unsettled past claims and any future litigation. The Northerly Districts are anticipated to support this amendment in exchange for Reclamation's support of activities that would lead to the achievement of drainage service.

Under Northerly District management, drainage water discharges will be minimized by using on-farm and District source control improvement measures, the recirculation and reuse of drainage water on tolerant crops, the interception of groundwater, concentration and management of salts, and further development of additional treatment and disposal projects. These activities will be coordinated with existing regional projects, like the Westside Regional Drainage Plan, the Grasslands Bypass Project, and the San Joaquin River Water Quality Improvement Project. The Northerly Districts would continue to use measures identified in Reclamation's 2007 Record of Decision (Reclamation, 2007), and all measures are subject to ongoing monitoring and regulation by the Central Valley Regional Water Quality Control Board (Reclamation, 2016b). Regulatory oversight and enforcement mechanisms existing in the current 3rd Use Agreement will remain in effect.

Enacting this agreement would therefore convert the Northerly District's water service contracts into repayment contracts with existing key terms and conditions, effectively changing the interim water contracts into permanent rights to a stated share of CVP water, but the terms and conditions, including the 'shortage clause', should be substantially the same as the status quo contracts. Enacting the Northerly Agreement should not impact the progress made towards the selenium reduction progress achieved with the GBP and other measures (Reclamation, 2009, 2016c). Water quality objectives set by the CV Regional Water Quality Control Board must be met through 2019 for the GBP to continue to discharge drainage water. To become enacted, the Northerly Agreement was to be passed by January 15, 2017, but decisions on this act have been temporarily superseded by other litigation (Doyle, 2017). It is feasible that this agreement will pass into law before the expiration of the 3rd Use Agreement.

Other selenium sources

There are several sources that contribute to the overall selenium concentrations observed in the waters, sediments, and organisms in the Bay-Delta and San Joaquin River systems. In undisturbed systems, selenium concentrations in runoff from rain events in seleniferous areas are observed to be very low (Hamilton, 2004), so the natural background levels in this system are assumed to also have been low even though most of the San Joaquin Valley and the Coast Ranges soil contain degrees of seleniferous marine sediments (Presser & Schwarzbach, 2008). Instead, the largest contributor of selenium contamination to the system originates from human activities. Other than the previously identified agricultural discharges transported via the San Joaquin River to the Bay-Delta, the Bay Area oil industry also discharges significant amounts of selenium into the Bay as waste from the refinery process (Presser & Luoma, 2013). Additionally, the Sacramento River contributes roughly 0.07 ppb of selenium during above normal to wet water years, which is an unregulated input (Presser & Luoma, 2010a). Runoff from mining activities in seleniferous areas can likewise be mobilizing selenium into waterways (Hamilton, 2004), however this pathway does not seem to be a source of concern in the Bay-Delta system.

EPA ambient chronic selenium water quality criteria

In July of 2016, the US Environmental Protection Agency (EPA) finalized a recommended freshwater selenium ambient chronic water quality criterion to be protective of aquatic life (EPA, 2016). In lentic (still water) systems the EPA established an allowable monthly (30-day) average of 1.5 µg/L and 3.1 µg/L in lotic (flowing) systems; neither system can exceed those levels more than once in a three year period and be considered protective. The EPA also recommended certain egg (or ovary) and whole body (or muscle tissue) selenium concentration thresholds to avoid reproductive failure. These levels may seem protective of aquatic systems when compared to the previous load recommendations and the amounts of selenium that were historically discharged from the Grasslands Bypass Project, or found at Kesterson Reservoir during the ecological disaster, but NMFS is concerned that both the fish tissue and water column criteria recommendations are insufficient to be protective of ESA-listed salmonids or sDPS green sturgeon considering their sensitivity to the contaminate (Melanie Ookoro and Joe Heublein, NMFS Central Valley Office, personal communication, December 2016). Some authors have suggested that to be sufficiently protective of the entire ecosystem, a criteria of less than 1 µg/L in-water selenium would be appropriate (Hamilton, 2004).

Other water quality issues

Besides selenium contamination, the water quality of the action area has been seriously degraded over the last 150 years. Increased water temperatures, decreased dissolved oxygen levels, increased turbidity, and harmful contaminant loads have decreased quality of the Bay-Delta system for rearing, migration, and feeding of many fishes, including salmonids and sturgeon. The Regional Board, in its 1998 Clean Water Act §303(d), characterized the Delta and the San Joaquin River as impaired water bodies having elevated levels of chlorpyrifos, dichlorodiphenyltrichloroethane (*i.e.* DDT), diazinon, electrical conductivity, Group A pesticides (aldrin, dieldrin, chlordane, endrin, heptachlor, heptachlor epoxide, hexachlorocyclohexanes [including lindane], endosulfan and toxaphene), mercury, low dissolved oxygen, organic enrichment, and other unknown toxicities (Water Quality Control Board, 2016). In addition, low dissolved oxygen levels frequently are observed in the portion of the Stockton deep-water ship channel extending from Channel Point to downstream of the Turner and Columbia Cuts. The data derived from the California Data Exchange Center files indicate that dissolved oxygen depressions occur during all salmonid migratory months, especially during months when California Central Valley steelhead adults and smolts might use this area of the San Joaquin River. Instead current water quality conditions may act as a migratory barrier, because dissolved oxygen levels below 5 mg/L have been reported as delaying or blocking fall-run Chinook salmon (Hallock, Elwell, & Fry, 1970).

Recently, an extended low dissolved oxygen event occurred in the San Joaquin River (Don Portz, CDFW, personal communication, November 2016). It is hypothesized that hypoxic conditions were created in managed ponds that had accumulated a large amount of biological material, which decayed. These hypoxic conditions in the ponds coincided with the first rain event of 2016 and storm runoff overflowed the pond barriers. The overflow was not controlled and hypoxic water from the ponds began entering Mud Slough and aquatic areas downstream of the San Luis Drain, starting October 28, 2016 (Don Portz, CDFW, personal communication, November 2016). In-stream measurements showed dissolved oxygen levels down to 1.7 milligrams per liter of water, starting November 3, 2016, which killed fish in Salt Slough. Some fish that perished in the observed fish kills were introduced non-native species, however at least six pre-spawning Central Valley fall-run Chinook salmon died while being captured for trap-and-haul activities. Fall-run Chinook are regularly captured in this area before transport to the upper San Joaquin River so they may naturally spawn, and it was very unusual for fall-run to die in the capture area due to low oxygen (Don Portz, CDFW, personal communication, November 2016). Low dissolved oxygen measurements were observed down to Hills Ferry Barrier and subsequent readings indicated the event persisted for at least two weeks following pond overflow. While this occurrence was linked to a natural storm event, it was not a typical or desirable outcome of regular pond operations. Steps were taken by CDFW to avoid creating similar events in the future by updating pond management procedures.

Non-native invasive species

Non-native species can alter natural food webs by displacing the native prey base, or by outcompeting native predators and consuming more prey per individual. Predation is a major concern cited in the listing of Sacramento River winter-run Chinook salmon, because non-native predatory species such as striped bass, largemouth, and smallmouth bass are present in high densities throughout the system and prey on out-migrating juvenile salmon. These species introduction to and success in the system, combined with the presence of man-made structures and degraded conditions, have contributed to increased predation levels and have become a significant source of mortality that may be hindering winter-run Chinook salmon recovery (NMFS, 2014). There is also concern these non-native predatory species are similarly negatively affecting the recovery of spring-run Chinook salmon.

In the Bay-Delta, perhaps the most significant example of an altered prey base is illustrated by the Asiatic freshwater clams *Corbicula fluminea* and *Potamocorbula amurensis* (Lee, Lee, & Luoma, 2006). The arrival of these clams in the estuary disrupted the normal benthic community structure by displacing native clams, and their highly efficient filter feeding disrupted normal phytoplankton levels in the estuary (Cohen & Moyle, 2004). The reduction in phytoplankton levels caused a depression in the zooplankton population that depended upon the phytoplankton, and thus reduced the available forage base to juvenile salmonids and sturgeon using the Delta and San Francisco Bay for rearing or migrating. Attempts to control non-native invasive species may also have had unintentional adverse consequences on the fishes of the affected water systems. For example, the control programs that manage the populations of invasive water hyacinth (*Eichhornia crassipes*) and Brazilian Elodea (*Egeria densa*) plants in the Delta and San Joaquin River must balance the toxicity of applied herbicides with the probability of harming listed salmonids over the duration of herbicide application. There are other potential negative effects of the treatment protocols as well, particularly the possibility of further decreasing the dissolved oxygen levels if the vegetable matter is allowed to decompose and persist in the area for lengths of time.

Ecosystem restoration projects

There have been efforts to restore the San Joaquin River and Delta to a more natural state, or closer to historical baseline conditions. In 1988, a coalition of environmental groups, led by the Natural Resources Defense Council, filed a lawsuit challenging the renewal of long-term water service contracts between the United States and the CVP Friant Division Contractors. On September 13, 2006, the Settling Parties, including Natural Resources Defense Council, Friant Water Users Authority, and the U.S. Departments of the Interior and Commerce, filed a stipulation of the terms and conditions of the settlement (Settlement), which was subsequently approved by the U.S. District Court, Eastern District of California, on October 23, 2006. The Restoration Goal of the Settlement, is to restore and maintain fish populations in "good condition" in the mainstem San Joaquin River below Friant Dam to the confluence with the Merced River, including naturally reproducing and self-sustaining populations of salmon and other fish. President Obama signed the San Joaquin River Restoration Settlement Act on March 30, 2009, which authorized implementation of the Settlement, as part of the Omnibus Public Land Management Act of 2009 (Act; Pub. L. No. 111-11, 123 Stat.991). The Settlement 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 Chinook salmon, *O. tshawytscha* no later than December 31, 2012, consistent with applicable law to achieve the Restoration Goal. Title X, section 10011(b) of the Act states that spring-run Chinook salmon shall be reintroduced in the San Joaquin River below Friant Dam pursuant to section 10(j) of the ESA, provided that a permit for the reintroduction may be issued pursuant to section 10(a)(1)(A) of the ESA. In addition, Title X, section 10011(c)(2) of the Act states that the Secretary of Commerce shall issue a final rule pursuant to section 4(d) of the ESA governing the incidental take of reintroduced CV spring-run Chinook salmon prior to the reintroduction. Furthermore, Title X, section 10011(c)(3) of the Act states that the rule issued under paragraph 2 shall provide that the reintroduction will not impose more than *de minimus* water supply reductions, additional storage releases, or bypass flows on unwilling third parties due to such reintroduction. Third parties, in this context, are defined as persons or entities delivering or receiving water pursuant to applicable State and Federal laws and shall include CVP contractors outside of the Friant Division of the CVP and the SWP. On December 31, 2013 (78 FR 251), the final rule was published in the Federal Register to address these statutory requirements related to designation of an experimental population of CV spring-run Chinook salmon under ESA section 10(j); the first release of CV spring-run Chinook salmon into the San Joaquin River below Friant Dam occurred in April of 2014. This entire program is implemented by the San Joaquin River Restoration Program and is managed in part by NMFS.

Also, the Central Valley Project Improvement Act was implemented in 1992 and requires that fish and wildlife get equal consideration with other demands for water allocations derived from the CVP. From this Act many programs began with the intent to benefit listed salmonids: the Anadromous Fish Restoration Program, the Anadromous Fish Screen Program, and the Water Acquisition Program. Some of their activities include: fish passage improvement, water diversion fish screening, riparian easement and land acquisitions, development of watershed planning, instream and riparian habitat improvements, acquiring water for fish and habitat needs, and gravel augmentation.

## 2.5 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 to 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.

Biological opinions usually analyze each species and their critical habitats separately during the effects analysis. However, total separation would be difficult and redundant in this case because the primarily pathway by which this action could harm the anadromous fishes under consideration is to adversely modify their environments and critical habitat by the introduction of high concentrations of selenium produced by the action. Once introduced, selenium contamination is pervasive throughout the aquatic environment, and the ultimate effect on individuals of each species depends on many complex, interrelated factors (such as the species' sensitivity to selenium; the degree to which the areas in the San Joaquin River and Delta may be contaminated with selenium and how each species may use those areas that are contaminated with selenium; the extent and duration an individual of a species may use these areas; the life stages at which they may use selenium contaminated areas; each species' prey preferences and prey availability; the selenium uptake, trophic transfer amounts, and bioaccumulation rates for each prey type; which forms of selenium may be present in certain areas and their availability for uptake; the characteristics of the water body the selenium-organism exposure may occur in; and the water year type of the exposure year. Leading experts have attempted to model selenium exposure-risk for a variety of aquatic predators of higher trophic levels, such as waterfowl, large fishes, and humans (Presser & Luoma, 2010a; Presser & Luoma, 2013).

For the purposes of this evaluation however, the determination of the risk to individuals of each species is difficult given the multitude of factors at play and ultimately, each analysis largely leads to similar conclusions. Therefore, this effects analysis will discuss the introduction of selenium, how selenium travels through the aquatic environment, how selenium bioaccumulates through the food web, and the differences in how species may be affected to assess the risk to each species.

### 2.5.1 Effects of water delivery on aquatic selenium availability

The following effects analysis considers the full delivery of the water amounts stated in the service contracts for the interim contract period: 94,000 acre-feet to the Panoche Water District, and 125,080 acre-feet to the San Luis Water District. To fulfill the obligations of these water contracts, Reclamation will use surface waters diverted, stored, and/or re-diverted via the regular operations and infrastructure of the CVP and SWP.

The greatest use of the water delivered to the San Luis Water District (SLWD) and Panoche Water District (PWD) is to irrigate croplands within their districts. Before this land was converted from a natural state for agricultural purposes, it was sparsely vegetated upper grassland foothills situated in the rain shadow of the Southern Coast Range. This area normally receives little annual precipitation (Dr. Jennifer Lewis, Reclamation San Luis Unit, November 2016) or snow melt run-off and contains few natural streams, most of which are ephemeral in nature. Within the PWD and SLWD boundaries, marine sediments form a layer called Corcoran Clay just under the fertile soil layer, which has poor drainage rates and leads to topsoil that contains high concentrations of salts and other elements usually only encountered in trace amounts. In addition, these districts are situated on top of a high water table, which quickly leads to saturated, saline soil conditions when irrigated (Kelley & Nye, 1984). To remedy the drainage issues, farmers installed infrastructure like ditches and tile lines to drain the subsurface saline water away from the fertile layer of their fields. Once the CVP and SWP made more water available for irrigation, historically landowners began planting more water-intensive crops, expanding the extent of the cropland, and therefore produced greater amounts of salty drainage water. The irrigation and subsurface drainage resulted in wastewater containing salts and elements in concentrations higher than runoff which would otherwise naturally occur, some being at harmful levels.

The most concerning element discharged at harmful concentrations from these water districts relative to anadromous fish impacts is selenium. The drainage runoff exceeds allowable concentrations of selenium when left untreated. Selenium has been found to be extremely harmful to wildlife, being acutely toxic at high concentrations [mortalities observed in California salmonids at 47-67 ppb or µg/L in water, (Hamilton, 2004)] and also suppressing reproductive success with chronic, dietary ingestion [sublethal effects in California salmonids at 5.3 to 26 µg/L in the diet, (Hamilton, 2004). Additionally, selenium is likely to bio-accumulate in food webs if waterborne selenium is greater than 3 to 5 µg/L (Hamilton, 2004) and has a half-life of 20 to 30 days in small fish (Hamilton, 2004) but 63 days in the muscle tissue of rainbow trout (Adams, 1976). Even short duration selenium loads released into the environment remain indeterminately once introduced into aquatic ecosystems (Maier, Foe, & Knight, 1993), sometimes seemingly indefinitely, after source loads are discontinued (Lemly, 1997). As such, water use and agricultural drainage discharge from these seleniferous areas has been stipulated by agreements (Reclamation, 2007, 2009, 2016a) to reuse or retain water, and to treat or remove the selenium and other salts to specific loads before discharge.

The 3rd Use Agreement that established allowable selenium discharge thresholds and the reports

Reclamation submits regarding GBP performance are not actually referring to elemental selenium. In nature, selenium is most often found in an elemental speciation rather than the pure elemental form. Selenate is often the dominate form in agricultural drainage runoff, coal mining, valley fill leachate, and copper mining discharge (Presser & Luoma, 2010a, 2010b). Selenite is another speciation, found in oil refinery effluents. Organo-selenium is found commonly in ponds used for treatment of agricultural drainage and in the ocean after a selenium form is oxidized and bonded to carbon, a result of being taken up by plants as selenite. Selenate is the least reactive and uptake by plants is slow, while selenite and organo-selenium are more readily uptaken into food webs. Dissolved selenium speciations can undergo phase transformation reactions to particulate selenium (Presser & Luoma, 2010a), but which selenium species are present will influence the process. For example, uptake by plants or phytoplankton of selenate, selenite, or dissolved organo-selenium may result in the reduction to particulate organo-selenium available for animal uptake or sequestration of selenite into sediments as elemental selenium (which would remove available selenium to the water column ecosystem) but instead would make it available to sediment-based food webs or adsorption as co-precipitated selenite or selenite via reactions with particle surfaces. Selenium particulate phases absorbed by plants or phytoplankton would ultimately be recycled back into the water column as detritus, after the plants die and decay (Presser & Luoma, 2010b).

Particulate selenium is the primary form by which selenium enters food webs, and the potential toxicity of selenium in an ecosystem is influenced by the type and amounts of particulate material found in each aspect of the environment. For example, from a study of a slough of the San Joaquin River by (Saiki, Jennings, & Wiedmeyer, 1992), selenium concentrations were 0.47 µg/L in the sediments, 2.4 µg/L in algae, 7.9 µg/L in detritus, and 13 µg/L in the water column. Due to the ever changing selenium amounts and readings in a natural system, the relationship between water column and particulate selenium concertation is expressed as the $K_d$ ratio, where the concentration of the particulate is divided by the concentration of the water column at the time of the sampling, so the environmental partitioning between the dissolved and particulate phases of selenium is represented at that one instant. In the prior example of a slough of the San Joaquin River, the $K_d$ would therefore be 36 in the sediments, 185 in algae, and 608 in detritus, respectively. $K_d$ can be used as an indicator of how much of the selenium in the system is available for uptake by organisms, and so selenium uptake by ingestion of detritus would be the avenue of most concern. Also, the specific form selenium speciates into determines its bioavailability to invertebrates, and how each invertebrate interacts with the various physical aspects of its environment (water, sediment, and particulate matter) determines the likelihood and extent of selenium uptake. $K_d$ ratios must be used in biodynamic models attempting to predict selenium impacts, because there is no way to directly predict the amount of bodily selenium that may result in a higher trophic level organism such as a fish from a water column selenium measurement.

Because selenium concentrations do not directly transfer 100% to the predator, species specific trophic transfer factors (TTF) must be used to link particulate, invertebrate, and predator selenium concentrations and $K_d$ ratios together (Presser & Luoma, 2010a, 2010b). Trophic transfer factors are also ratios between the selenium concentrations in each animal compared to the selenium concentrations in their food. For example, the TFF of an invertebrate defines their dietary uptake as they feed on primary producers, detritus, microbes, or other particulate matter that contains selenium. Trophic transfer factors are important to consider because they vary widely among consumers due to their differing physiologies. This is true also for the TTFs of predatory species like larger fishes and birds (Presser & Luoma, 2010b; Presser & Luoma, 2013). Observed selenium concentrations in predators have been found to strongly correlate to the concentration of particulate selenium, and predator tissue concentrations can be predicted when appropriate food webs models are used (Presser & Luoma, 2013). When selenium moves up the food chain, it can be ingested and accumulate in individuals of listed species. Depending on their bodily concentrations, selenium toxicity could cause their death, chronic sub-lethal effects, or reduce their overall reproductive success (EPA, 2016; Hamilton, 2004; Presser & Luoma, 2013), and subsequently, their species' recovery potential.

The hydrology of the area receiving selenium-laden effluent is also important because those conditions influence the selenium phase transformations and its residence time in the system. If selenate is dominate form and it is discharged into a flowing system, the residence time is short and there is limited reactivity of selenate, so less of it is transformed into particulate materials. Sloughs, wetlands, or estuaries create opportunities for longer residence times and allow for greater uptake by plants, algae, and microorganisms. There is also greater recycling of selenite and organo-selenium back into solution in these areas in particulate forms, further accelerating selenium uptake into the food web. The reaction to reoxidize these reactive forms back to selenate takes hundreds of years, so the net outcome in an estuary is a gradual buildup of selenite and organo-selenium dissolved in the water and a higher partitioning of these forms into particulate material (Presser & Luoma, 2010a, 2010b). That is why environments downstream of a discharge point can have much higher concentrations of selenium in their sediments, detritus, and organisms than areas close to the discharge point, representative of the cumulative contributions of selenium recycling. The Delta, a large and important estuarine wildlife ecosystem, is downstream of the discharge point and the San Joaquin River, and so is included as impacted by the indirect effects of this action. The Delta has the potential to act as a sponge for discharged selenium and the ecosystem it supports is at a greater risk than even the San Joaquin River because the water in the Delta moves slower and allows more resident time for particulate selenium to integrate into the food web or be recycled back into prey pathways as previously discussed, even though the Delta is much farther away from the discharge point. Also, productivity and biological activity is generally higher in lentic systems like the Delta compared to lotic systems like the San Joaquin River, potentially increasing their selenium toxicity risk (Simmons & Wallschlager, 2005). The listed fish species analyzed in this opinion all utilize the Delta, and so each will be examined in light of their habitat use and time in the Delta and the San Joaquin River, and in regard to each species' particular sensitivity to selenium.

2.5.1a *Sacramento River winter-run Chinook salmon risk and exposure*

Following migration upstream, adults are distributed in the upper Sacramento River and its tributaries throughout summer for holding and ultimately spawning. Adults will only be potentially exposed to selenium briefly during their transition and they are not expected to feed to any great extent in the Bay-Delta (Groot et al., 1995; Quinn, 2005). Winter-run juveniles, however, may begin their migration to the sea after only four to seven months in the river. Juveniles that use the Delta for rearing enter from November – May and depending on their size, may leave immediately or stay until they grow to approximately 118 millimeters over a seven month period. Additionally, pumps operated by the CVP and SWP pull Sacramento River water down into the south Delta, creating unnatural near and far-field hydrodynamics in the rest of the Delta which confound use of normal salmonid outmigration pathways, possibly causing some juvenile winter-run to become entrained in to the waters of the southern Delta and experience a lower than expected survival rate.

Chinook salmon juveniles in the Delta are known to feed on crustacean zooplankton, Diptera and daphniidae fly life stages, chironomid larvae and pupae, and larval fishes when possible (Merz, 2001; Sommer, Nobriga, Harrell, Batham, & Kimmerer, 2001). An insect-based food web selenium loading model best suits predicting the risk-exposure for Chinook salmon [Figure 18, (Presser & Luoma, 2013)]. According to these models, the trophic translation factor for insectivorous fishes is 0.6 to 1.8, though obviously this depends on the availability of the prey species and the fish's individual prey selections. Potential detriments to survival of rearing juvenile winter-run Chinook salmon include reduced growth rates, hepatotoxicity, compromised body condition, impaired immune function, behavioral impairments, and increased mortality rates (Hamilton, 2004; Presser & Luoma, 2013).

Actual field concentrations of selenium in Chinook salmon are presented by Saiki et al. (1991) and others for the time period of 1986 – 1987 (shortly after the Kesterson Wildlife Refuge ecological disaster), however dietary studies where Chinook salmon juveniles that were fed short courses of 5.3 – 26 µg/ L dietary selenium of various forms accumulated bodily selenium concentrations of 4.0 – 10.8 µg/ L (Hamilton, 2004). After 1 µg/ L bodily selenium, Chinook salmon juvenile survivorship decreases by approximately 10% for every >1 µg/ L increase, down to less than 20% survival after 10 µg/ L bodily selenium (Hamilton & Buhl, 1990). If juveniles bioaccumulate selenium while rearing in the Delta, but then survive to return as adults, there is less concern regarding potential reproductive depression due to accumulated selenium loads, because selenium does depurate (i.e., leave bodily tissues) over time. Estimates of depuration for small fish range 20 to 30 days, the half-life of selenium, but the different speciates of selenium have different half-lives and different toxicities (Kleinow & Brooks, 1986), and total time ultimately depends on the pervasiveness of selenium contamination in prey and the habitat after major selenium ingestion ceases, and the fish's individual physiology, among other factors (Hamilton, 2004). Chinook salmon seem to be more sensitive to selenium than some of the other freshwater fishes that occupy the Delta despite their low TTF, and so Presser & Louma (2013) have estimated that Chinook salmon face an intermediate risk of selenium toxicity in the Delta.

2.5.1b *sDPS North American green sturgeon risk and exposure*

Green sturgeon may utilize the Bay-Delta and upstream habitat for spawning from March through October. While spawning in the Sacramento or Feather rivers, they are unlikely to be exposed to harmful levels of selenium but, unlike salmonids, adults, sub-adults, and juveniles are expected to feed opportunistically at any time (NMFS, 2016c). Therefore, while adults are passing through the Bay-Delta to their spawning grounds, they may feed, and sub-adults and juveniles are also expected to use the Bay-Delta for feeding and rearing extensively. Sturgeon are bottom oriented predators of invertebrate prey, their potential TTF and risk exposure is best modeled using the clam-based food web (Figure 18). However, this model expected *Corbula*

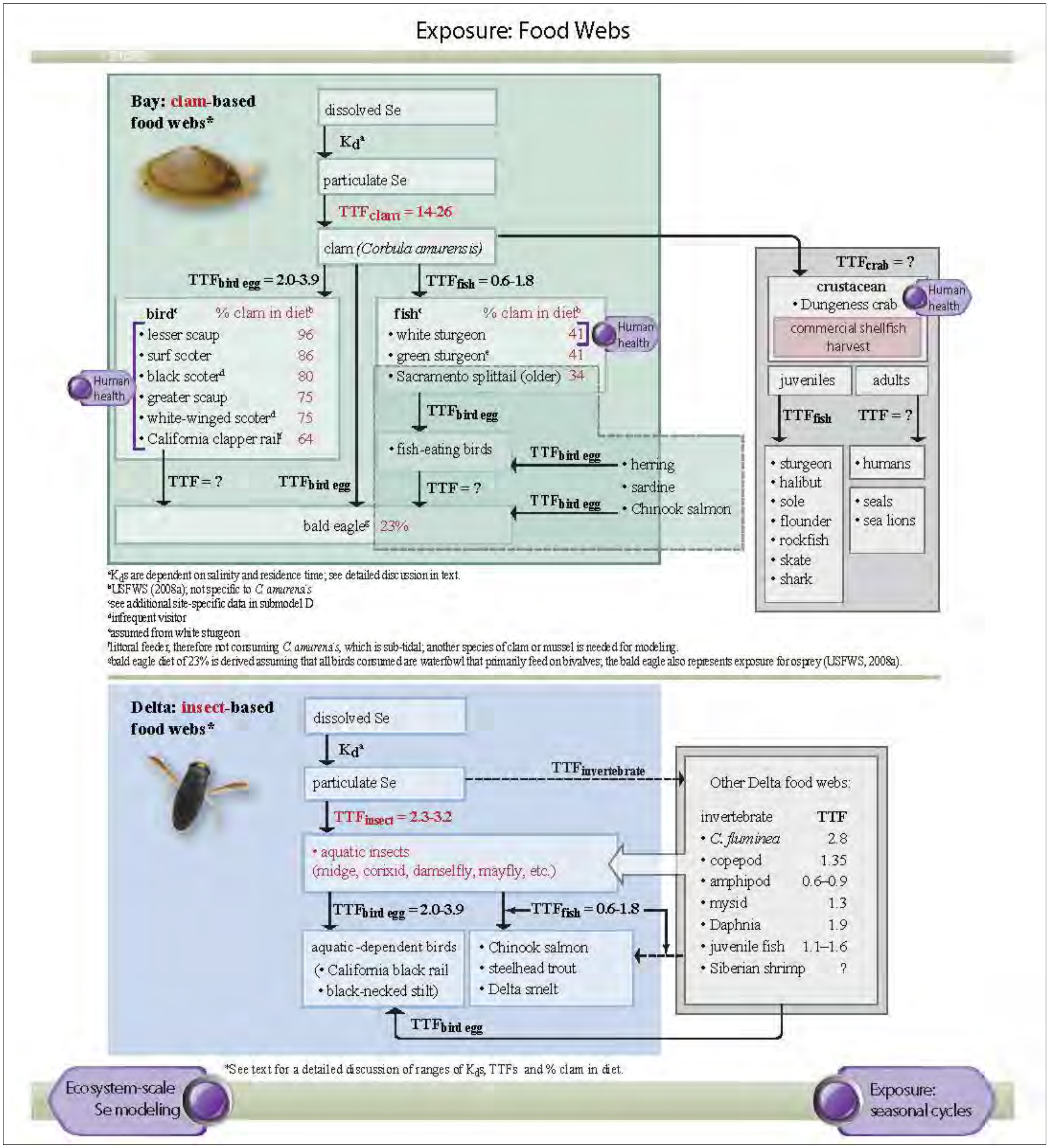


Figure 18. Selenium exposure model for clam-base and insect-based food webs (Presser & Luoma, 2013).

*amurensis* or *C. fluminea* clams to comprise approximately 41% of sturgeon diet, however recent studies indicate this portion is likely closer to 90% of their diet in the Delta (Melanie Ookoro and Joe Heublein, NMFS Central Valley Office, personal communication, November 2016).

In addition, Asiatic and other invasive clams have displaced resident species of bivalve in the Delta, and exhibit concentrations of selenium that regularly exceed the thresholds for chronic prey toxicity of birds and fish (i.e., > 10 µg/g) (Linares-Casenave, Linville, Van Eenennaam, Muguet, & Doroshov, 2015). In the model presented by Presser & Louma (2013), sturgeon TTF may be 1.3 from a prey TTF of 9.2, but that is estimated from a diet that is only 50% Asiatic clam, so it is likely that this number may be higher. This model places green sturgeon at the highest risk due to the time they spend foraging in the Bay-Delta, what prey they forage on, the high selenium transfer rates of those prey items, and their inherent sensitivity to selenium. Their internal egg maturation schedule (>1 year) increases their vulnerability to reproductive deformations due to selenium, presenting the potential of depressed reproduction potential (Linville, 2006). White sturgeon from the San Francisco Bay have been reported to have ovarian selenium concentrations between 29 - 72 µg/gram. These levels approach or exceed thresholds at which severe deformities or mortalities may be expected in larvae (Presser & Luoma, 2013). If healthy larvae do hatch, the Bay-Delta is the only major estuarine feeding and rearing habitat that may be used by sDPS green sturgeon produced by the Sacramento River.

Green sturgeon may also be exposed to selenium by contact with the sediments. However, studies which examine the toxicity of contact with selenium-laden sediments verses ingestion are unavailable for sturgeon, but several studies have demonstrated fish with regular access to bottom sediments accumulate more selenium than those suspended above such sediments with access to similar prey (Hamilton, 2004). Most literature agrees that selenium toxicity is reached when sediment concentrations exceed 4 µg/gram (Hamilton, 2004). Measurements of the selenium concentrations in the sediments in Mud Slough or the San Joaquin River were not provided in the BA for this project (Reclamation, 2016a), but periodic evaluation of suspended solids from various locations in the GBP revealed regularly high selenium concentrations ranging from 12 to 140 milligrams / L, with a mean of 47 milligrams/L (Reclamation, 2015).

Green sturgeon's sensitivity to selenium, in experiments conducted by Silvestre, Linares-Casenave, Doroshov, and Kultz (2010), found that larval green sturgeon were significantly more sensitive to temperature and selenium stress than larval white sturgeon. Their overall risk to selenium toxicity due to the actions of this project is difficult to estimate because green sturgeon have not been recorded using the southern Delta or the San Joaquin River for breeding, though anecdotal accounts of adult occurrence do exist (Gruber et al., 2012). It is possible that selenium contamination is one of the factors preventing reproductive success and repopulation of sDPS green sturgeon in the southern Delta and San Joaquin River. But, individuals born in the Sacramento or Feather rivers and all individuals that may use the Bay-Delta for feeding have been placed in the highest, most at-risk category in North Bay selenium outcome scenarios (Presser & Luoma, 2013), indicating green sturgeon are the most vulnerable species analyzed.

<u>2.5.1c *Spring-run Chinook salmon risk and exposure*</u>

The risk spring-run Chinook salmon face due to selenium contamination from this project are largely the same as those faced by winter-run Chinook salmon, especially the natural populations breeding in the Sacramento River basin, including their potential TTFs (Presser & Luoma, 2013). The biggest differences stem from their slightly different adult migration timing up and juvenile emigration timing down the river that may result in more months spent in freshwater than winter-run, and that the non-essential experimental population will be exposed in both the San Joaquin and in the Delta. Regardless, the previously stated exposure of intermediate stands for spring-run Chinook as well, since the model used was likely intended for fall-run, which are ubiquitous throughout the Sacramento-San Joaquin system.

2.5.1d *California Central Valley steelhead risk and exposure*

The pathway and risk for steelhead exposure to selenium is the largely the same as it was for the Chinook salmon, however there are some data available regarding *O. mykiss* specific selenium measurements of body tissues. When juveniles were fed 9-12 µg/gram selenite for extended periods (80 – 294 days) they accumulated 4-5.3 µg/gram whole-body selenium, which resulted in mortality, reduced growth rates, and reduced kidney function (Hamilton, 2004). When exposed to in-water selenium concentrations of 47 µg/L, juveniles experienced increased mortality or suppression of total lengths. A feeding study using adult rainbow trout observed toxicity at 13 µg/L in dry feed (Hamilton, 2004). Adams (1976) reported a selenium half-life of 63 days in muscle concentrations of adult rainbow trout. All stated measurements were taken from laboratory studies and no *in situ* steelhead bodily concentration estimates exist from the Delta or the San Joaquin River. Steelhead juveniles are assumed to consume approximately the same prey items as juveniles Chinook salmon, and their exposure while rearing in the San Joaquin River or the Delta places them at an intermediate risk, in part due to their sensitivity to selenium. In addition, some steelhead remain in freshwater over a year before emigrating out of the system, and such fish would face the greatest risk due to the duration of exposure. To some extent, adult steelhead may feed more readily than Chinook salmon once in freshwater systems, but not to the degree that may affect reproductive success by feeding on selenium contaminated prey.

2.5.2 Change in effects due to climate change

Climate change has the potential to amplify or lessen the long-term effects of a proposed action (NMFS, 2016h). To account for this possibility, NMFS also uses a qualitative conceptual model of the situation built using previously determined effects as a baseline and uses the model to examine links between the climate, typical conditions of the local environment, and the species' responses, and can also include human actions which may interact with the other factors. According to this model, since the effects of this action will last longer than 10 years after action completion, the effects may vary in response to difference environmental conditions. Since Reclamation and the water districts will no longer be subject to the stipulations in the 3rd Use Agreement regarding selenium loads after 2019 *and* no suitable measures exist to control selenium contamination after discharge and infiltration into ecosystems, the long-term effects of this action may be amplified as a result of climate changes and should be evaluated to the extent possible.

It is highly probably the advent of climate change will amplify the effects of the selenium in contaminated areas. This is because, while selenium may be discharged below currently acceptable standards, it persists when incorporated into the sediments of aquatic ecosystems, (Adams, 1976; EPA, 2016; Hamilton, 2004; Lemly, 1997; Presser & Luoma, 2010a, 2010b; Presser & Luoma, 2013; Simmons & Wallschlager, 2005). Following climate change predictions, it is likely surface water availability throughout California will decrease with increased air temperatures, overall less precipitation, and less snowpack relative to rainfall (Anderson, 2015). If ESA-listed species rearing areas remain in the Delta in the future, the wetted areas may become highly concentrated with selenium due to the combination of decreases in the contribution of freshwater and an increase in evaporation. Available forage areas will be used more intensively by more individuals of all species since less area total will be accessible. This could lead to juveniles of listed species ingesting prey that has higher tissue concentrations of selenium than values observed today, to a point where mortality may occur from bio-accumulation of lethal amounts of selenium. Furthermore, while this proposed action only accounts for selenium discharges up until 2019 and expects “zero discharge” starting 2020, continuing discharge is to be expected as these particular lands are likely to be farmed until such activities become unprofitable. Therefore, areas previously compromised by selenium contamination will continue to receive agricultural selenium discharges but without auxiliary freshwater inputs that would dilute the concentration.

The ESA-listed salmonids that rear in the Delta would be negatively affected if such climate change-induced selenium amplification occurred, but green sturgeon populations would suffer the most, potentially reaching a jeopardy-level threat depending on the severity of the situation. Green sturgeon already face a higher risk due to their increased sensitivity to selenium, diet preferences, increased exposure of tissues to selenium in sediments while feeding, evidence that their natural prey will be displaced by an Asian con-specifics that stores selenium in greater concentrations in its tissues, and that both adults and juveniles may use contaminated areas of the Delta for feeding. This situation will be further exacerbated if increased temperatures also make the Delta more hospitable to invasive species and less suitable for native species, increasing the percentage Asiatic clams contribute to their diets.

In another scenario, climate change may bring increased precipitation to California, effectively diluting in-water selenium concentrations downstream and potentially scouring sediments contaminated with selenium further downstream to, or out of, Delta via heavy flood flows. The end result of such a scenario is unclear, because while more water in the system might dilute the concentrations experienced on an individual level and change previously lentic system to less affected lotic systems, run-off coming from the water districts would be exempt from standards control according to the 3rd Use Agreement (Reclamation, 2009) and ultimately more selenium may be discharged than what is currently regulated. In such a scenario, the ESA-listed salmonid populations may do well with increased water flows, and uptake less selenium if juveniles reared in the Delta, because increased dilution of selenium concentrations in water would translate into less selenium in suspended prey items. Even with decreases in water selenium concentrations, it remains reasonable that North American green sturgeon could still be negatively impacted in a wet-world scenario due to their feeding preferences.

## 2.6 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.

Some continuing non-Federal activities are reasonably certain to contribute to climate effects within the action area. However, it is difficult if not impossible to distinguish between the action area's future environmental conditions caused by global climate change that are properly part of the environmental baseline *vs.* cumulative effects. Therefore, all relevant future climate-related environmental conditions in the action area are described in the environmental baseline (Section 2.4).

Agricultural activities

Agricultural practices in and upstream of the San Joaquin River may continue to adversely affect riparian and wetland habitats through upland modifications of the watershed that lead to increased siltation or reductions in water flow in stream channels flowing into the San Joaquin River. Agricultural practices in the Delta have adversely affected riparian and wetland habitats through upland modifications of the watershed that lead to increased siltation or reductions in water flow in stream channels flowing into the Delta. Unscreened agricultural diversions throughout the Delta may entrain fish including juvenile salmonids. Grazing activities from dairy and cattle operations can degrade or reduce suitable critical habitat for listed salmonids by increasing erosion and sedimentation as well as introducing nitrogen, ammonia, and other nutrients, which then flow into the receiving waters of the San Joaquin River and the Delta. Stormwater and irrigation drainage related to both agricultural and urban activities contain numerous pesticides and herbicides (Dubrovsky et al. 1998, 2000; Daughton, 2003) that may adversely affect listed salmonid and sDPS green sturgeon reproductive success and survival rates.

Of particular note, in addition to CVP water delivered in these interim contracts, the water users also apply water from other sources to augment or to replace CVP water when it is unavailable (Table 3). As the recent severe drought progressed, use of water sources other than that delivered by the CVP increased as CVP's ability to deliver water decreased. During these years, the water districts and the GBP continued to discharge drainage water and selenium into the San Joaquin River through the San Luis Drain, though they remained below the load thresholds stipulated by the 3rd Use Agreement. Based on these trends, in future years when Reclamation is unable to deliver allocations to these water districts, it is highly likely the water users will continue to seek out and use other sources of irrigation water, like deep wells (Kelley & Nye, 1984), and continue with agricultural activities like irrigation that will continue to produce contaminated drainage water regardless of CVP water availability.

Table 3. Water sources, amounts, and number of irrigated acres within the Panoche and San Luis Water Districts 2011-2015. Note 0% delivery of contract CVP water from Reclamation to water districts 2014 and 2015.

| Water Year[1] | CVP Contract Amount (acre-feet) | CVP Allocation[2] | CVP Contract (acre-feet) | Other Water Used | Total Applied Water | Irrigated Acres |
|---|---|---|---|---|---|---|
| Panoche Water District | | | | | | |
| 2015 | 94,000 | 0% | 0 | 38,672 | 38,672 | 37,366 |
| 2014 | 94,000 | 0% | 0 | 48,272 | 48,272 | 37,341 |
| 2013 | 94,000 | 20% | 18,800 | 43,663 | 62,463 | 37,436 |
| 2012 | 94,000 | 40% | 37,600 | 28,395 | 65,995 | 37,000 |
| 2011 | 94,000 | 80% | 75,200 | 0 | 75,200 | 37,240 |
| | **Averages** | **28%** | **26,320** | **31,800** | **58,120** | **37,277** |
| San Luis Water District | | | | | | |
| 2015 | 125,080 | 0% | 0 | 60,117 | 60,117 | 30,283 |
| 2014 | 125,080 | 0% | 0 | 63,524 | 63,524 | 28,481 |
| 2013 | 125,080 | 20% | 25,016 | 56,319 | 81,335 | 33,819 |
| 2012 | 125,080 | 40% | 50,032 | 43,087 | 93,119 | 34,664 |
| 2011 | 125,080 | 80% | 100,064 | 209 | 100,273 | 32,486 |
| | **Averages** | **28%** | **35,022** | **44,651** | **79,674** | **31,947** |

1 A Contract Year is from March 1 of a given year through February 28/29 of the following year.
2 Source: http://www.usbr.gov/mp/cvo/vungvari/water_allocations_historical.pdf.

In addition to measures taken in the GBP to reduce selenium discharge, another tool used by the Westside Regional Drainage Plan is the San Joaquin River Water Quality Improvement Project (SJRIP). This project is owned and managed by the Panoche Drainage District, and consists of 6,000 acres of salt-tolerate crops primarily irrigated by re-using drainage water from the Grassland Drainage Area. Other activities include pumping shallow wells for groundwater and water table management, and providing concentrated drainage water for the development of treatment and salt disposal technology and practices (Reclamation, 2016b). The United States provides funding for the SJIRP to develop further selenium capturing technologies and has constructed a pilot demonstration treatment plant, but SJRIP may be considered an action taken by private entities. SJRIP activities have been key in effectively reducing selenium loads ultimately discharged by the GBP, and helping these water and drainage districts meet their discharge load standards of the 3rd Use Agreement.

Population growth and urbanization

The Delta, East Bay, and Sacramento regions; which include portions of Contra Costa, Alameda, Sacramento, San Joaquin, Solano, Stanislaus, and Yolo counties; are expected to increase in population by nearly 3 million people by the year 2020. Increases in urbanization and housing developments can impact habitat by altering watershed characteristics, and changing both water use and stormwater runoff patterns. The anticipated growth will occur along both the I-5 and US-99 transit corridors in the east and Highway 205/120 in the south and west (http://www.ci.lathrop.ca.us/about/). Increased growth will place additional burdens on resource allocations, including natural gas, electricity, and water, as well as on infrastructure such as wastewater sanitation plants, roads and highways, and public utilities. Many of these actions, particularly those which are situated away from water bodies, will not require Federal permits, and thus will not undergo review through the ESA section 7 consultation processes with NMFS but may none the less negatively influence the recovery of anadromous fishes.

## 2.7 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 2.5) to the environmental baseline (Section 2.4) and the cumulative effects (Section 2.6), 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) appreciably diminishes the value of designated or proposed critical habitat for the conservation of the species.

### 2.7.1 Sacramento River winter-run Chinook salmon

Post Euro-American settlement land use and water management practices, and the implementation of large federal and state water projects, have compromised the viability of the Sacramento River winter-run Chinook salmon ESU. In all cases, their population declines and sustained depressions have been directly attributed to habitat loss, fragmentation, and degradation (Section 2.2, 2.4). Specifically, lack of access to the higher tributaries of spawning habitat beyond terminal dams, and the loss and reduction in quality of freshwater rearing sites in valley floor reaches of the Sacramento River and the Delta. Increased water diversion and storage greatly altered the hydrologic regime throughout the California Central Valley and Delta, essentially removing the functionality these areas once provided these species (Section 2.4, 2.6). As a result from human alterations, Sacramento River winter-run Chinook salmon remained listed as endangered despite recovery efforts (Section 2.2).

The Sacramento River winter-run Chinook salmon PBFs of volitional migratory pathways, spawning areas, and Sacramento River riparian rearing habitats will not be effected by this action. However, both adult and juvenile endangered Sacramento River winter-run Chinook salmon may be exposed to project-related contaminates while they use the Delta either for a migration corridor on their way to spawning areas, as a potential rearing area, or during physiological transitioning between freshwater and the Pacific Ocean. Adult exposure and risk is likely to be minimal because it is highly unlikely that they will feed to any large degree while in selenium-contaminated areas. Juvenile exposure duration and risk is greater because it is more likely that juveniles may feed on prey containing selenium while they rear in the Delta, though the time any one individual may spend in these areas is variable (one to eight months). Furthermore, any selenium ingested from prey found in contaminated areas depends on individual prey preference and availability. Selenium accumulation rates in prey preferred by juvenile Chinook salmon are low relative to other fishes, so the total amount of selenium ingested per body weight of the fish will likely result as a sub-lethal dose. A sub-lethal dose is most likely to produce stress, among other effects, and negatively influence their swimming capabilities, which may increase their risk of predation. If the fish escapes predation and juvenile mortality, and completes the transition to a smolt that enters the ocean, feeding on oceanic prey and increasing their body weight should decrease the overall selenium concentrations in their body tissues. By the time affected individuals return as adults, any selenium remaining in their tissues should be below levels that would be expected to negatively influence their reproductive success.

Sacramento River winter-run Chinook salmon are the only species listed as endangered in this opinion. One of the recovery criteria to downlist this ESU is to establish additional populations and for at least one of the populations to meet the low extinction risk criteria (>500 effective population size, no productivity declines, no catastrophic events, and low hatchery influence, (Lindley et al., 2007; NMFS, 2014)). Reclamation's proposed action could reduce this ESU's probability of recovery via adversely affecting the PBF of Delta habitat which supports successful juvenile development and survival, if Reclamation, the water districts, or the water users exceed the selenium discharge control standards in the San Luis Drain 3rd Use Agreement. But, while all parties continue to adhere to the stipulations in the 3rd Use Agreement regarding allowable selenium loads discharged into natural waterways, NMFS determines that the likelihood of this action negatively affecting the recovery of this ESU is not appreciable.

### 2.7.2 North American green sturgeon, southern Distinct Population Segment

The causes of the decline in abundance that led to listing sDPS North American green sturgeon as threatened are largely the same as those described above as causing the listing of Sacramento winter-run Chinook salmon: habitat loss, fragmentation, and degradation (Section 2.2, 2.4). These persisting factors have compromised the viability of the sDPS so that they remain listed despite recovery efforts. In addition, the degradation of water quality by increased pesticide and pollutant contamination is a major threat as sturgeon are more sensitive to this type of degradation than are salmon.

Green sturgeon spawning and rearing in the Sacramento River basin, and the PBF contained therein, will not be affected by this action since it is outside the action area. Sufficient information about adult sDPS green sturgeon presence in, and use of, the San Joaquin River basin is lacking though green sturgeon adults have been reported as in the river, infrequently on recreational sturgeon cards. However, since the San Joaquin River was once considered a sister river equal in magnitude to the Sacramento River, it is highly likely that sDPS historic uses of this southern basin were similar to those currently observed in the Sacramento River. If adults were present in portions of the San Joaquin River in the action area of this project, it is more likely that they would be there for spawning purposes instead of feeding purposes. Such an event has not been recorded in recent history, as San Joaquin River water quality is not within green sturgeon preferences and there may be an insufficient number of adults at any one time to trigger a spawning event. Without spawning and resulting offspring, juvenile resident time in, and use of, the main stem of the San Joaquin River is currently unknown, but again, expected to be similar to that seen in the Sacramento River (several months to 2 years).

Juveniles should be expected to feed on benthic prey as opportunities arise, in either fresh or brackish water. Based on observed habitat use in the northern DPS, both adult and juvenile green sturgeon do make extensive use of estuarine and brackish areas for foraging on benthic prey. Additionally, green sturgeon feed on prey that regularly contain higher selenium concentrations and TTFs than other prey items in similar areas (Presser & Luoma, 2013), and research suggests that green sturgeon are more sensitive to selenium toxicity than even their counterparts, white sturgeon (Silvestre et al., 2010). Furthermore, green sturgeon are almost always in contact with the bottom and sediments while using inland waterways, and therefore could uptake significant amounts of selenium from the environment by tissue contact (Hamilton, 2004) rather than ingestion, making them the only species under consideration in this opinion facing an increased selenium risk through contact.

Reclamation's action may adversely affect the green sturgeon PBFs in estuarine areas used for foraging and alters the sediment quality in the Delta necessary for normal behaviors, growth, and viability of all life stages. Information suggests sDPS green sturgeon adults preferentially feed on prey that can bio-accumulate high concentrations of selenium and adults also come into contact with selenium contaminated sediments while foraging in amounts sufficient to illicit teratogensis or developmental deformities in subsequent embryos, potentially leading to unsuccessful reproduction and depressed population production (Presser & Luoma, 2013). Surviving juveniles could suffer increased mortality rates if also feeding on prey containing harmful selenium concentrations and using areas contaminated with selenium.

It is unknown if green sturgeon are currently using the San Joaquin River for breeding, or to the extent juveniles and adults may feed in the south Delta, so it is impossible to establish that the sDPS is experiencing appreciable reductions in reproductive success due to effects from this action. It is likely that some green sturgeon will be negatively affected by the increased selenium content in their prey and sediments in the Delta, but the severity of the risk, exposure, and resulting concentrations cannot be assessed until green sturgeon are observed using these areas and their tissues are chemically assayed to establish *in situ* selenium bio-accumulation concentrations.

The green sturgeon sDPS has an additional recovery criteria of maintaining adult contaminant levels below certain thresholds to avoid negatively impacting population maintenance or growth (NMFS, 2016c), which ties directly to the main point of concern in this opinion. Reclamation's proposed action could prevent the sDPS from achieving this criteria, hampering their recovery and viability (NMFS, 2015, 2016c). Again, for Reclamation to avoid appreciably contributing to this known issue, all contributing parties must adhere to the selenium discharge control standards in the San Luis Drain 3rd Use Agreement.

#### 2.7.3 Central Valley spring-run Chinook salmon

The viability of the Central Valley spring-run Chinook salmon ESU remains compromised due to the same factors described for Sacramento River winter-run Chinook salmon, expect they have largely been extirpated from almost the entirety of their historic stronghold, the San Joaquin River basin (Section 2.2, 2.4). In the fall of 2016, experimental, nonessential adults released into the upper San Joaquin River below Friant Dam created three redds. These redds occurred above the confluence with the San Luis Drain, and so should not be adversely affected by this action. The San Joaquin River Restoration Program and NMFS are currently waiting to see if fry and juveniles will result from this limited spawning event, sometime in 2017. Even so, there are currently no plans to collect and transplant resultant offspring from these redds down to the

Delta. Until volitional passage and in-river conditions that support natural production in the south Central Valley are achieved, along with various other criteria, the spring-run ESU will not be delisted.

Regarding the specifics of this action, the PBFs that support adult passage to, and spawning in, the Sacramento River basin are not likely to be affected. Adults are unlikely to feed even though spring-run arrive in freshwater areas immature, regardless if traveling to the Sacramento River or the San Joaquin River, therefore selenium uptake in adults would be minimal and should not negatively impact reproductive success initially. Once the resultant juveniles begin rearing and moving downstream to the lower reaches and begin to interact with the Delta, they may be affected by agricultural drainage from the proposed action. Juvenile exposure duration and risk is similar to that discussed for Sacramento River winter-run Chinook as they feed on the same prey items and utilize these areas in similar ways, and therefore face the same selenium-related exposure and risk. However spring-run smolts would be expected to face a slightly elevated risk compared to winter-run due to the increased duration of exposure as they utilize the lower reaches of the Sacramento and San Joaquin Rivers for long time periods, some times over a year.

For Central Valley spring-run Chinook to achieve recovery, their ESU must be supported by several populations that meet the low risk criteria as outlined previously for winter-run, including establishing low-risk populations in the main stem and tributaries of the San Joaquin River (Lindley et al., 2007; NMFS, 2014). Therefore, associated adverse effects of this action could negatively influence this ESU's recovery by negatively impacting spring-run PBFs of suitable water quality and juveniles survival in the estuarine areas of the Delta and possibly the riparian habitat that supports juvenile development and growth in the future as the nonessential experimental population of the ESU re-establishes in the San Joaquin River, but appreciable adverse effects should be avoided as long as all parties adhere to the selenium discharge load thresholds outlined in the 3rd Use Agreement.

#### 2.7.4 California Central Valley steelhead

Baseline factors affecting listed Chinook salmon described above, widespread habitat destruction and degradation, also apply to CCV steelhead. They are also believed to be currently extirpated from the San Joaquin River, upstream of the confluence with the Merced River (Eilers et al. 2010), but that may change with SJRRP restoration actions or flood flows. Even with access to the upper San Joaquin River, CCV steelhead are still blocked from the highest historical spawning reaches and will likely continue to suffer a larger loss of spawning habitat than even Chinook salmon have experienced, keeping them listed as a threatened species.

When and if volitional passage in the San Joaquin River is achieved, both adult and juvenile CCV steelhead use and travel throughout the action area may increase. Current adult escapement of steelhead in all of the San Joaquin River tributaries combined is estimated at a few dozen per year, and a low number of smolts are captured by monitoring activities throughout the year in the San Joaquin River tributaries. In regards to exposure and risk for adults, exposure to selenium contamination should be brief and feeding limited as they travel upstream to reach spawning and holding grounds above the confluence with the discharge point. Offspring produced in tributaries that connect to the impacted portion of the San Joaquin River below the San Luis Drain, and any juveniles which may use the Delta for rearing and feeding, may encounter prey that has bio-accumulated selenium. Most selenium bio-accumulation research focuses on forage species that are juvenile Chinook salmon preferences instead of steelhead smolt preferences, so it is unclear how their selenium ingestion rates may differ even when foraging in similar areas as Chinook smolts. Assuming some overlap in dietary items between these species is reasonable to consider, it is likely California Central Valley steelhead juveniles may be adversely affected by selenium ingestion while rearing in these areas. Steelhead are known to stay in freshwater longer than Chinook salmon (sometimes over one year before migrating to the ocean), therefore the duration of their selenium ingestion as juveniles would be greater. California Central Valley steelhead have similar recovery criteria as previously discussed for winter-run and spring-run Chinook salmon, and so this action may negatively affect the DPS's recovery by introducing selenium to the PBFs that support riverine and estuarine rearing downstream of the San Luis Drain discharge, and therefore decrease juvenile survival, especially if rearing in the San Joaquin River basin. But again, as long as all parties adhere to the stipulations in the 3rd Use Agreement, Reclamation's action of executing water contracts should not appreciably reduce the DPS's viability and recovery probabilities.

#### 2.7.5 Designated critical habitat

The main avenue by which this action may adversely affect these populations is continuing to input selenium into a natural system that has already been compromised by selenium discharges from water users, since selenium bio-accumulates in the environment and across food webs. It is unlikely that the execution of these contracts by Reclamation will decrease the amount of designated critical habitat of any of the affected listed species. However, executing the proposed action does have the potential to continue to decrease the quality of designated critical habitat downstream of the discharge drain via continued salt and selenium contamination, if the resulting agricultural discharge is not properly managed.

Most adverse effects arise when individuals forage in areas containing selenium-contaminated prey and sediments, and selenium accumulates to harmful levels within their body tissues. Sacramento River winter-run Chinook salmon, sDPS North American green sturgeon, CV spring-run Chinook salmon, and CCV DPS steelhead juveniles all depend on PBFs in the Delta that support juvenile rearing, growth, and development that lead to their survival, such as the suitable prey base, water quality, and sediments. Sub-lethal selenium doses and tissue concentrations in juveniles can produce stress, which negatively impacts swimming performance (potentially leading to increase predation), and alters normal behavior. The combination of these sub-lethal effects can ultimately increase the likelihood of mortality before adulthood, which decreases the population's viability and growth potential decreasing the ESUs'/ sDPSs' recoveries.

Sub-lethal selenium ingestion and tissue concentrations in adults decreases the reproductive success of individuals and has the potential to result in deformities in the offspring, decreasing offspring survival and further reducing a population's growth potential. Only adult sDPS green sturgeon would be likely to be negatively affected via selenium contamination of sediments and prey while they forage in the Delta and interact with PBFs described there as essential to the normal use of their critical habitat.

These water districts, drainage districts, and Reclamation have made great efforts in monitoring, managing, and curtailing selenium discharge from irrigation drainage into the San Joaquin River. Over the series of interim contracts to these water districts that NMFS has reviewed and provided opinions for from 2009 – 2019 to Reclamation, total selenium loads ultimately discharged into the San Joaquin River have been reduced by 96% (Table 1, Figure 16). While these reductions in selenium discharge are great progress, they do not account for any selenium discharged into the natural system by storm run-off. According to the 3rd Use Agreement (Reclamation, 2009), these drainage districts and the GBP are exempt from adhering to the yearly, monthly, and 4-day average selenium load standards and loads set in place to regulate discharge, if the discharge can be attributed to run-off from a natural storm event instead of agriculturally sourced. While this stipulation does make sense as far as the inability to control the amount of rainfall over these lands or the amount of stormwater run-off that is ultimately discharged, it does not address the fact that far more selenium may be washed out by rainwater since the soil has been disturbed by agricultural cultivation. Selenium that may have been detained by controlled evaporation in connecting drains and sloughs will be mobilized through the retention system by first rain flushes and into the natural areas downstream in much greater quantities than those reported as "controlled discharge" by the GBP.

It is a fact that water users continuing to irrigate these lands will produce selenium-laden drainage in some form, though the resulting toxic discharge's impact on ESA-listed species ultimately comes down to the proper management and retention of the discharge, preferably by keeping all compromised wastewater and sediments from reaching natural areas. Reclamation is proposing to supply surface water to water districts primarily known to use said water for irrigation purposes, therefore it is reasonable to assume wastewater with toxically high concentrations of salt and selenium will be produced as a result of Reclamation executing these water contracts. However, due to the severe drought years and water shortages in 2014 and 2015, Reclamation was unable to deliver any CVP surface water to the Panoche or San Luis water districts (Table 3). These water districts did apply some water, the lowest amount applied in the available time-series (presumably pumped groundwater), and the selenium discharged during these years was the lowest recorded (Reclamation, 2016*a*). But, selenium was still discharged from the water districts during these years despite not receiving CVP water, indicating that Reclamation supplying CVP water to these districts is not necessarily the only cause behind the selenium drainage issues of the project. Furthermore, Reclamation, the water districts, and the drainage districts continue to strive towards 'zero discharge' in the near future by utilizing a variety of water conservation, management, treatment, retention, and disposal strategies, and pledge to continue to participate in the San Joaquin River Water Quality Improvement Project and the Grassland Bypass Project. Their adherence to the specific selenium load and discharge standards informed by a comprehensive monitoring program has brought the selenium discharge down to much less harmful levels. NMFS continues to support these, and any other efforts, that will lead to actual achievement of zero discharge of selenium from these naturally contaminated areas to wildlife areas.

#### 2.7.6 Climate change

The increased average atmospheric temperatures and possible decreases in precipitation and snowpack in California associated with climate change may exacerbate selenium related issues in the future. This may occur if available surface waters were greatly reduced as a result of less overall precipitation and less of the precipitation consisting of snowpack. This would reduce the extent of wetted areas and shorten the duration of wet area persistence and possibly negatively influencing accessibility between areas, decreasing the total acreage of functional aquatic habitats available to wildlife. If less areas were available, biological activity would become more concentrated, increasing selenium recycling and bioaccumulation rates, and a higher percentage of the water input would be from agricultural and drainage discharge with less natural freshwater flows occurring. In such a situation, not only could selenium be higher in concentration but more individuals of various species may be exposed as reduction in available foraging habitat would force them to forage in accessible areas with greater intensity. Therefore, juveniles of all species that use the Delta for rearing and adult green sturgeon may ingest more selenium, possibly bio-accumulating concentrations that could lead to increased mortality rates. This situation may occur even if all selenium discharges were halted immediately, since these systems are already compromised to a point where the selenium concentrations affect wildlife.

NMFS can suggest few options to avoid such circumstances beyond not producing selenium-laden drainage at all. This could be accomplished by either achieving the “zero discharge” goal of the Grasslands Bypass Project and San Luis Drain 3rd Use Agreement achievement standards, working towards a true zero discharge that includes measures to retain or treat produced selenium discharge before it interacts with storm runoff and is introduced to wildlife areas, or avoiding activities that create toxic drainage water in their normal execution. One option would be to move water users in these water districts away from such activities in compromised soil areas indefinitely, to avoid the possibility of users continuing selenium producing activities without Reclamation’s oversight after this interim water contract has expired.

## 2.8 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, or recovery of, Sacramento River winter-run Chinook salmon, the southern Distinct Population Segment of North American green sturgeon, Central Valley spring-run Chinook salmon, or California Central Valley steelhead. Also, without direct causation, and while Reclamation and these water districts are actively striving to resolve the selenium drainage and discharge issues, NMFS does not find that executing Reclamation’s proposed actions will result in the adverse modification or destruction of the designated critical habitat of these species.

## 2.9 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 ITS.

### 2.9.1 Amount or Extent of Take

In the biological opinion, NMFS determined that incidental take is reasonably certain to occur as follows:

NMFS anticipates incidental take if the form of depressed reproductive success of adults and decreased survivorship of juveniles of Sacramento River winter-run Chinook salmon, southern Distinct Population Segment (sDPS) North American green sturgeon, Central Valley spring-run Chinook salmon, and California Central Valley steelhead in the San Joaquin River or in the Delta as a result of increased selenium contamination in those waters, sediment, and forage prey originating from drainage discharge from this project. Selenium may accumulate in the bodies of these species while they migrate through these areas via direct contact, or more likely, while they feed upon prey which have also accumulated increased levels of selenium from ecosystems previously and currently impacted by agricultural selenium discharge. Specifically, NMFS anticipates that sDPS green sturgeon adults and juveniles may be disproportionately adversely affected when they utilize the Sacramento-San Joaquin River Delta to feed upon benthic prey. Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and California Central Valley steelhead juveniles which spend time rearing in the Delta or lower San Joaquin River may also be adversely affected. To a lesser degree, NMFS also anticipates that Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and California Central Valley steelhead adults may be adversely affected if they forage in Delta areas before their transition to their freshwater running forms, or before they move through these areas into their freshwater spawning reaches upstream from impacted areas. In all cases, these species and life stages can be detrimentally affected via exposure and ingestion of elevated levels of selenium in their prey species, which may ultimately impair their reproductive success, growth, and survival in the wild.

NMFS cannot, using the best available information, specifically quantify the anticipated amount of incidental take of individual North American green sturgeon, Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, or California Central Valley steelhead because of the variability and uncertainty associated with: 1) attributing a reasonable percentage of the selenium discharged into natural areas originating solely from executing project actions, 2) the individual use of impacted habitat or duration of use within the project area by the listed species that would result in exposure or ingestion, 3) the varying population size of each species, and 4) annual variations in the timing of migration, spawning, and rearing of these species in relation to the variability in timing, amount, concentrations, and retention of drainage discharge. Also, the uncertainty in associating the selenium discharge loads into the San Joaquin River resulting from agricultural drainage originating from project actions versus loads originating from other irrigation water sources such as groundwater, or from stormwater runoff produced by storm events, confounds NMFS's ability to quantify take.

However, it is possible to designate ecological surrogates for the extent of take anticipated to be caused by the project, and to monitor those surrogates to determine the level of take that is occurring. The most appropriate ecological surrogates for the extent of take caused by the project are the measured concentrations and estimated discharge loads of selenium into Mud Slough and the San Joaquin River, along with the continued participation by the San Luis and Panoche water districts in the GBP, SJRIP, and San Luis Drainage Feature Re-evaluation Demonstration Treatment Facility at the Panoche Drainage District.

1. Ecological Surrogates

- The analysis of the effects of the proposed project anticipates that measured selenium concentrations and loads into Mud Slough and the San Joaquin River will continue to be below or meet the Regional Water Quality Control Board Basin Plan waste discharge requirements for the GBP identified in the Effects of the Action, Section 2.5, and that occurrences exceeding those thresholds will be limited to the influence of overland flow resulting from major storm events.

- The analysis of the effects of the proposed project anticipates that the San Luis and Panoche water districts will continue to participate in the Grasslands Bypass Project, the SJRIP, and the San Luis Drainage Feature Re-evaluation Demonstration Treatment Facility at Panoche Drainage District throughout the life of the contracts (or for 18 months in the case of the latter project), thereby minimizing the volume and concentrations of selenium introduced into the habitat of listed species as a result of agricultural discharges from their districts.

If the specific parameters of these ecological surrogates are not met (i.e., the selenium discharge requirements and thresholds for the Grasslands Bypass Project are exceeded besides instances when measurements are influenced by storm events), the proposed project will be considered to have exceeded anticipated take levels, triggering the need to reinitiate consultation on the project.

### 2.9.2 Effect of the Take

In the biological opinion, NMFS determined that the amount or extent of 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.

### 2.9.3 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 has determined that the following reasonable and prudent measures (RPMs) are necessary and appropriate to minimize the incidental take of listed anadromous fish. These reasonable and prudent measures also would minimize adverse effects on designated critical habitat.

1. Measures shall be taken to minimize the amount of agricultural subsurface drainage discharged to the San Joaquin River from the San Luis and Panoche water districts, regardless of actual surface water delivery amounts.

2. Measures shall be taken to ensure participation in the Grasslands Bypass Project, the SJRIP, and the San Luis Drainage Feature Re-evaluation Demonstration Treatment Facility at Panoche Drainage District for the duration of the Interim Renewal Contract Project. This shall be done in order to ensure that anticipated take levels of listed species do not exceed those described above in the ecological surrogates section.

3. Before expiration of this interim contract and the 3rd Use Agreement (Reclamation, 2009), and before the Northerly District Agreement (Reclamation, 2016b) begins (i.e. before the responsibilities associated with use and operations of the GBP and San Luis Drain are transferred from Reclamation to the drainage districts following initiation of the Northerly District Agreement if enacted, starting January 1, 2020), Reclamation shall facilitate communication between the newly responsible parties (the Northerly Drainage District, consisting of the San Luis, Pancheco, and Panoche Drainage Districts) and NMFS, regarding anadromous ESA-listed species responsibilities; including appropriate conservation measures and practices that should be used to avoid take of individuals or modification or destruction of designated critical habitat. The Northerly Agreement does mention that the Northerly Districts will still be responsible for ESA commitments, however the federal nexus that will be used to address such considerations was not determined in the upcoming Northerly Agreement and will be likely be an agency other than Reclamation. Early and voluntary ESA consultation would be the most prudent route for the Northerly Districts to avoid negative interactions and impacts on listed anadromous fishes and their critical habitats.

4. Measures shall be taken to protect California Central Valley steelhead and Central Valley spring-run Chinook salmon in the San Joaquin River above the confluence with the Merced River from high selenium pulses through coordination with California Department of Fish and Wildlife, especially during the September to December time period, including increased oversite and updated pond management practices.

5. Measures shall be taken to assess and monitor the concentrations of selenium within the waters, sediments, vegetation, and invertebrates of the San Joaquin River as well as in the mouths of Salt Slough and Mud Slough (north) to assess the selenium contributions from each pathway into natural systems downstream. This shall be done in order to demonstrate that the proposed action does not exceed anticipated take levels related to selenium waste discharge requirements in the Regional Water Quality Control Board Basin Plan described above in the ecological surrogates section, until the expiration date of the contract.

### 2.9.4 Terms and Conditions

The terms and conditions described below are non-discretionary, and Reclamation or any applicant must comply with them in order to implement the RPMs (50 CFR 402.14). Reclamation or any applicant has 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 the above 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. Measures shall be taken to minimize the amount of agricultural subsurface drainage discharged to the San Joaquin River from the San Luis and Panoche water districts.

    a. Reclamation shall require the water districts' continued participation in the Westside Regional Drainage Plan, which employs actions leading to zero discharge of subsurface drainage water beyond the boundaries of regional drainage management facilities, including but not limited to:

        i. Recirculating tailwater on-farm;

        ii. Employing micro irrigation and drip irrigation systems to the maximum extent practical;

        iii. Lining district water delivery facilities to the maximum extent practical;

        iv. Applying collected subsurface drainage water to salt tolerant crops and other drainwater displacement projects (such as road wetting for dust control); and

        v. Converting any remaining furrow and flood agricultural practices to contoured row agriculture employing micro, drip, or overhead sprinkler irrigation wherever feasible.

2. Measures shall be taken to ensure the continued participation in the Grasslands Bypass Project, the SJRIP, and the San Luis Drainage Feature Re-evaluation Demonstration Treatment Facility at Panoche Drainage District for the duration of the Interim Renewal Contract Project (or for 18 months in the case of the latter project). This shall be done in order to ensure that anticipated take levels of listed species do not exceed those described above in A.1. Ecological surrogates.

    a. Reclamation shall require the San Luis and Panoche water districts' continuing participation in the Grasslands Bypass Project, the SJRIP, and San Luis Drainage Feature Re-evaluation Demonstration Treatment Facility at Panoche Drainage District.

3. Measures shall be taken to protect CCV steelhead and CV spring-run Chinook salmon from high selenium pulses in the San Joaquin River above the confluence with the

Merced River, through coordination with California Department of Fish and Wildlife and the operation of the Hills Ferry Barrier at least during the September to December time period.

a. Reclamation shall coordinate with the California Department of Fish and Wildlife and create an action plan to protect CCV steelhead and CV spring-run Chinook salmon from high selenium pulses resultant from the operations of the Grassland Bypass Project and discharge from the San Luis Drain into the San Joaquin River, above the confluence with the Merced River, through the operation of the Hills Ferry Barrier and scheduled discharge timing over at least the September to December time period.

4. Measures shall be taken to assess and monitor the concentrations of selenium within the waters, sediments, vegetation, invertebrate prey species, and non-ESA listed fishes of the San Joaquin River, and at the mouths of Salt Slough and Mud Slough (north) to assess the contributions of selenium from each pathway. This shall be done in order to demonstrate that the proposed action does not exceed anticipated take levels related to selenium waste discharge requirements in the Regional Water Quality Control Board Basin Plan described above in the ecological surrogate statement above.

   a. Reclamation shall design and initiate a plan for sampling the selenium concentrations in the waters, sediment, vegetation, invertebrates, and non-ESA listed fishes of the San Joaquin River at the mouth of Mud Slough and above the confluence with the Merced River.

   b. Reclamation shall design and initiate a plan for sampling the selenium concentrations in the waters, sediment, vegetation, and invertebrates of the San Joaquin River at the mouth of Salt Slough and just upstream of the mouth of Mud Slough.

   c. Reclamation shall provide an annual report to NMFS summarizing the results of sampling and monitoring conducted in accordance with the plans described above.

Updates and reports required by these terms and conditions are due to NMFS no later than June 1, 2018, (covering the period of March 1, 2017, through February 28, 2018) and June 3, 2019, (covering the period of March 1, 2018, through February 28, 2019). These updates and reports shall be submitted to:

Erin Strange, San Joaquin River Branch Chief
National Marine Fisheries Service
Central Valley Office
650 Capitol Mall, Suite 5-100
Sacramento CA 95814
FAX: (916) 930-3629
Phone: (916) 930-3600

## 2.10 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. Reclamation should support and promote aquatic and riparian habitat restoration within the Delta region, and encourage practices that avoid or minimize negative impacts to salmon, steelhead, and green sturgeon.

2. Reclamation should support anadromous monitoring programs throughout the Sacramento-San Joaquin Delta to improve the understanding of migration and habitat utilization by salmonids and green sturgeon in this region.

3. Reclamation should provide and implement a monitoring plan in order to gather additional information about selenium levels in waters, sediment, vegetation, invertebrate prey species, and fishes in the San Joaquin River between the confluence of the Merced River and continuing just upstream of Salt Slough.

In order for NMFS to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, NMFS requests notification of the implementation of any conservation recommendations.

## 2.11 Reinitiation of Consultation

This concludes formal consultation for

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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 ITS 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 on 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 RESPONSE

Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) directs Federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect essential fish habitat (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 Reclamation and descriptions of EFH for Pacific Coast salmon (PFMC, 2014) contained in the fishery management plans developed by the Pacific Fishery Management Council (PFMC) and approved by the Secretary of Commerce. Freshwater EFH for Pacific salmon in the California Central Valley includes waters currently or historically accessible to salmon that are managed by PFMC (Figure 19). Species that are managed under the Pacific Coast Salmon fishery management plan that occur in the California Central Valley and the action area of this project are Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley fall-run Chinook salmon, and Central Valley late-fall run Chinook salmon (all *Oncorhynchus tshawytscha*).

## 3.1 Essential Fish Habitat Affected by the Project

Designation of Pacific Coast salmon EFH is broad due to the diversity of habitats used by Pacific salmon to successfully fulfill their life history needs (PFMC, 2014). The execution of these interim renewal water contracts for the Panoche and San Luis Water Districts will adversely affect both freshwater and marine Pacific Coast Salmon EFH by resulting in discharge of agricultural subsurface drainage water. The agricultural drainage water will degrade water quality and increase selenium concentration of the waters, substrate, and prey biota in the San Joaquin River and the Sacramento-San Joaquin River Delta (Delta). Salmonids in this fishery management plan require the affected areas for spawning, feeding, and growth to maturity. The action area of this project (Figure 2) includes adult and juvenile migration corridors to and from the Pacific Ocean, and Habitat Areas of Particular Concern (HAPCs) (e.g., complex channel floodplain and riparian habitats used for juveniles rearing and growth). Important elements of marine EFH affected by the project are also HAPCs, and include estuarine rearing habitat found in the Delta, as well as juvenile and adult migration corridors (PFMC, 2014).

Figure 19. Pacific Coast salmon essential fish habitat in California, as designated by their Fishery Management Plan (PFMC, 2014).

## 3.2 Adverse Effects on Essential Fish Habitat

The adverse effects on EFH from this action stem from the addition of selenium and salts into natural waterways from agricultural drainage discharge at concentrations beyond those expected from natural run-off and potentially harmful to wildlife, and from unanticipated detrimental outcomes associated with managing the agricultural drainage wastewater. Exposure to water with extremely high selenium concentrations can be acutely toxic to aquatic wildlife, and mortality can result shortly after ingesting prey items with high concentrations of selenium (Hamilton, 2004; Hamilton & Buhl, 1990). Chronic sub-lethal exposure to selenium in the environment and ingestion of prey with low selenium concentrations can translate to elevated levels of selenium in the tissues of fishes via bio-accumulation. At sufficiently harmful internal concentrations, selenium can reduce reproductive success, decrease growth rates, produce persistent physiological stress, negatively influence swimming performance, and alter regular behaviors (Adams, 1976; EPA, 2016; Presser & Luoma, 2010a; Presser & Luoma, 2013). When these influences are severe enough or compound, juveniles experience higher mortality rates than they would have otherwise. Furthermore, selenium persists in various forms in the sediments once introduced and may be uptaken by forage species and bioaccumulate throughout food webs (EPA, 2016; Hamilton, 2004; Lee et al., 2006; Lemly, 1997; Presser & Luoma, 2010b; Presser & Luoma, 2013; Simmons & Wallschlager, 2005). Selenium has been found in prey species of juvenile Pacific Coast salmonids rearing in the contaminated areas.

<u>In the San Joaquin River</u>

The main stem of the San Joaquin River, downstream of the San Luis Drain discharge point, serves as migration corridor for adult Chinook salmon accessing their spawning tributaries like the Merced, Tuolumne, and Stanislaus Rivers, and the upper portion of the San Joaquin River below Friant Dam, when connected. This stretch of the San Joaquin River contains HAPCs, such as submerged aquatic vegetation, complex riparian channels, and floodplain habitat. However, once adults enter the tributaries beyond the impacted main stem of the San Joaquin River they will no longer be exposed to selenium concentrations in the water and sediment. Therefore, adult exposure time is limited to the time period when they are using this pathway to reach their spawning destinations. Selenium transfer into organisms from contact only (verses ingestion) is low and takes additional time to effect fishes (Hamilton, 2004; Kleinow & Brooks, 1986), so direct adverse effects to adult Pacific Coast salmon from contaminated water and sediment likely minimal. Adult Central Valley spring-run, fall-run, and late fall-run Chinook salmon in the San Joaquin River will have made the physiological transition into their running forms and ceased feeding (Groot et al., 1995; Groot & Margolis, 1991), and therefore are unlikely to eat prey with high selenium concentrations and their reproductive success should therefore not be impacted.

Juvenile Central Valley Chinook salmon (fry, parr, or smolts) face a greater risk than adults because they may be exposed to elevated selenium concentrations in various aspects of their environment over longer period of times and are far more likely to ingest prey that has bioaccumulated selenium. Chinook salmon can be expected to rear in their natal rivers (one to five months) before emigration downstream (Presser & Luoma, 2013). The duration over which they may rear in the main stem habitat of the San Joaquin River depends on their run type and the water year type. Therefore, EFH and HAPCs in the main stem of the San Joaquin River used by juveniles for growth and survival may be negatively affected by this project as discussed in Section 2.5, 2.6, and 2.7 in the ESA consultation of this document.

In the Delta

The expected impacts in the Delta are similar to those described above for juveniles at risk for selenium bioaccumulation, however the Delta may be used more extensively for rearing and growth than the main stem of the San Joaquin River (Presser & Luoma, 2013) and hosts more prey containing selenium. Juveniles of some Central Valley Chinook salmon runs may stay several months, up to a year, rearing in brackish water, due to increased prey diversity and abundance in these areas and the amount of predator refugia available (Merz, 2001; NMFS, 2014; Saiki et al., 1992; Sommer et al., 2001; Utz, Zeug, & Cardinale, 2012). Therefore, while further downstream from the discharge drain than rearing areas in the San Joaquin River, Pacific Coast salmonids may face greater selenium ingestion and toxicity risks while feeding and rearing in the Delta. Increased selenium in the tissues of juvenile, if not acutely toxic, could lead to decreased juvenile survival as discussed above. Adult Pacific Coast salmonids transitioning from oceanic forms to freshwater running forms also may feed in the Delta (Joe Heublein, NMFS Central Valley Office, personal communication, November 2016) depending on the amount of time they spend in the area, but are not known to feed extensively after leaving the Pacific Ocean (Groot et al., 1995; Groot & Margolis, 1991).

## 3.3 Essential Fish Habitat Conservation Recommendations

Conservation Recommendations that minimize the effects of this action and manage problems associated with returning agricultural drainage water to a natural water body, such as increased salinity and concentrations of toxic compounds and decreased dissolved oxygen, are described by Section 4.2.2.20 of Appendix A of the Salmon EFH plan (PFMC, 2014) and would be suitable to apply to this action. Typical Conservation Recommendations from this Section highlight water conservation measures but, such practices are already described in detail in the preceding ESA consultation. Also considering that the habitat requirements of Central Valley fall-run/ late fall-run Chinook salmon within the action area are similar to the needs of federally listed species addressed in the preceding biological opinion including Central Valley spring-run Chinook salmon, NMFS recommends that all the Terms and Conditions as well as all the Conservation Recommendations (CRs), Section 2.10, in the preceding consultation be adopted as EFH Conservation Recommendations.

A significant difference between the Conservation Recommendations suggested in Section 4.2.2.20 of Appendix A (PFMC, 2014) for typical agricultural run-off management and this project are that selenium is a particularly toxic element, even at relatively low levels, and is difficult to recover or mitigate once introduced into the natural environment (Hamilton, 2004). Selenium originating from agricultural drainage and discharge associated with this project also has the potential for dispersion into nearby ecosystems via biotic transport to areas other than those directly downstream (Lemly, 1997; Presser & Luoma, 2013; Simmons & Wallschlager, 2005). Therefore, the most protective conservation recommendation NMFS could offer to agencies wishing to avoid impacting EFH going forward is to cease introducing additional selenium to these areas.

As such, in addition to terms and recommendations made in the preceding ESA consultation, NMFS advises Reclamation:

> CR 4) To undertake additional efforts which result in changes in land use on acreage within these water district boundaries from agricultural activities to those that do not produce selenium discharges (besides discharges associated with stormwater created from natural storm events). These efforts should be directed at areas with poor drainage and consist of Corcoran Clay that must be managed in perpetuity due to their high marine sediments composition and high potential to discharge toxic wastewater without management effort to control the discharge of selenium from irrigated land use. Such impaired land could be indefinitely fallowed, retired, or used for other purposes which would not regularly produce run-off with high selenium concentrations. Alternatively, such lands could instead be used to help to control, retain, or manage high selenium runoff from remaining irrigated land or natural stormwater by the installation of treatment trains [bio-retention ponds, bio-swales, or vegetated bio-strips, etc., (Minnesota Pollution Control Agency, 2017)] around and downslope of impaired areas.

Such a recommendation should already be underway in discussions with the Northerly and Grassland Districts as it is included in the host of basin alternatives proposed to tackle drainage and selenium issues (Presser & Schwarzbach, 2008). As a resource agency, it seems necessary for NMFS to point out that if this conservation recommendation was implemented to a substantial degree, all other conservation recommendations aimed at controlling the effects of the discharged drainage water once created would not be necessary and full protection of anadromous fishes from the adverse effects from this action would be achieved.

### 3.4 Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, Reclamation 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, minimizing, mitigating, or otherwise 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

Reclamation 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 Bureau of Reclamation. Other interested users could include the citizens of the affected areas, others interested in the conservation of the affected Pacific Coast salmon and the ESA-listed species considered in the above ESA consultation, the Northerly Drainage Districts, the Panoche and San Luis Water Districts, managers of the Grassland Bypass Project, managers of the San Joaquin River Water Quality Improvement Project, and managers of the Kesterson Wildlife Reserve. This opinion will be posted on the Public Consultation Tracking System website (https://pcts.nmfs.noaa.gov/pcts-web/homepage.pcts).

## 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.

# 5. REFERENCES


Adams, W. J. (1976). *The toxicity and residue dynamics of selenium in fish and aquatic invertebrates.* Michigan State University, East Lansing, Unpublished dissertation.

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