ENVIRONMENTAL ASSESSMENT

ISSUANCE OF AN ENDANGERED SPECIES ACT SECTION 10(A)(1)(A) ENHANCEMENT PERMIT TO THE U.S. FISH AND WILDLIFE SERVICE FOR HATCHERY AND MONITORING ACTIVITIES ASSOCIATED WITH THE SAN JOAQUIN RIVER RESTORATION PROGRAM

Photo credit: Paul Adelizi, CDFW

Prepared by the
National Marine Fisheries Service
West Coast Region, California Central Valley Office

COVER SHEET

Title of Environmental Review:	Issuance Of An Endangered Species Act Section 10(a)(1)(A) Enhancement Permit To The United States Fish And Wildlife Service For Hatchery and Monitoring Activities Associated with the San Joaquin River Restoration Program
Evolutionarily Significant Units/ Distinct Population Segments:	Central Valley spring-run Chinook salmon ESU California Central Valley steelhead DPS
Responsible Agency and Official:	Barry A. Thom Regional Administrator West Coast Region National Marine Fisheries Service 7600 Sand Point Way N.E., Building 1 Seattle, Washington 98115
Contacts:	**Amanda Cranford** West Coast Region California Central Valley Office 650 Capitol Mall, Suite 5-100 Sacramento, California 95814
Legal Mandate:	Endangered Species Act (ESA) of 1973, as amended and implemented – 50 CFR Part 223
Location of Proposed Activities:	San Joaquin River Restoration Program Restoration Area, Central Valley spring-run Chinook salmon donor stock locations, and quarantine facilities
Activity Considered:	Hatchery, broodstock collection, and monitoring activities associated with the San Joaquin River Restoration Program, including the Salmon Conservation and Research Facility Program. The Federal action considered in this environmental assessment is the National Marine Fisheries Service's proposed issuance of a Section 10(a)(1)(A) enhancement permit, Permit 20571, for these hatchery, broodstock collection, and monitoring activities.

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LIST OF ACRONYMS

CABA	Center for Aquatic Biology and Aquaculture
CCV	California Central Valley
CDFW	California Department of Fish and Wildlife
CESA	California Endangered Species Act
CEQ	Council on Environmental Quality
CV	Central Valley
CWT	Coded Wire Tag
DDT	Dichlorodiphenyltrichloroethane
DPS	Distinct Population Segment
DSCHP	DeSabla-Centerville Hydroelectric Project
DSCP	Donor Stock Collection Plan
cfs	cubic feet per second
EA	Environmental Assessment
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FRFH	Feather River Fish Hatchery
HGMP	Hatchery and Genetic Management Plan
HUC	Hydrologic Unit Code
JSATS	Juvenile Salmon Acoustic Telemetry System
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NRDC	Natural Resources Defense Council
PG&E	Pacific Gas and Electric
PEIS/R	Program Environmental Impact Statement/Report
PIT	Passive Integrated Transponder
PVC	Polyvinyl Chloride
RBDD	Red Bluff Diversion Dam
RM&E	Research Monitoring and Evaluation
RST	Rotary Screw Trap
RWQCB	Regional Water Quality Control Board
SCARF	Salmon Conservation and Research Facility
SJTH	San Joaquin River Trout Hatchery
SJRRP	San Joaquin River Restoration Program
SIRF	Salmon Incubation and Rearing Facility
USFWS	United States Fish and Wildlife Service

1 PURPOSE AND NEED

1.1 Background

In 1988, a coalition of environmental and fishing groups, led by the Natural Resources Defense Council (NRDC), filed a lawsuit to challenge the water operations for the upper San Joaquin River. On September 13, 2006, the Settling Parties, including NRDC, agreed on the terms and conditions of a settlement to the lawsuit (Settlement). Implementation of the Settlement will be accomplished through the San Joaquin River Restoration Program (SJRRP).

One of the two primary goals of the Settlement, the Restoration Goal, is to restore and maintain fish populations in "good condition" in the mainstem San Joaquin River below Friant Dam to the confluence of the Merced River, including naturally reproducing and self-sustaining populations of salmon and other fish. The term 'good condition' comes from California Fish and Game Code 5937 which holds the owner of any dam to allow enough water to pass at all times to keep fish below the dam in 'good condition'.

The Federal Implementing Agencies are authorized to carry out the Settlement by the San Joaquin River Restoration Settlement Act. This legislation also mandates that Central Valley (CV) spring-run Chinook reintroduced into the San Joaquin River under the SJRRP be designated as an experimental population pursuant to section 10(j) of the Endangered Species Act (ESA) of 1973 (16 U.S.C. 1539(j)). The collection of CV spring-run Chinook for use in establishing the experimental population, release of those individuals for the purpose of establishing self-sustaining population, and monitoring of the population, requires action pursuant to section 10(a)(1)(A) of the ESA.

1.2 History of the SJRRP Conservation Hatchery Facilities

The Conservation Program consists of the Salmon Conservation and Research Facility (SCARF), which is currently under construction and planned to be complete in late 2018, an interim SCARF (Interim Facility), and a small, Satellite Incubation and Rearing Facility (SIRF). The facilities were/are being constructed by the California Department of Fish and Wildlife (CDFW) under the SJRRP for propagating CV spring-run Chinook salmon to reintroduce them to the San Joaquin River as part of completion of the Restoration Goal of the Settlement.

The Interim Facility is currently in operation and located along the San Joaquin River adjacent to the CDFW's San Joaquin State Fish Hatchery, in Friant, California. The SCARF is being constructed adjacent to the Interim Facility. The SIRF is located 0.75 miles upstream of the SCARF on the United States Bureau of Reclamation's (Reclamation's) Friant Dam Property and also in operation. The Interim

Facility and SIRF are expected to meet SJRRP production goals in the meantime and might be repurposed after the SCARF is operational.

In fall 2010, the small-scale Interim Facility began operation using fall-run Chinook salmon to provide the Conservation Program with practical experience with captive rearing. Central Valley spring-run Chinook salmon were reared at the Interim Facility beginning in 2012. The first spawn at the Interim Facility occurred in November of 2012 as part of an experimental fall-run Chinook captive rearing study to help refine spawning protocols and techniques for the Conservation Program.

Smolt and broodstock production has been variable annually since 2012. Detailed production and release information for each year is included in reports associated with the permits that authorize activities at the facilities, and in the annual San Joaquin River CV Spring-run Chinook Salmon Technical Memorandums. Future juvenile releases, which are scheduled to increase each year, are detailed in the associated Hatchery and Genetic Management Plan (HGMP; CDFW 2016).

1.3 Purpose and Need Statement

The purpose of this EA is to analyze the activities described in the ESA section 10(a)(1)(A) enhancement permit application submitted by USFWS and associated HGMP. The actions of the EA must ensure that the proposed SJRRP activities: 1) work to reintroduce CV spring-run Chinook salmon into the Restoration Area, 2) comply with the Restoration Goal of the Settlement, to restore fish below Friant Dam to 'good conditions', and 3) are ESA compliant. According to the Final Recovery Plan for Central Valley Salmon and Steelhead (NMFS 2014), the population of CV spring-run Chinook salmon in the SJRRP Restoration Area is considered a top priority for reintroduction. The proposed action is a necessary regulatory component of this reintroduction effort.

1.4 Action Area

The Action Area includes the SJRRP Restoration Area, which is the San Joaquin River below Friant Dam to the confluence of the Merced River. In addition, because the Proposed Action includes broodstock collection from Butte Creek and the FRFH, those sites are also part of the Action Area. Transport routes from the broodstock collection sites, and quarantine facilities, are also included in the Action Area. Potential quarantine facilities include the Silverado Fisheries Base, in Yountville, California, and the Center for Aquatic Biology and Aquaculture (CABA) located in Davis, California (Figure 1-1). The program hatchery facilities are located near the base of Friant Dam (Figure 1-2).

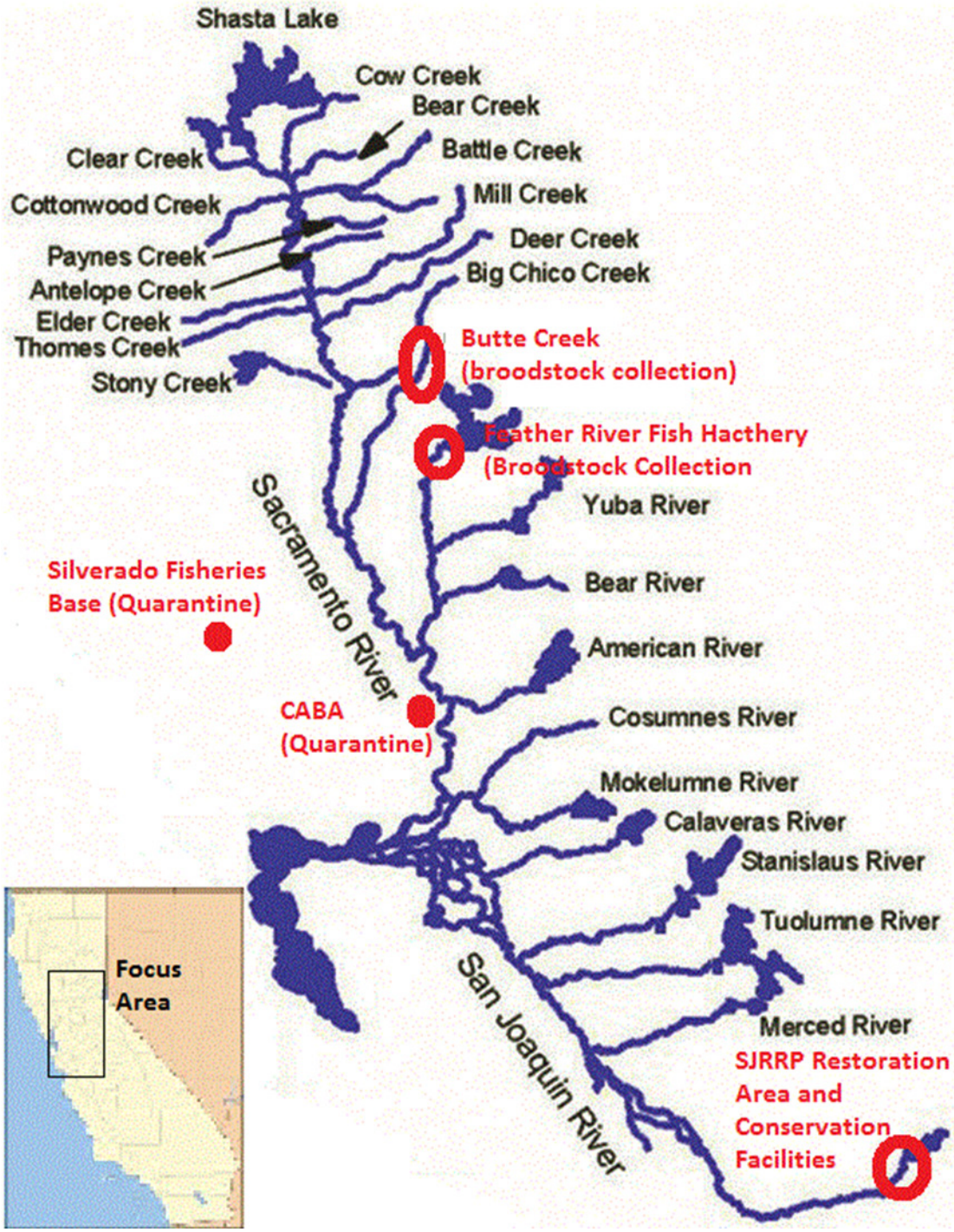

Figure 1-1 Locations of Action Area sites in the California Central Valley

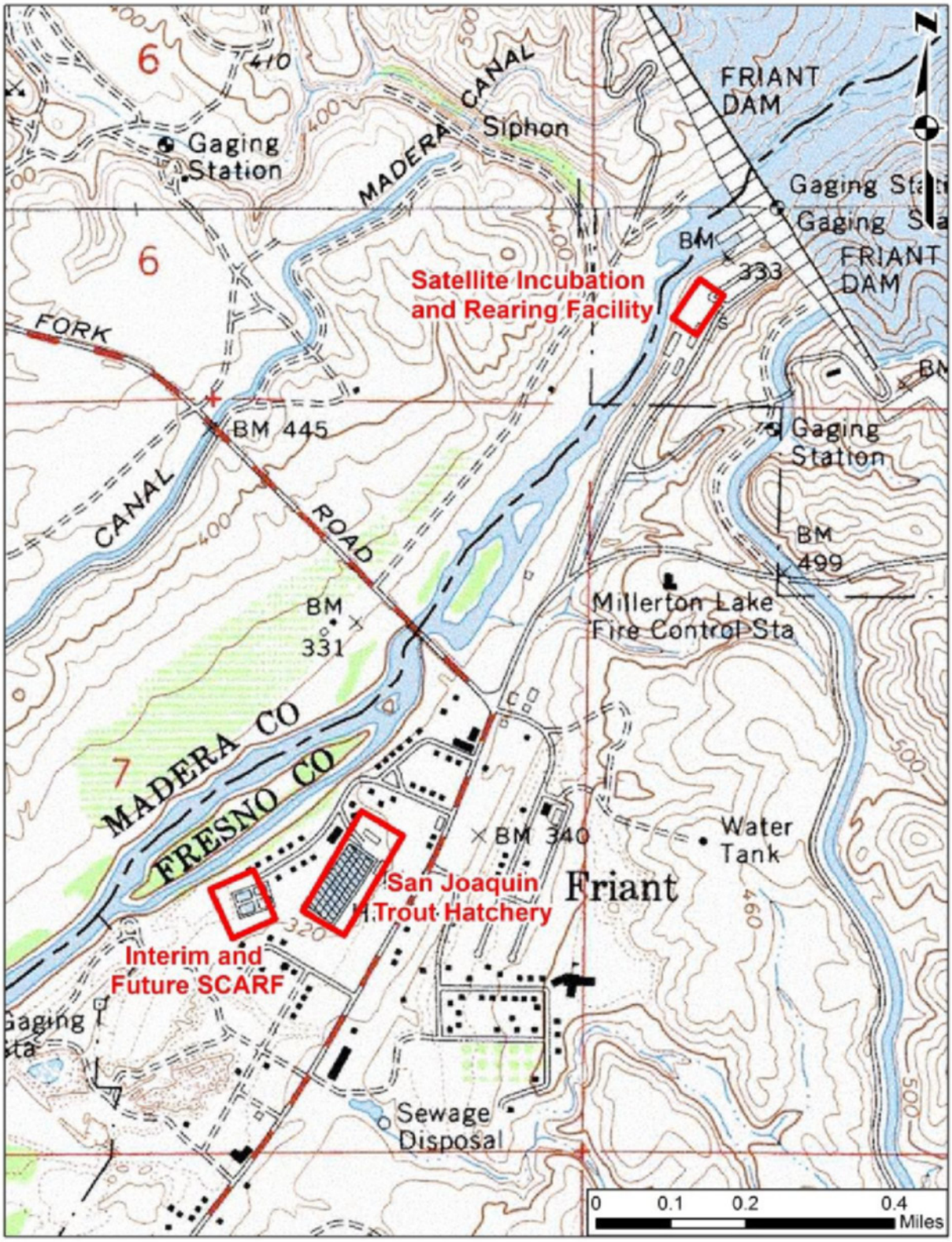

Figure 1-2. Location of the Interim Facility and SCARF (under construction), the SIRF, and the San Joaquin Trout Hatchery

1.5 Public Involvement

1.5.1 Scoping

On September 29, 2016, CDFW submitted an HGMP and requested initiation of formal consultation under section 7 of the ESA to "authorize direct take of listed species" through the issuance of a section 10(a)(1)(A) enhancement permit (Permit Application 20571, to be issued to USFWS). On June 12, 2017, USFWS completed Permit Application 20571, and the HGMP was attached to that application. The HGMP described the Proposed Action and the potential effects of the action on CV spring-run Chinook salmon. As part of the scoping process the following events occurred:

- On July 27, 2016, NMFS published a Notice of Receipt in the *Federal Register*, requesting public comment on the submitted section 10(a)(1)(A) permit application and the associated HGMP. Two sets of comments were received from the public. The permit application was changed in response to those comments, where applicable.
- On May 7 2018, NMFS published a Notice of Availability in the *Federal Register*, requesting public comment on the draft environmental assessment for issuance of a section 10(a)(1)(A) Enhancement Permit for hatchery operations associated with the San Joaquin River Restoration Program. No comments were received.

2 ALTERNATIVES

2.1 Alternatives to be Analyzed

Two alternatives are considered in this EA: (1) no permit issuance, no HGMP approval (No-action), and (2) issue the permit with conditions and approve HGMP (Proposed Action/Preferred Alternative).

2.1.1 Alternative 1: Do Not Issue the Permit, Do Not Approve the HGMP (No-action Alternative)

Under a No-action Alternative, NMFS concludes that the permit application does not meet the ESA section 10(a)(1)(A) permit issuance criteria and approval of the associated HGMP is not warranted. NMFS would not issue the ESA section 10(a)(1)(A) permit to USFWS authorizing take of ESA-listed species associated with the requested hatchery propagation activities and monitoring. For the purpose of this analysis, this alternative would not allow the activities necessary for successful completion of the purpose and need, to reintroduce CV spring-run Chinook salmon into the Restoration Area. Because the Conservation Facilities are already in existence or under construction, it is unclear what the facilities would be used under the No-action alternative. If spring-run Chinook are not reintroduced by the SJRRP, fall-run Chinook would be reintroduced in order to meet obligations under the Settlement, whether by natural recolonization or planting. Impacts to environmental resources from fall-run Chinook salmon reintroduction would be similar to the impacts of spring-run Chinook salmon and are described where appropriate under each resource impacts analyses.

2.1.2 Alternative 2: Issue the Section 10(a)(1)(A) Permit with Conditions and Approve the HGMP (Proposed Action/Preferred Alternative)

The Proposed Action is to issue a permit under section 10(a)(1)(A) of the ESA to USFWS, for a period of five years authorizing the implementation of the HGMP at the SCARF/SIRF/Interim Facility (together the SJRRP Conservation Facilities) and other activities associated with the SJRRP. The HGMP is intended to provide a single, comprehensive source of information to describe and assess the impacts of current and proposed operations of the SJRRP Conservation Facilities on ESA-listed Central Valley populations of anadromous salmonids. As a result of permit issuance, some take of ESA-listed Central Valley salmonids would be authorized. These activities are outlined in the permit application and associated HGMP. All actions are related to the propagation of spring-run Chinook salmon at SJRRP Conservation Facilities and monitoring of spring-run Chinook salmon and CCV steelhead in the San Joaquin River. The SJRRP Hatchery Program would be operated to conserve listed species, through implementation of the HGMP.

If issued, Permit 20571 would replace two existing Section 10(a)(1)(A) permits issued to the United States Fish and Wildlife Service (USFWS) by the National Marie Fisheries Service (NMFS) for SJRRP

activities. Permits 14868 and 17781 will both expire by the end of 2018 and actions under those permits will be covered by actions under permit 20571. Under the application for Permit 20571, proposed take activities for CV spring-Run Chinook salmon include: (1) broodstock collection, (2) broodstock rearing and spawning, (3) broodstock offspring (hatchery origin) and ancillary broodstock releases, (4) release of translocated hatchery origin juveniles, and (5) trap and haul of juveniles and returning adults. Activities also include restoration area monitoring and in-river research, which could involve take of both CV spring-run Chinook salmon and California Central Valley (CCV) steelhead.

Broodstock collections, as with all hatchery activities, would occur pursuant to the attached HGMP (CDFW 2016), and include potential collections from Butte Creek (juvenile life stage), Feather River Fish Hatchery (FRFH; juvenile and/or egg life stage), or/and the San Joaquin River (adult, juvenile, and/or egg life stage). Details for collection by source and life-stage, including quarantine and pathology testing protocols, are included in the permit application. Hatchery produced fish and ancillary broodstock may be released at various life stages based on production targets, hatchery capacity, river conditions, and program needs. Population monitoring and evaluation may include adult monitoring by video, acoustic tracking, visual surveys, and redd and spawning surveys; juvenile monitoring may consist of various outmigrant traps, and fry emergence monitoring.

2.1.2.1 Artificial Propagation Activities

The HGMP includes a number of biologically-based hatchery management strategies, all directed toward improving the propagation of spring-run Chinook salmon at the SJRRP Conservation Facilities. Activities in the HGMP submitted by CDFW have been incorporated into the permit application submitted by USFWS, and are summarized as follows:

Table 2-1. SJRRP Conservation Program details under current conditions

Species	Population	Collection Dates	Broodstock Collection Method	Target Life Stage	Maximum Annual Collection
Central Valley spring-run Chinook salmon	Feather River Fish Hatchery	2012 -	Hatchery Operations	Eggs, Juveniles	5,470
	San Joaquin River	Pending Permit Approval	Redd Extraction, Emergence Trap, Rotary Screw Trap, Fykes or Weirs, Seine, Dip nets	Eggs, Juveniles, Adults	2,980
	Butte Creek[1]	Pending Permit Approval	Rotary Screw Trap	Juveniles	2,910

[1] As stated in the text, collections from Butte Creek would only occur given sufficient escapement of adults that produce the juveniles to be collected each year. Escapement on Butte Creek would be monitored and determined by either direct adult counts at a counting weir or by snorkel survey estimates during the holding period. No juveniles would be collected if the number of female spawners is less than 250. The maximum number collected would scale up from 250 on a two to one basis with the number of female spawners up to 1,455. When the number of female spawners exceeds 1,455 up to the maximum of 2,910 juveniles may be collected. SJRRP staff would consult with CDFW Regional staff prior to collections each year to ensure that actual collection numbers are consistent with results of monitoring efforts of the source population. Source: CDFW 2016

Table 2-2. Actual and Projected* Releases and Proposed Source Populations

Species	Release Year	Source Population	Number Released	Life Stage	Mark Percentage
Central Valley spring-run Chinook salmon	2014	Feather River Fish Hatchery	60,114	Juveniles	100
	2015	Feather River Fish Hatchery	54,924	Juveniles	100
	2016	Feather River Fish Hatchery	57,320	Juveniles	100
		Interim Facility	47,560	Juveniles	100
		Feather River Fish Hatchery	544	Juveniles (1+)	100
		Interim Facility	25	Adults	100
	2017	Feather River Fish Hatchery	38,106	Juveniles	100
		Interim Facility	51,044	Juveniles	100
		Feather River Fish Hatchery	1,450	Juveniles (1+)	100
		Interim Facility	115	Adults	100
	2018*	SCARF (Feather River Fish Hatchery)	200,000	Juveniles	100
	2019*	SCARF (Feather River Fish Hatchery, Butte Creek, San Joaquin River)	600,000	Juveniles	100
	2020*	SCARF (Feather River Fish Hatchery, Butte Creek, San Joaquin River)	700,000	Juveniles	100
	2021*	SCARF (Feather River Fish Hatchery, Butte Creek, San Joaquin River)	960,000	Juveniles	100
	2022*	SCARF (Feather River Fish Hatchery, Butte Creek, San Joaquin River)	1,000,000	Juveniles	100

*Additional ancillary broodstock (adults and 1+ juveniles) may be released in years 2018 and beyond according to strategies discussed in the HGMP (i.e. based on conditions/capacity in the hatchery facilities and in the San Joaquin River).

Broodstock Collection and Mating: Broodstock for the SJRRP Conservation Facilities are to be obtained from three potential sources: the FRFH (juvenile fish, eggs), the San Joaquin River (adult fish, juvenile fish, eggs), and Butte Creek (juvenile fish only). To date, broodstock have only been sourced from the FRFH, and the SJRRP believes it is important to incorporate genetics from other stocks to begin population establishment with as genetically diverse a population as possible. Broodstock have not been sourced from the San Joaquin River because no returning adult CV spring-run Chinook salmon have been

detected in the restoration area since the inception of the SJRRP. Broodstock have not been sourced from Butte Creek because collection from Butte Creek was not included in previous SJRRP activity permits.

In an effort to increase broodstock effective population size, a decision was made to try to double the number of males used in spawning events, so the SJRRP proposes to collect up to 5,400 broodstock individuals from all potential sources combined, although 2,700 is the minimum needed to meet production targets. Because the ratio of juveniles in a population is expected to be 50:50, and because the sex cannot be immediately determined, doubling the number of males in a broodstock population calls for a doubling of the total number of collected individuals. Additionally, 60 fish from each collection event would be sacrificed for pathology screening at the time of collection and another 10 from each collection event would be sacrificed for pathology screening near the end of the quarantine period. The total number of eggs or juveniles collected annually and the collection source would be constrained by the SJRRP Conservation Facilities capacity and donor stream conditions. Maximum numbers to be collected from each potential source are included in Table 1-1 and anticipated release numbers are included in Table 2-2.

If conditions are suitable, the SJRRP would prefer to collect equally from all three donor sources, with collection ratios dependent on acceptable take from each donor source. If the FRFH is the only available donor source, the SJRRP would collect a maximum of 5,470 individuals from the FRFH including collections for pathology.

The SJRRP proposes to collect a maximum of 2,910 juveniles annually from Butte Creek including collections for pathology (2,700 for broodstock, and 70 for pathology for up to 3 collection periods). Collection would be dependent on the ratio of escapement to population size. Escapement on Butte Creek would be monitored and determined by either direct adult counts at a counting weir or by snorkel survey estimates during the holding period. No juveniles would be collected if the number of female spawners is less than 250. The maximum number collected would scale up from 250 on a two to one basis with the number of female spawners up to 1,455. When the number of female spawners exceeds 1,455 up to the maximum of 2,910 juveniles may be collected. SJRRP staff would consult with CDFW Regional staff prior to collections each year to ensure that actual collection numbers are consistent with results of monitoring efforts of the source population. Juvenile fish from Butte Creek would be collected using a rotary screw trap, which is typically present in the system for population monitoring.

When spring-run Chinook salmon adults return to the Restoration Area, the SJRRP proposes to collect a maximum of 2,980 individuals, including collections for pathology from the SJR. Collections may be

done at the adult, egg, and/or juvenile stage. If adults are collected for broodstock spawning, the SJRRP proposes to collect a maximum of ten percent of returning adults, up to 250 individuals annually. A variety of collection methods may be used to collect broodstock from the restoration area, depending on life stage to be collected.

An annual Donor Stock Collection Plan (DSCP) reviewed and approved by NMFS and CDFW would outline: the number of individuals to be collected every year from each donor source, the manner in which collections would occur, and at which lifestage collections would take place. The DSCP would be provided to NMFS at least 60 days prior to any collections. Amendments to the DSCP may be necessary because egg collections at FRFH can take place as early as September, but juvenile collections would take place throughout the spring. The final determination on collecting wild donor stock would be informed by spawner surveys. If the SJRRP modifies actions described in the DSCP, because spawner survey data would not be available prior to planning egg collections, an addendum to the DSCP would be provided to NMFS.

The Conservation Program would follow hatchery protocols to minimize domestication selection and inbreeding. In order to maximize the genetic diversity of the experimental population and facilitate local adaptation, the hatchery mating protocols may allow for crossing of broodstock from multiple source populations.

The Conservation Program would use genetically-defined spawning matrices to avoid matings between closely related individuals. The selected cut-off for relatedness would depend on the genetic characteristics of the collected broodstock and would be included in Annual Reports. The spawning matrix would be organized by female, with all potential male mates listed below in order of preference based on their coefficient of relatedness (most desirable male mate is the least genetically-related). All broodstock males and females would be examined weekly or biweekly (depending on temperatures and the number of fish that are close to spawning) during the spawning season to determine sexual maturity. All fish would be spawned when sexually mature. Actual pairings would attempt to involve the males highest on the list when the female is mature, but no matings would involve fish related at the level of halfsibling or higher. Detailed description of the mating and selection procedures are included in the HGMP.

Outbreeding depression (progeny with lower fitness than the parents, from the expression of genes that are not adapted to either parental habitat) may result from crossing distantly related populations of

salmon. Monitoring independent success of each source population's establishment in the Restoration Area would require genetic analysis. Genetic monitoring of the reintroduced population using parentage analysis should provide the Conservation Program with information on the frequency of outcrossed matings, their relative survival in the Restoration Area, and whether to incorporate them into hatchery matings. If any cross type performs poorly, mating practices would be adjusted in the SCARF to reduce the proportion of these crosses. Over time, selection on the natural population should eliminate outbreeding depression as the reintroduced populations comingle and natural selection takes over.

Ideally, the Conservation Program would not change the genetic characteristics of the source populations and would produce offspring for release that display the full range of genetic diversity found in the source populations. However, hatchery operations carry genetic risks like inbreeding depression, domestication selection, and loss of genetic diversity through genetic drift. In general, the success in capturing and maintaining the source population's genetic diversity depends in part on adequate collection of broodstock fish and proper mating, respectively.

Egg Incubation, Rearing, and Release: Egg incubation and rearing currently occur in the Interim Facility, but would predominately occur in the SCARF when it is completed in 2018. However, since the SCARF is under construction and has 100% designs, the planned specifications of the facility are well known. Once selected for mating, fish are killed and bled. Females are cut to expel eggs, and eggs are fertilized by squeezing milt from four males into eggs. Eggs are then washed and placed in Ovadine for disinfection. Eggs are measured volumetrically, and incubated in vertical stack incubator egg trays that are divided into four sections to facilitate batch monitoring. Stacks are treated daily for fungus using Ovadine. The Interim Facility has six 12-stack vertical tray incubators, two deep matrix incubators, and one moist air incubator. For the SCARF, the incubators would be increased to 31 16-stack vertical tray incubators.

During incubation, hatching temperatures would be based on the objectives of the SJRRP and may include: mimicking SJR temperatures, slowing or speeding egg development, and/or utilizing temperature to produce thermal marks on otoliths. Dissolved oxygen levels would be maintained near saturation. Eggs would be monitored daily, and visibly dead eggs would be removed. Eggs would be incubated and then reared under controlled hatchery conditions to sufficient age and size to be tagged and released to the river.

All measuring and most marking activities would require netting, removal, and handling. To minimize the likelihood of such affects, Tricaine Methane Sulfonate (MS-222) or carbon dioxide (e.g. Alka-Seltzer or compresses cylinders compressed gas) anesthesia would be administered to juveniles during measuring and weighing activities and PIT tag implantation. All processed fish would be allowed to recover before returning to the rearing tanks.

The entire population of captive reared broodstock would receive a Coded Wire Tagged (CWT), Passive Integrated Transponder (PIT) tag, be adipose fin clipped, and be genotyped for parental based tagging. Parental based tagging involves the collection of a small fin clip from spawned fish. The tissue samples would be sent to the CDFW Tissue Archive in Sacramento where half of the tissue would be archived and half would be sent to a contracting lab for genetic analysis. In the lab, the genetic sample from each fish would be genotyped and identified for sex. The results would be stored in a parent database. After juvenile broodstock reached a minimum fork length of 65 mm, 12 mm PIT tags would be inserted. PIT tags would be used for monitoring individual fish throughout captivity. CWTs are small (less than 1 mm) lengths of wire implanted into the snout of each juvenile fish using specialized automated equipment. All fish that are reared for release into the river (i.e. not broodstock) would not necessarily be PIT tagged, but would receive a CWT and be adipose fin clipped. A subset of released fish may also be acoustic tagged with Juvenile Salmon Acoustic Telemetry System (JSATS) or other appropriate acoustic technology (e.g. tag transmitters appropriately sized for the individual fish). Further details related to marking and tagging are included in the HGMP and in the permit application.

With recent upgrades to the Interim Facility, broodstock holding facilities are composed of four 3-ft circular tanks, eight 6-ft circular tanks, three 16-ft circular tanks and two 20-ft circular tanks. The Interim Facility improvements allow the capability to spawn a total of approximately 50-100 adult salmon annually and to rear their offspring to a size at which they can be coded wire tagged and released in the San Joaquin River. Smaller tanks (3-ft to 6-ft) are covered by portable carports and each/every tank is individually screened to prevent fish from jumping out and predators from gaining access to broodstock.

After subsequent years of drought-related impacts to water supply temperature, CDFW added chillers to the recirculation systems on all egg incubation, fry production, and early rearing facilities, as well as on all 6-to-16 ft. diameter tanks. The two 20-ft diameter tanks are capable of recirculating up to 70% of the incoming supply water but do not have associated chillers, because these tanks would be used during a time of year when water supply temperatures should not be a concern.

For the SCARF, The incubation room (15-ft x 34-ft) would be part of a common hatchery building containing an entrance from the outside and from the prep room, and an entrance into a fry production/early-rearing room. Each entrance would be fitted with a disinfection footbath and a hand sanitizing station. The room would provide low light conditions for incubation and would use multiple styles of incubators for egg development. Recirculation/chiller systems would be installed for egg incubation. The incubation system would allow segregation of a total of 980 individual crosses.

The SCARF rearing facilities would be organized into three main areas; fry production, smolt production, and captive rearing. The smolt production area would be an open-air area consisting of twelve 20-foot diameter and four 30-foot diameter circular culture tanks used for smolt production. Ventria (operable openings) on the side of the tanks would allow fish to leave the hatchery on their own during periods of fish outmigration.

Additionally, six 8-foot, six 20-foot, and three 30-foot diameter circular culture tanks would be used for rearing and holding broodstock. The SCARF would be designed to accommodate the maximum broodstock size of approximately 1,350 adult broodstock that are spawned at the hatchery per broodyear with a ratio of two males per one female.

After fish reach maturity at the Interim Facility or SCARF, they would be spawned and their progeny reared at the facility from the egg to juvenile stage for eventual release into the SJR. Some eggs or juveniles may be transferred to the SIRF for rearing and/or research. Whether transferred directly from the SIRF, FRFH, or reared from eggs, juveniles released into the SJR would either be held in net pens or in transport tanks for acclimation and imprinting before being released to the river. Fish that are raised primarily on SJR water would not require imprinting time. The required acclimation period would be determined as necessary by temperature differential (i.e., a holding time necessary to temper at rate not greater than 1℃/hour and not more than 5℃/day). Holding times may be reduced at the discretion of NMFS to increase predicted survival depending on river conditions (e.g. if fish in holding tanks are exhibiting signs of confinement stress).

After the acclimation period, these fish would be trucked to predetermined locations along the SJR. Fish would be released as high in the system as possible, given water quality and passage conditions lower down in the system, or other logistical considerations. Juvenile releases would take place between January and April depending on river conditions and fish size. Yearling and older releases may occur opportunistically as hatchery and river conditions dictate. Criteria for releasing yearling and older

broodstock, and further details related to release and rearing, are included in the HGMP and the permit application.

2.1.2.2 Research, Monitoring, and Evaluation (RM&E)

The SJRRP is a largescale restoration program that involves multiple research and monitoring components to evaluate the effectiveness of the program related to hatchery operations and changes to river conditions. Monitoring for listed fish occurs at multiple life stages, including egg/fry (emergence trapping), juvenile (snorkeling, trapping, acoustic and PIT tag monitoring, and coded wire tag monitoring), adult (snorkeling, trapping, camera visual monitoring, acoustic tracking, and spawning surveys), and post mortem (carcass surveys). For more details on research and monitoring details please refer to the HGMP (Sections 11 & 12) and permit application[1] (Project Description Section 5 & Supplemental Information Methods Section).

2.2 Alternatives Considered and Eliminated from Further Consideration

NMFS concluded that the alternative[1]s described below would not achieve the objective to enhance the propagation or survival of the Central Valley spring-run Chinook salmon ESU consistent with the Purpose and Need for the Proposed Action. Thus, NMFS would not analyze these alternatives in detail in this EA.

2.2.1 Eliminate Hatchery Production/Improve Habitat

Under this alternative, the SJRRP Conservation Program would be eliminated and the SJRRP would instead focus on improving habitat in the SJRRP Restoration Area.

Both fall-run and spring-run Chinook salmon were extirpated from sections of the Restoration Area. However, fall-run Chinook salmon populations have persisted in some San Joaquin tributaries. Spring-run Chinook salmon were functionally extirpated from the entire San Joaquin River basin by 1950, with the exception of sporadic reports of occasional fish exhibiting a spring-running phenotype in some SJR tributaries (Fry 1961). The Settlement's foundational fishery goal, stated in the Restoration Goal, is to restore and maintain fish populations in "good condition" in the mainstem San Joaquin River below Friant Dam to the confluence of the Merced River (the Restoration Area), including naturally reproducing and self-sustaining populations of Chinook salmon and other fish. The general SJRRP strategy for establishing spring-run and fall-run Chinook salmon populations in the Restoration Area includes two

[1] The permit application and the HGMP are on the APPS website at: https://apps.nmfs.noaa.gov/index.cfm.

types of actions: (1) reintroduce salmon into the system, and (2) create conditions that allow salmon to complete their life history and populations to grow. The Program has adopted two different approaches for reintroducing salmon into the system: (1) volitional strategy for fall-run Chinook, and (2) artificial propagation for spring-run Chinook. So while habitat improvement have occurred and would continue to occur, a volitional spring-run Chinook salmon strategy is unlikely to succeed in the Restoration Area because there are no recognized spring-run Chinook salmon populations in the San Joaquin River to contribute to population reestablishment. Therefore, the Program is using artificial propagation to reintroduce spring-run Chinook salmon to the system.

2.2.2 Reduce Hatchery Production

Under this alternative, hatchery production would be reduced by 50 percent resulting in the annual release of approximately 500,000 juveniles at maximum annual production. Broodstock collection would be similarly reduced.

The annual hatchery production goals, and related broodstock collection targets, are the result of analysis by state and federal fisheries managers, and discussed in the HGMP and in multitude of SJRRP documents including the Fisheries Management Plan (FMP, SJRRP 2010) and the Reintroduction Strategy for Spring Run Chinook Salmon document (SJRRP 2011). Reducing the hatchery production or broodstock collection goals below the targets determined by analysis of restoration area and donor population capacity could result in a less robust genetic structure of the reintroduced population, and may cause the failure of the spring-run Chinook salmon reintroduction and reduce the SJRRP's likelihood of meeting the Restoration Goal of the Settlement.

2.2.3 Do not include Broodstock Collection from Butte Creek/Maintain Broodstock Program with Contributions from the Feather River Fish Hatchery and the San Joaquin River

Under this alternative, the SJRRP Conservation Program broodstock would be maintained solely by contributions from the FRFH and the San Joaquin River.

The Reintroduction Strategy for Spring Run Chinook Salmon (SJRRP 2011) document identifies that each of the three extant CV spring-run Chinook salmon lineages has biological characteristics that might be favorable for a successful reintroduction project. CV Spring-run Chinook salmon vary in a number of important traits like: distinctive use of diverse aquatic habitats, timing of spawning, migration, and breeding, and natal fidelity (the ability for adults to return to the site where they were spawned). Conditions on the San Joaquin River would likely provide strong, novel selection pressure that may result

in the potential for evolution of traits to occur. To date, broodstock collection has been limited to the FRFH.

The benefits associated with diversifying the broodstock include an increase in overall genetic diversity and reduction in inbreeding risk. Failing to incorporate genetics of additional CV spring-run sources could prevent the reintroduction population from having the flexibility to adapt to their reintroduction location, and therefore may cause the failure of the spring-run Chinook salmon reintroduction and reduce the SJRRP's likelihood of meeting the Restoration Goal of the Settlement.

3 AFFECTED ENVIRONMENT

The affected environment in this analysis is defined as that portion of the physical, biological, and social environment that may be affected by implementation of the alternatives. The Proposed Action would impact resources in the upper San Joaquin River basin, FRFH, and Butte Creek, and could impact resources in the marine environment because spring-run Chinook salmon released from SJRRP Conservation Facilities migrate to the ocean. Resources that could be impacted and are part of this environmental analysis include water resources (water quality), biological resources (including fish species and fish-eating birds), and socioeconomics. The Proposed Action is not expected to have effects on other resources (i.e., hydrology, geologic resources, air quality, noise, visual resources, vegetation, and species of wildlife other than those addressed), so these other resources are not specifically addressed in this analysis.

While FRFH and Butte Creek are considered as potential donor populations, fish would only be collected from FRFH when excess production is available at the hatchery (e.g., in 2017 the hatchery was not able to produce excess production and no fish were transferred to the SJRRP), and fish would be collected from Butte Creek from a pre-existing rotary screw trap. In both cases, there would not be impacts to the systems beyond biological impacts to the source populations themselves. In addition, the NEPA considerations of various potential donor stock populations were discussed in the 10(j) EA (Section 2.2)[2]. Therefore, additional resources (e.g. water quality, geologic resources, etc.), for FRFH and Butte Creek, are not further discussed here.

3.1 Water Resources

Over the past two centuries, development of water resources transformed the San Joaquin River. In the late 1880s, settlers in the Central Valley drained large areas of valley floor lands and put these lands into agricultural production, supported by small and seasonal diversion dams on the river and a series of water conveyance and drainage canals. Hydroelectric project developments in the upper portions of the San Joaquin River watershed harnessed power from the river and modified the natural flow patterns.

In 1944, Reclamation completed construction of Friant Dam on the San Joaquin River. With the completion of Friant-Kern Canal in 1951 and Madera Canal in 1945, Friant Dam diverted San Joaquin River water supplies to over 1 million acres of farmland along the eastern portion of the San Joaquin

[2] The final environmental assessment for the Nonessential Experimental Population Designation and 4(d) take provisions for reintroduction of Central Valley Spring-run Chinook Salmon to the San Joaquin River below Friant Dam: http://www.westcoast.fisheries.noaa.gov/publications/Central_Valley/San%20Joaquin/san_joaquin_reintroduction_10j_final_environmental_assessment_123013.pdf

Valley. Operation of the dam ceased flow in some portions of the river and, in concert with other stressors, extirpated salmon runs in the San Joaquin River upstream from its confluence with the Merced River.

3.1.1 Water Quality

Water quality in the Restoration Area is discussed in detail in the PEIS/R (2011; Chapter 14.0), the Broodstock EA (Section 3.8.5) and the Release EA (Section 3.4.3). The primary source of water at the upstream end of the Restoration Area (i.e., releases from Friant Dam) is generally considered very good in terms of water quality, having low temperature, low salinity, high dissolved oxygen, low nutrient concentrations, and no known problems with trace elements or pesticides. The reach from Gravelly Ford to the Mendota Pool (Reach 2) is frequently dry, except during Friant Dam flood releases; because water released at Friant Dam is diverted upstream to satisfy water rights agreements, or the water percolates to groundwater. Surface water quality in various sections of the Project Area have been degraded due to low river flows, agricultural operations, and illegal dumping, resulting in increased concentrations of salts, pesticides, nutrients (from fertilizers), and trash or debris. Water quality criteria applicable to some beneficial uses were historically met within Reaches 3 and 4 of the SJRRP Restoration Area (DWR 2012). However, as part of the Settlement, the Restoration Administrator is authorized to suggest Restoration Flow Guidelines. Restoration Flows connected the Restoration Area hydrologically beginning in 2017, and the river is expected to maintain hydrologic connectivity in perpetuity except in very dry years.

The Restoration Area is extensively monitored for water quality indices, including temperature, dissolved oxygen, and contaminants. Increased incidence of flow connectivity, in concert with regular monitoring, is likely to improve water quality conditions in the Restoration Area.

The Interim Facility is adjacent to the San Joaquin River Trout Hatchery (SJTH), which produces trout that are not a component of the SJRRP. Both facilities are operated by the CDFW. Prior to 2016 the water flow to both facilities was supplied from the Reclamation Friant Dam via a 35 cubic feet per second (cfs) transmittal line. Water was conveyed through an 18-24-inch pipeline tapped into Friant Dam's river outlet penstocks and/or a 30-inch diameter pipeline connected to the Friant Kern Canal, which discharges into a 44-inch diameter pipeline connected to the SJTH. Following the completion of the SCARF water supply and infrastructure project in 2017, the transmittal capacity was increased to 55 cfs.

3.2 Biological Resources

The biological resources potentially affected by the Proposed Action are those within SJRRP Restoration Area, Butte Creek, and FRFH. The status of listed and unlisted salmonid species is discussed below, as well as the status of other fish species in the Basin.

3.2.1 Salmon and Steelhead

3.2.1.1 Central Valley spring-run Chinook salmon

The CV spring-run Chinook salmon Evolutionarily Significant Unit (ESU) is listed as threatened under the ESA. CV spring-run Chinook salmon were originally listed as threatened on September 16, 1999 (64 FR 50394). This ESU consists of Chinook salmon occurring in the Sacramento River basin. CV spring-run Chinook salmon were extirpated from the San Joaquin River following the completion of Friant Dam and resultant channel dewatering over 60 years ago. Critical habitat was designated for CV spring-run Chinook salmon on September 2, 2005 (70 FR 52488), and because spring-run Chinook salmon had been extirpated from the San Joaquin River, it was not considered for critical habitat determination. In 2015, NMFS completed a five-year status review of CV spring-run Chinook salmon and recommended that they remain a threatened species (National Marine Fisheries Service 2016a).

A final rule was published to designate a nonessential experimental population of CV spring-run Chinook salmon to allow reintroduction of the species between Friant Dam and the confluence with the Merced River on the SJR as part of the SJRRP (78 FR 79622; December 31, 2013). Pursuant to ESA Section 10(j) the nonessential experimental population of CV spring-run Chinook salmon is treated as a species that is proposed to be listed as threatened. The final rule includes proposed protective regulations under ESA section 4(d) that provides specific exceptions to prohibitions under ESA Section 9 for taking CV spring-run Chinook salmon within the experimental population area, and in specific instances elsewhere. Fish from this nonessential experimental population were first released into the San Joaquin River in 2012, and annual releases have occurred since.

The FRFH spring-run Chinook salmon population has been included as part of the CV spring-run Chinook salmon ESU in the most recent listing decision (70 FR 37160, June 28, 2005). Although FRFH spring-run Chinook salmon production is included in the ESU, these fish are not subject to ESA Section 9 take prohibitions (70 FR 37160, June 28, 2005).

Spring-run Chinook salmon were once the predominant run in the Central Valley. Present day abundance of spring-run Chinook salmon has declined dramatically from historical levels. Commercial harvest data comparing average catch from 1916 through 1949 and 1950 through 1957 showed a 90 percent reduction in spring-run Chinook salmon harvest over that time period (Skinner 1958). Dam construction and habitat degradation have eliminated spring Chinook populations from the entire San Joaquin River Basin and from many tributaries to the Sacramento River Basin.

Current spawning habitats for spring-run Chinook salmon in the upper Sacramento River include the main stem Sacramento River downstream of Keswick Dam and Clear, Beegum, Battle, Antelope, Mill, Deer, and Butte creeks. CV spring-run Chinook salmon also occur in Feather and Yuba Rivers. Changes in timing of migration apparently occurred after the construction of Shasta Dam, and indicate possible hybridization with fall-run Chinook salmon in the upper Sacramento River.

The Final Recovery Plan for Central Valley Salmon and Steelhead (NMFS 2014) contains ESU-level and population-level recovery criteria for CV spring-run Chinook salmon. In order to meet the recovery criteria for this ESU and thereby delist the species, there must be at least eight populations at a low risk of extinction distributed throughout the Central Valley, as well as, additional populations at a moderate risk of extinction. As described in Williams et al. (2016), these recovery criteria are not currently being met.

Butte Creek is one of three independent populations of CV spring-run Chinook salmon that remains in the Central Valley. Water conditions in Butte Creek have been largely determined by the Pacific Gas and Electric (PG&E) De Sabla-Centerville Hydroelectric Project (DSCHP). Since 1999, the DSCHP was operated under a Project Operations and Maintenance Plan developed each spring in consultation with the state and federal fisheries managers for the protection and enhancement of Chinook salmon. Under the plan, water was released from reservoirs on the Feather River, first from Round Valley Reservoir, followed by the release of water from Philbrook Reservoir as high temperatures occurred during the summer. Butte Creek has experienced recent returns ranging from below 2,000 adults to nearly 20,000 adults. Preliminary data for 2017 suggests estimates the adult return for 2017 to be 926 fish, which would be the lowest estimate in the last 20 years. In addition, in February of 2017 PG&E announced that it is withdrawing its application to relicense the DSCHP, and so the long term water operations, and the CV spring-run Chinook population that depends on that water, are currently unknown.

3.2.1.2 California Central Valley steelhead

The CCV steelhead Distinct Population Segment (DPS) is listed as threatened under the ESA. CCV steelhead were originally listed as threatened on March 19, 1998 (63 FR 13347). Following a new status review (Good et al. 2005) and after application of the agency's hatchery listing policy, NMFS reaffirmed its status as threatened and also listed the FRFH and Coleman National Fish Hatchery stocks as part of the DPS in 2006 (71 FR 834). In June 2004, after a complete status review of 27 west coast salmonid ESUs and DPSs, NMFS proposed that CCV steelhead remain listed as threatened (69 FR 33102). On May 5, 2016, NMFS completed another 5-year status review of CCV steelhead and recommended that the CCV steelhead DPS remain classified as a threatened species (National Marine Fisheries Service 2016b).

Critical habitat was designated for CCV steelhead on September 2, 2005 (70 FR 52488). Designated critical habitat for CCV steelhead includes stream reaches such as those of the Sacramento, Feather, and Yuba Rivers, and Deer, Mill, Battle, and Antelope creeks in the Sacramento River basin; the SJR, including its tributaries; and the waterways of the Delta (70 FR 52488).

Currently the CCV steelhead DPS and critical habitat extends up the SJR up to the confluence with the Merced River. Critical habitat includes the stream channels in the designated stream reaches and the lateral extent as defined by the ordinary high-water line. The southern end of critical habitat for CCV steelhead is the confluence of the Merced River, which is the northern end of the San Joaquin River portion of the action area. Therefore, CCV steelhead critical habitat does not occur within San Joaquin River portion of the action area.

Historic abundance of CCV steelhead in the action area is difficult to determine, but CCV steelhead were once widely distributed, with abundance estimates of 1 to 2 million adults throughout the Central Valley system (McEwan 2001). If CCV steelhead were currently present in the action area, the likelihood of survival would be low, as current conditions do not reliably provide suitable rearing or migratory habitat. Three successive years of monitoring in 2012, 2013, and 2014 failed to capture CCV steelhead in Reaches 4B and 5, leading to the belief that CCV steelhead have been extirpated from all reaches of the SJRRP Restoration Area (SJRRP 2012, SJRRP 2015). While CCV steelhead are likely extirpated from the action area, improvements in fish passage and flows that are part of the SJRRP may encourage some straying and recolonization of the area.

Annual monitoring for CCV steelhead would continue in the downstream reaches of the SJRRP Restoration Area as part of the CCV steelhead monitoring plan (NMFS Section 10(a)(1)(A) Permit 16608-2R). Any CCV steelhead captured during these activities would be transported out of the Restoration Area.

The Final Recovery Plan for Central Valley Salmon and Steelhead (NMFS 2014) includes specific, measureable criteria for recovery of the CCV steelhead DPS. The plan calls for a minimum of two viable populations of steelhead within the Basalt and Porous Lava Diversity Group, one within the Northwestern California Diversity Group, four within the Northern Sierra Nevada Diversity Group, and two within the Southern Sierra Nevada Diversity Group. The best chance for eventual delisting of this species is expansion of their range, as it was the creation of dams that has removed them from over 80 percent of their original spawning and rearing habitat in the Central Valley (Williams et al. 2016).

3.2.1.3 Central Valley Late-fall Chinook Salmon and Central Valley fall-run Chinook salmon

Central Valley fall-run and late-fall Chinook salmon are not listed under the ESA or the California ESA (CESA) at present. However, natural populations of these Central Valley stocks are identified as species of concern (September 16, 1999, 50 FR 50394). The ESU includes all naturally spawned fall-run Chinook salmon in the San Joaquin and Sacramento Basins, east of Carquinez Strait, California.

Central Valley late-fall-run Chinook salmon: The historic distribution of late fall-run Chinook salmon is not well documented, but this species most likely spawned in the upper Sacramento and McCloud rivers, in reaches now blocked by Shasta Dam and flooded by Shasta Reservoir, as well as in portions of major tributaries that provided adequate cold water in summer. There is also some evidence they once spawned in the San Joaquin River in the Friant region and in other large San Joaquin tributaries (Yoshiyama et al. 1998). Currently, late fall-run Chinook salmon are found primarily in the Sacramento River, where most spawning and rearing of juveniles takes place in the reach between Red Bluff Diversion Dam (RBDD) and Redding (Keswick Dam). Although late fall-run Chinook salmon occur in tributary streams to the Sacramento River, most spawn in the mainstem Sacramento River. The primary population depends on dam operations for maintenance of suitable habitat. While affected to a lesser degree than fall-run Chinook salmon, this run remains of ongoing concern due to the strong influence of salmon hatchery stocks in the CV and associated potential ecological and genetic impacts to the sustainability of the run. Abundance estimates of late-fall Chinook salmon are depressed from historic levels, but have been stable relative to the dramatic fluctuations of abundance observed for CV fall-run Chinook salmon. Less

management is directed to benefit late fall-run Chinook salmon than for any other run in the Sacramento River, because little is known about the run and it is considered a race within the fall-run Chinook ESU.

Central Valley fall-run Chinook salmon: Fall-run Chinook salmon are the most abundant run of salmon in the Central Valley. The historic abundance of fall-run Chinook salmon is difficult to estimate, because populations declined before extensive monitoring occurred and good records were kept. Hydraulic mining operations during the Gold Rush Era buried spawning and rearing areas under mining debris before the first estimates of salmon numbers were made. Construction of large dams throughout the Central Valley in the 1940s-60s further reduced wild Chinook salmon numbers. However, the extent of these impacts on Central Valley Chinook populations is uncertain because artificial propagation began in this era and no effort was made to differentiate wild Chinook from those produced in hatcheries. Until recent years, escapement estimates for fall-run salmon included both hatchery and natural-origin fish with the relative proportions unknown.

Currently, Central Valley fall-run Chinook salmon are supported by a large-scale hatchery programs that produce a total of approximately 32 million juveniles annually. The effects of hatchery production on abundance and population dynamics of fall-run Chinook has been poorly documented, but recent studies are allowing a better analysis of stock composition in the Central Valley. Data from the Constant Fractional Marking Program indicates that a high proportion of fall-run Chinook salmon spawning in-river are of hatchery origin, particularly in streams with large hatchery facilities. Recent studies of otolith microchemistry suggest the same results (Barnett-Johnson et al. 2007, Johnson et al. 2012, Kormos et al. 2012). In addition, stray rates between river basins are variable and in some cases relatively high (Kormos et al. 2012). Genetic evidence suggests that Central Valley fall-run Chinook populations are now genetically homogenous (Williamson and May 2005, Lindley et al. 2007).

The SJRRP has adopted a volitional strategy for establishing fall-run Chinook salmon populations in the Restoration Area where the population would establish from strays from other San Joaquin River basin tributary populations. The strategy relies on the fact that, unlike spring-run Chinook salmon populations, fall-run Chinook salmon populations have not been extirpated from the entire basin. Fall-run Chinook salmon have been returning to the downstream end of the Restoration Area and efforts to trap-and-haul fall-run Chinook salmon from the lower end to the upper end (where suitable spawning habitat exists) occurred annually between 2012 and 2016.

3.2.2 Other Fish Species

3.2.2.1 Southern Distinct Population Segment of North American Green Sturgeon

Two DPSs of North American green sturgeon (*Acipenser medirostris*) have been identified; a northern DPS (NDPS) and a southern DPS (SDPS). While individuals from the two DPSs are visually indistinguishable and have significant geographical overlap, current information indicates that they do not interbreed or utilize the same natal streams. The SDPS of green sturgeon include those that spawn south of the Eel River, specifically within the Sacramento and Feather rivers and possibly also the Yuba River.

In June of 2001, NMFS received a petition to list green sturgeon and designate their critical habitat under the ESA. After completion of a status review (Adams et al. 2002), NMFS found that the species comprises two DPS's that qualify as species under the ESA, but that neither DPS warranted listing. In 2003, this decision was challenged in federal court and NMFS was asked to reconsider available life history information. In April of 2005, NMFS revised its "not warranted" decision and proposed to list the SDPS as "threatened" (71 FR 17757). In 2006, in its final decision to list SDPS green sturgeon as threatened, NMFS cited the presence of the only known spawning population limited to a single river (Sacramento River), in California's Central Valley. It also cites the loss of historical spawning habitat, mounting threats regarding habitat quality and quantity in the Delta and Sacramento River, and an indication of declining abundance based on salvage data from the State and Federal salvage facilities (71 FR 17757). Since the original 2006 listing decision, new information has become available, reaffirming NMFS concerns that SDPS green sturgeon face substantial threats to their viability and recovery (Israel and Klimley 2008).

While SDPS green sturgeon were previously believed to be extirpated from the San Joaquin River Basin, a single adult individual was positively observed in the Stanislaus River in fall of 2017 (Joe Heublein, pers. comm.).

3.2.2.2 Pacific Lamprey

Pacific lamprey (*Lampetra tridentata*) occur along the Pacific coast from Hokkaido Island, Japan (Morrow 1980), through Alaska and south to Rio Santo Domingo in Baja California (Ruiz-Campos and Gonzalez-Guzman 1996). Their populations have declined in abundance and have become restricted in distribution throughout California, Oregon, Washington, and Idaho. In the Central Valley, their upstream

range appears to be limited by impassable dams that exist on all large rivers, primarily on the valley floor and foothills. The lower reaches of most west-side streams are seasonally dry or have low, warm flow and probably do not provide rearing habitat for ammocoetes (larvae), but they can function as migration corridors for both upstream migrating adults and downstream migrating juveniles.

In 2003, USFWS received a petition to federally list the Pacific lamprey in Oregon, Washington, Idaho, and California as threatened or endangered under the ESA. In 2004, the USFWS found that the petition did not provide the required information to indicate that listing the species may be warranted and, therefore, a status review was not initiated.

3.2.3 Fish Eating Bird Species

3.2.3.1 Bald Eagle

Bald eagles (*Haliaeetus leucocephalus*) occur in North America from central Alaska and Canada south to northern Mexico (USFWS 1995). They are found primarily along coasts, inland lakes, and large rivers, but may also be found along mountain ranges during migration. Bald eagles are carnivores that prey upon fish, mammals, smaller birds, and, when necessary, carrion. Prey is sometimes obtained by stealing from other birds. The bald eagle is known to occur in the Action Area. Bald eagles are known to frequent Lake Millerton, particularly in the wintertime, when maximal counts of eagles are recorded. Arrival of eagles may occur in early October. Telemetry studies of banded eagles revealed that the lake's population breeds on the Great Slave Lake area of Canada, Northwest Territories.

3.2.3.2 Osprey

The osprey (*Pandion haliaetus*) breeds in northern California from Cascade Ranges south to Lake Tahoe, and along the coast south to Marin County. Regular breeding sites include Shasta Lake, Eagle Lake, Lake Almanor, and other inland lakes and reservoirs (Polite 2008). Ospreys are found only in association with lakes, reservoirs, coastal bays, or large rivers. They feed predominantly on fish, although some mammals, birds, reptiles, and amphibians are also eaten. Ospreys are known to use riparian forests near the Sacramento and San Joaquin River mainstems and are ubiquitous from March through October; peak nesting occurs during May and June (Watchable Wildlife 2005).

3.3 Socioeconomics

The SJRRP Restoration Area forms the border between Madera and Fresno counties, and flows into Merced County. The counties, which are in north-central California, together have around 1.1 million inhabitants. The largest city is Fresno, which has over 500,000 residents. Agriculture is the principal

source of economic activity in all three counties, but urban economic drivers in the city of Fresno are also contributors.

The total number of staff employed by various agencies under the SJRRP who perform hatchery and monitoring activities, and provide the necessary regulatory support to perform those activities in the field, is variable annually and seasonally. Depending on the specific workload of the SJRRP at any given time, and is usually more than 30 people. While most of those employees are not solely supported by actions analyzed in this EA, issuance of the permit is critical for the ongoing activities of the SJRRP. The SCARF, which began construction in 2017 and is expected be completed in 2018, required ~$23.7 million for construction, and would contribute additional funds to the local economy for operation and maintenance.

3.4 Commercial and Recreational Fisheries

Spring-run Chinook salmon propagated at the SJRRP Conservation Facilities are not intended for harvest, although some are incidentally harvested in fisheries targeting non-listed salmon. Most incidental harvest occurs in the ocean recreational fishery south of San Francisco Bay. By providing a source of coded-wire tagged spring-run Chinook salmon, the SJRRP indirectly benefits harvest management. Recovery of CWTs from spring-run Chinook salmon originating from SJRRP facilities may be used to monitor the effectiveness of harvest regulations and to inform decisions related to harvest management, which are aimed at reducing the harvest of listed Chinook salmon.

3.4.1 Ocean Harvest

While adult Chinook salmon exploitation rates can reach 70 percent for some stocks (CA HSRG 2012, PFMC 2014), there is substantial uncertainty related to the magnitude and annual variability of the effect of ocean harvest on spring-run and fall-run Chinook salmon to be produced by the Program. The fall-run Chinook salmon ocean harvest rate index peaked in the late 1980s and early 1990s, ranging from 60–80 percent, but has since declined. With the closure of nearly all Chinook salmon ocean fisheries south of Cape Falcon, Oregon in 2008 and 2009, the index dropped to six percent and one percent in these years, respectively. Although ocean fisheries resumed in 2010, commercial fishing opportunity was severely constrained, particularly off California, resulting in a harvest rate index of 16 percent. Since 2011, ocean salmon fisheries in California and Oregon have had more typical levels of fishing opportunity. The average fall-run Chinook salmon ocean harvest rate index from 2011–2014 was 45 percent. Attempts have been made to estimate CV spring-run Chinook salmon ocean fishery exploitation rates using CWT recoveries from natural origin Butte Creek fish (Grover et al. 2004), but due to the low number of tag

recoveries, the uncertainty of these estimates is too high to accurately determine actual harvest rates (NMFS 2016). Importantly, it is possible CV spring-run Chinook salmon experience lower overall fishing mortality than do fall-run Chinook salmon. The CV spring-run Chinook salmon spawning migration largely concludes before the mid- to late-summer opening of freshwater salmon fisheries, suggesting in-river fishery impacts on CV spring-run Chinook salmon are relatively minor (NMFS 2016). Overall, it is highly unlikely harvest resulted in overutilization of CV spring-run Chinook salmon, but actual harvest rates on fish produced from the Restoration Area would not be known for many years. Harvest exploitation rates for SJRRP fish would be refined over time based on the results of updated CWT analyses.

The Program's assumption is spring-run and fall-run Chinook salmon populations can be restored at the current exploitation rate of 50 percent (i.e., the assumption is harvest rates would not be reduced in the future). Monitoring would determine whether harvest is preventing the Program from meeting adult abundance targets.

3.4.2 Freshwater (Inland) Harvest

CDFW has established specific in-river fishing regulations and no-retention prohibitions designed to protect CV spring-run Chinook salmon in the San Joaquin River during their freshwater life stages. The San Joaquin River is closed to salmon fishing, at least for retention. In addition, the CV spring-run Chinook salmon spawning migration largely concludes before the mid- to late-summer opening of freshwater salmon fisheries elsewhere, suggesting in-river fishery impacts on CV spring-run Chinook salmon are relatively minor (NMFS 2016). Prior to the inception of the SJRRP, Reach 1 of the Restoration Area was planted with rainbow trout from the SJTH; while some legacy rainbow trout remain in the area, that fishing opportunity has been somewhat curtailed, but fishing for non-salmonid fish species continues year-round in the Action Area.

4 ENVIRONMENTAL CONSEQUENCES

This section provides the scientific and analytic basis for comparing the two proposed alternatives. It includes a discussion of the probable consequences of the two proposed alternatives on environmental resources. The following is an analysis of the potential environmental consequences on the major components of the environment based on the current affected environment conditions described in Section 3 (Affected Environment), organized by the alternatives considered in Section 2 (Alternatives Including the Proposed Action). Differences between the No-action and Proposed Action alternatives are primarily related to incremental biological improvements as a result of full implementation of the monitoring and enhancement activities in the permit and the HGMP over the five year life of the permit.

4.1 Effects from Alternative 1 (No-action Alternative)

Under a No-action Alternative, NMFS concludes that the permit application does not meet the ESA section 10(a)(1)(A) permit issuance criteria and approval of the associated HGMP is not warranted. NMFS would not issue the permit to USFWS authorizing take of ESA-listed species associated with the requested SJRRP hatchery propagation activities. For the purpose of this analysis, this alternative would not allow the activities necessary for continued operation of the SJRRP Conservation Program, nor would it allow for continued operation of a captive broodstock program for CV spring-run Chinook salmon. Consequently, any directed take of spring-run Chinook salmon for the purpose of monitoring, enhancement, or artificial propagation would result in a violation of Section 9 of the ESA. Therefore, it is unclear at this point how the SJRRP would continue to try to meet its obligations under the Settlement for the reintroduction of spring-run Chinook salmon. If spring-run Chinook are not reintroduced by the SJRRP, fall-run Chinook would be reintroduced in order to meet obligations under the Settlement, whether by natural recolonization or planting. Impacts to environmental resources from fall-run Chinook salmon reintroduction would be similar to the impacts of spring-run Chinook salmon and are described where appropriate in the following section under each resource impacts analyses.

4.1.1 Water Resources

4.1.1.1 Water Quality

Under the No-action alternative, reintroduction of spring-run Chinook salmon in the SJRRP Restoration Area would not be possible. It is unclear what the future of the interim facility and eventually the SCARF would be, but the SJTH would continue to receive water via existing infrastructure in place to also support the interim facility and SCARF, and the SJTH would continue to release water into the San Joaquin River. The construction of the infrastructure necessary to increase supply from 35 cfs to 55 cfs to provide for the increased requirement of the SCARF was previously analyzed in an existing EA (BOR

2016). When construction of the SCARF is complete it could help propagate fall-run Chinook for reintroduction under the SJRRP, even if the spring-run Chinook reintroduction did not occur. Because the FRFH only provides fish for the SJRRP when its own production targets have been met, production actions at the FRFH would not appreciably change with regards to water quality, but the hatchery would not plan to produce fish for the SJRRP. Therefore, there would be only minimal changes to either the FRFH operations or the environment.

4.1.2 Biological Resources

4.1.2.1 Salmon and Steelhead

Central Valley spring-run Chinook salmon

Under Alternative 1 (No-action) as described in Section 2.1, if NMFS does not issue the permit, the implementing agencies, including USFWS, would have to decide how to proceed in implementing the SJRRP to try to achieve the restoration goal of the Settlement. The SJRRP would have interim expired coverage under the previous 10(a)(1)(A) permits (as long as there is new permit application submitted[3]), but they would not be able to adapt to the changing needs of the program. It is unclear at this point whether and how all of the elements of the program would be implemented given that the hatchery and monitoring components of the SJRRP require an ESA Section 10(a)(1)(A) permit to occur without being in violation of the ESA. Without a take authorization, collection and handling of spring-run Chinook salmon would cease. And it is unclear whether collection and handling of listed spring-run Chinook salmon could cease given that fish are currently in possession.

If the spring-run Chinook salmon hatchery Conservation Program were eliminated, all potential negative impacts from the program on biological resources, including anadromous salmonid species, would be eliminated. However, the hopes of reintroducing CV spring-run Chinook to the San Joaquin River would also be essentially eliminated. According to the Final Recovery Plan for Central Valley Salmon and Steelhead (NMFS 2014), the population of CV spring-run Chinook salmon in the SJRRP Restoration Area is considered a top priority for reintroduction. Eliminating the possibility of reintroducing CV spring-run Chinook salmon to the Restoration Area has the potential to affect the possibility of recovery of the entire ESU.

Given the adverse conservation consequences of eliminating the hatchery and monitoring component of the SJRRP Conservation Program, the history of the program operating similar to current hatchery

[3] https://www.law.cornell.edu/cfr/text/50/222.304

practices, and the uncertainty regarding whether elements of the SJRRP would continue or not, NMFS believes it is appropriate to also analyze the effects of continuing current operations at the SJRRP Conservation Facilities under the No-action alternative, even though such operations would change without the issuance of this permit.

Under such circumstances, production levels are limited and no collection from Butte Creek would be possible. One of the potential impacts of hatchery propagation at the Interim Facility and the SCARF is the genetic and demographic consequences of inbreeding. The fish that are most highly related to the other fish in their populations are at the highest risk for causing inbreeding depression and are the least likely to have alleles otherwise not present within their populations.

Inbreeding results when closely related adults are spawned at a hatchery and the survival of progeny is decreased. Inbreeding depression is addressed directly by avoiding sibling breeding (Woodworth et al. 2002). This potential issue is significantly reduced by the broodstock selection techniques currently employed by SJRRP staff. However, the potential for inbreeding depression increases dramatically if collection from additional extant CV spring-run Chinook salmon populations (i.e. Butte Creek) are not permitted.

Reintroduction of fall-run Chinook salmon would have no impact on spring-run Chinook salmon under the no-action alternative because spring-run Chinook salmon would not exist within the restoration area.

California Central Valley Steelhead

Because the Restoration Area is located upstream of the critical habitat designated for CCV steelhead, and the No-action Alternative is not likely to adversely affect any prey resources or migration corridors utilized by ESA-listed salmonids. NMFS does not anticipate that the No-action Alternative would have any effect on essential features of critical habitat for CCV steelhead. Therefore, the No-action Alternative is not likely to negatively impact critical habitat for CCV steelhead.

Central Valley fall-run Chinook salmon and Central Valley late-fall Chinook salmon

Under the No-action Alternative, any potential negative effects of implementing the SJRRP to other races of Chinook salmon would no longer occur, as discussed in Section 4.1.2.1. However, the SJRRP, when fully implemented, is likely to provide a net benefit for all native fish, including non-listed salmonids, especially fall-run Chinook salmon through reintroduction activities. Under Alternative 1, these benefits would not be realized for spring-run Chinook salmon.

4.1.2.2 Other Fish Species

Southern Distinct Population Segment of North American Green Sturgeon

SDPS green sturgeon were believed to have been extirpated from the San Joaquin River, but a recent citing in a San Joaquin tributary stream indicates that they have the potential to occur there. However, the proposed fish propagation and monitoring are not expected to result in direct or incidental impacts to SDPS green sturgeon. Therefore, the No-action Alternative is not likely to adversely affect SDPS green sturgeon or their critical habitat.

Pacific Lamprey

The No-action Alternative is not expected to affect the physical, chemical, or biological conditions for Pacific lamprey spawners within the San Joaquin River. However, spring-run Chinook salmon juveniles have the potential to prey on larval lamprey, which hatch within several weeks of spawning activity and drift downstream to backwater areas where they burrow into the substrate and commence feeding as ammocoetes (Kostow 2002). Since under the No-action alternative, spring-run Chinook salmon would likely not be present in the Action Area, this effect would not occur. If fall-run Chinook are reintroduced, they may prey on larval lamprey. However, predation by spring-run or fall-run Chinook salmon under either alternative is not likely to significantly affect juvenile Pacific lamprey due to the diversity of other prey items utilized by Chinook salmon juveniles and the relatively high fecundity of larvae produced by Pacific lamprey.

In addition, Chinook salmon are prey for adult Pacific lamprey. The spring-run Chinook salmon adults produced by the SJRRP Conservation Facilities could provide a food source for Pacific lamprey in both the marine and freshwater periods of their life-cycle. Therefore, Alternative 1 (No-action) could negatively affect Pacific lamprey adults although the reintroduction of fall-run Chinook could provide some degree of a food source for lamprey. The availability of other more abundant and desirable food sources means that elimination of spring-run Chinook salmon hatchery production is not expected to result in significant impacts to Pacific lamprey adults.

The monitoring activities, which would be eliminated under the no-action alternative, have the potential to inadvertently capture some non-target fish, including pacific lamprey adults and juveniles. These effects are likely to be small, but would be eliminated without implantation of the permit.

4.1.2.3 Fish Eating Birds

Under the No-action alternative, the SJRRP would cease to release CV spring-run Chinook salmon juveniles. The SJRRP juvenile salmon production possibly is a small benefit to overall foraging opportunities for fish-eating birds by increasing the numbers of potential prey items in the San Joaquin River. However, if production of spring-run Chinook salmon were eliminated under the No-action Alternative, significant impacts to fish-eating birds are not likely to occur due to the relatively short amount of time that the outmigrating fish remain in the system, and the availability of other food sources in the upper San Joaquin River. Reintroduced fall-run Chinook could provide additional food sources for fish eating birds.

4.1.3 Socioeconomics

Under Alternative 1 (No-action), no significant effects on the population or employment are expected. As discussed above in Section 3.3, the total number of staff needed to operate the field work, hatchery work, and supporting regulatory aspects of the SJRRP is variable, but is relatively small compared to the population of the counties where the work occurs. The SJRRP hatchery facilities, and the federal and state employees would continue to be funded, although the ultimate use of the hatchery facilities would need to be determined, with the possibility of using the facilities to raise fall-run Chinook. Therefore, the impact of Alternative 1 (No-action) on regional employment and income is likely insignificant.

4.1.4 Commercial and Recreational Fisheries

4.1.4.1 Ocean Harvest

Under the No Action Alternative no spring-run Chinook would be collected, transported, or reintroduced into the San Joaquin River. Spring-run Chinook salmon are not intended to be produced for commercial consumption, but some fish are captured in the commercial ocean fishery. Commercial fishing of Chinook and other salmon off the coast of northern and central California would continue. There would be no significant adverse impacts under this alternative. There would be no contribution to the fishery of salmon Under the No Action Alternative; therefore there would be no beneficial impacts on spring-run Chinook stocks resulting from this alternative. Fall-run Chinook salmon reintroduction could contribute to ocean harvest in the future dependent on population success and provide beneficial impacts to the ocean fishery.

4.1.4.2 Freshwater (Inland) Harvest

Under the No-action alternative no spring-run Chinook would be collected, transported, or reintroduced into the San Joaquin River. However, CDFW fishing regulations prohibit the targeting or retention of Chinook salmon in the San Joaquin River below Mossdale, so there is not likely to be any significant impacts to the freshwater fishery associated with this alternative even if fall-run Chinook salmon are reintroduced.

4.2 Effects from Alternative 2 (Proposed Action)

Under Alternative 2, NMFS would issue permit 20571 under section 10(a)(1)(A) of the ESA to USFWS, for a period of five years, authorizing the implementation of the HGMP at the SJRRP Conservation Facilities and other activities associated with the SJRRP. The section 10(a)(1)(A) enhancement permit application and the associated HGMP have been submitted by the USFWS and CDFW, respectively, to fulfill their obligation for consultation under section 7(2)(a) of the Federal ESA. The HGMP is intended to provide a single, comprehensive source of information to describe and assess the impacts of current and proposed operations of the SJRRP hatchery facilities on ESA-listed Central Valley populations of anadromous salmonids. As a result of permit issuance, an exception to the take prohibitions would apply to the authorized activities. These activities are outlined in the permit application and associated HGMP and include actions related to propagation of spring-run Chinook salmon at SJRRP facilities and monitoring of spring-run Chinook salmon and CCV steelhead in the San Joaquin River. Through implementation of the HGMP, the SJRRP Hatchery Program would be operated to conserve listed species.

4.2.1 Water Resources

4.2.1.1 Water Quality

No significant effects on water quality are expected under Alternative 2 (Proposed Action). The SJTH effluent is regulated under Clean Water Act National Pollution Discharge Elimination System (NPDES) permit No. CA0004812 Order No. R5-2004-0118 (General Order), administered by the Central Valley Regional Water Quality Control Board (RWQCB). The SCARF would submit a Notice of Applicability to be covered under the General Order as a separate facility. Because of planned flow rates at the SCARF to provide sufficient flushing and optimal conditions for fish rearing, temperature increase is anticipated to be minimal and would remain within the guidelines provided by the CV RWQCB. Water discharged from the Interim Facility and SCARF would enter the associated effluent treatment systems and would be subject to compliance with NPDES requirements, the Water Quality Control Plan for the Sacramento and

San Joaquin River Basins, and regular monitoring of water quality within the SCARF for fish health. The potential water quality effects under the Proposed Action would be the same as described for Alternative 1 because there is no appreciable difference between the two alternatives in terms of activities that can affect water quality. Under the Proposed Action, water discharged from the SJRRP Conservation Facilities into the San Joaquin River would continue to contribute minor amounts of nutrient and organic matter to the river due to SJRRP operations. These small loads are not expected to result in significant impacts to nutrients and algae in the San Joaquin River. The characteristics of the discharge with regard to other water quality constituents also would likely be unchanged from current conditions. The SJRRP would continue to operate pursuant to an NPDES Permit that establishes conditions for the discharge to maintain compliance with the Clean Water Act. Therefore, the Proposed Action is not expected to result in significant impacts to other water quality constituents in the San Joaquin River for the same reasons as described for Alternative 1.

4.2.2 Biological Resources

4.2.2.1 Salmon and Steelhead

Central Valley spring-run Chinook salmon

Under the Proposed Action, effects on spring-run Chinook salmon would occur from continued operation of the SJRRP Conservation Facilities and implementation of the HGMP. Hatchery propagation of spring-run Chinook salmon under Alternative 2 would require the lethal take of various life stages of spring-run Chinook salmon for broodstock and the loss of individuals during incubation, rearing, and marking. There is also the potential for lethal and sub-lethal take to listed fish as a result of in-river monitoring. Releases of over one million juveniles are possible during the final years of the permit. Releases of additional individuals of various life stages, including yearlings and adults, would also be permitted. Additional details for potential collection numbers, and other forms of take, are detailed in the permit application.

In order to minimize the impacts to the source populations, the Conservation Program would target relatively small numbers of juvenile fish for use as broodstock through captive rearing. Specifically, for Butte Creek, collection would be dependent on annual escapement and proportion of collections from other donor sources. The actual number collected will depend on the number of adult returns to Butte Creek the previous spring and the number of individuals collected from other sources as detailed above. Escapement on Butte Creek will be monitored and determined by either direct adult counts at a counting weir or by snorkel survey estimates during the holding period. Escapement estimates by carcass surveys will be used for validation and to account for pre-spawn mortality. These surveys are currently conducted annually. The number of juveniles collected may range up to 2,910 annually. No juveniles would be

collected if the number of female spawners is less than 250. The maximum number collected would scale up from 250 on a two to one basis with the number of female spawners up to 1,455. When the number of female spawners exceeds 1,455 up to the maximum of 2,910 juveniles may be collected. Since juveniles would only be collected on a two to one basis relative to female spawners, and spawners each produce thousands of eggs, it is unlikely that the removal of juveniles would have a substantial effect on the Butte Creek population. SJRRP staff would consult with CDFW Regional staff prior to collections each year to ensure that actual collection numbers are consistent with results of monitoring efforts of the source population.

Although there is currently no population of CV spring-run Chinook salmon in the Restoration Area, restoration activities under the SJRRP are ongoing. Once a population of spring-run Chinook salmon begins to establish, the potential for indirect impacts to naturally-spawned salmonids may result from inbreeding depression, outbreeding depression, loss of diversity through genetic drift, competitive and predatory interactions, and disease transfer between hatchery-origin and natural-origin individuals in the San Joaquin River. These interactions are an indirect impact of the spring-run Chinook salmon program at the SJRRP Conservation Facilities and result in both positive and negative effects on salmonid populations.

Inbreeding depression: Inbreeding depression would be addressed directly by avoiding sibling breeding (Woodworth et al. 2002). Further, the Conservation Program would likely avoid inbreeding even when parentage is not known based on mating fish following allele-sharing relatedness estimates (Kozfkay et al. 2008). Cut-offs for related measures would be established each time the broodstock is genetically evaluated.

Outbreeding depression: Outbreeding depression is also a risk. Even if fish from different source populations are not crossed, using multiple broodstock sources provides a high probability that natural outcrossing would occur in the reintroduced San Joaquin River population. Salmon, like most other vertebrates, use mate choice mechanisms to evaluate mates and modulate between inbreeding and outbreeding. Genetic evaluation of the frequency of such matings, and the subsequent performance of their offspring, may be used to guide hatchery crossing strategies.

Genetic drift: Genetic diversity decreases through genetic drift, which increases with decreasing effective population size. Factorial matings with all available adults to produce families of approximately equal

size would maximize the effective population size (Fiumera et al. 2005, Frankham et al. 2000) and minimize loss of genetic diversity to random drift.

Predation: After natural salmon are re-established in the San Joaquin River, consideration would be given to the size of hatchery fish at time of release and timing of release to minimize the risk of predation with the natural fish. When possible, releases would occur at night to minimize predation. When river conditions allow, the use of temporary holding pens may allow the juveniles to acclimate before release, and thereby reduce the risk of predation. Although not covered under this EA, additional actions planned by the SJRRP may reduce predation losses in all reaches by reducing the extent and suitability of habitat for nonnative predatory fish. Improvements in habitat conditions related to restoration flows and floodplain restoration may limit risk of predation by many of the key predators present in the Restoration Area.

Competition: Similar to the impacts of predation, there is potential under Alternative 2 for impacts related to competition between hatchery-origin spring-run Chinook salmon and natural-origin salmonids for space in refugia and rearing habitat in the upper San Joaquin River Basin. However, after natural salmon are re-established in the San Joaquin River, consideration would be given to the number of fish to be released, the size of hatchery fish at time of release and timing of release to minimize the risk of competition with the natural fish.

Disease: Currently, CDFW certifies the health and disease status of spring-run Chinook salmon prior to their release in the upper San Joaquin River, and before any transfer to or among SJRRP facilities. Fish health in the SJRRP Conservation Facilities is, and would continue to be, monitored by CDFW fish health personnel. Diagnostic procedures for pathogen detection would follow American Fisheries Society professional standards as described in the American Fisheries Society Bluebook (AFS-FHS 2007). If disease is identified, appropriate treatments would be prescribed by a CDFW Fish Pathologist and follow-up examinations would be performed as necessary. Treatment methods prescribed by fish pathologists for disease outbreaks and treatment protocols would be carried out by hatchery staff. Depending on the cause of an outbreak, treatment methods may vary. Detailed disease screening and mitigation procedures are included in the HGMP.

The risks to CV spring-run Chinook salmon posed by the factors described above (i.e., inbreeding depression, outbreeding depression, genetic drift, competitive and predatory interactions, and disease transfer) are likely to be relatively minor for the reasons described above, and as described in more detail

in the HGMP. There are additional risks to future in-stream population resulting from instream monitoring and enhancement activities included in the permit (e.g., juvenile trapping, emergence trapping) and transport, however those risks would be minimized by following best management practices for each method as described in the application. While there are risks present under Alternative 2 to the hatchery population, and the natural population of CV spring-run Chinook salmon in the Restoration Area once it is established, the potential benefit to the entire population of CV spring-run Chinook salmon of continuing to implement the SJRRP far outweighs the risks.

California Central Valley Steelhead

ESA-listed natural-origin CCV steelhead are thought to have been extirpated from the SJRRP Restoration Area, but they have the potential to exist there. Restoration actions planned as part of the SJRRP beyond the scope of this EA, have the potential to improve habitat and passage conditions for CCV steelhead. Therefore, CCV steelhead may be incidentally impacted by the proposed hatchery activities at the SJRRP Conservation Facilities. Potential impacts associated with juvenile interactions between hatchery-origin spring-run Chinook salmon and naturally produced CCV steelhead are described in the section above (see Predation and Competition). If adult CCV steelhead were captured during monitoring activities they would be transported downstream of the SJRRP Restoration Area until such time that the SJRRP determines that the steelhead monitoring program is no longer necessary. During broodstock collection, injury or incidental mortality may result from trapping, handling, and transport of non-target salmonids, and CCV steelhead may be incidentally trapped during monitoring. However, those risks would be minimized by following best management practices for each method as described in the permit application.

Because the Restoration Area is located upstream of the critical habitat designated for CCV steelhead, and Alternative 2 is not likely to adversely affect any prey resources or migration corridors utilized by ESA-listed salmonids NMFS does not anticipate that Alternative 2 would have any effect on essential features of critical habitat for CCV steelhead.

Under Alternative 2 where SJRRP hatchery production and monitoring continues, broodstock collection activities for CV spring-run Chinook salmon would continue. The Butte Creek rotary screw trap would still be operated for the monitoring of spring-run Chinook salmon broodstock in that basin. CCV steelhead would potentially be collected in that trap. The monitoring activities that would be permitted under the proposed permit have the potential to inadvertently capture some steelhead, but those effects are likely to be small, and must be considered under the potential positive effects that continuing to

implement the SJRRP could have for all species of salmonid. If the permit is not issued it would be possible to continue to implement some components of the Settlement, but SJRRP managers would have to reconsider the framework for implementation of the Settlement.

Central Valley fall-run Chinook salmon and Central Valley late-fall Chinook salmon

Under Alternative 2, the monitoring activities that would be permitted under the proposed permit have the potential to inadvertently capture some non-target races of Chinook salmon. However, the potential detrimental effects to Chinook salmon resulting from the SJRRP conservation activities are minimal due to the differences in the timing of spawning, rearing, and juvenile emigration. Those negative effects are likely to be small, and must be considered under the potential positive effects that continuing to implement the SJRRP could have for all races of Chinook salmon. If the permit is not issued it would be possible to continue to implement some components of the Settlement, but SJRRP managers would have to reconsider the framework for implementation of the Settlement.

4.2.2.2 Other Fish Species

Southern Distinct Population Segment of North American Green Sturgeon

Substantive differences of life history and habitat use between green sturgeon and spring-run Chinook salmon produced at SJRRP Conservation Facilities make interactions between these species unlikely to occur. While there is some recent evidence of use of the San Joaquin Basin by SDPS green sturgeon, incidence of SDPS green sturgeon in the San Joaquin Basin is rare, and they have not been documented in the Restoration Area since the inception of the SJRRP. Therefore, Alternative 2 is not likely to adversely affect SDPS green sturgeon or their critical habitat.

Pacific Lamprey

Alternative 2 has the potential to affect biological conditions for Pacific lamprey spawners within the San Joaquin River. Spring-run Chinook salmon juveniles released by the SJRRP have the potential to prey on larval lamprey. However, predation by spring-run Chinook salmon under Alternative 2 is not likely to significantly affect juvenile Pacific lamprey due to the diversity of other prey items utilized by Chinook salmon juveniles and the relatively high fecundity of larvae produced by Pacific lamprey spawners.

In addition, Chinook salmon are prey for adult Pacific lamprey. The spring-run Chinook salmon adults produced by the SJRRP Conservation Facilities provide a food source for Pacific lamprey in both the marine and freshwater periods of their life-cycle. However, given the availability of other more abundant and desirable food sources, elimination of spring-run Chinook salmon hatchery production is not expected

to result in significant impacts to Pacific lamprey adults. Therefore, Alternative 2 is likely to have a small positive effect on Pacific lamprey adults.

The monitoring activities that would be permitted under the proposed permit have the potential to inadvertently capture some non-target fish, including pacific lamprey adults and juveniles, but those effects are likely to be small, and must be considered under the potential positive effects that continuing to implement the SJRRP could have for lamprey (e.g. habitat and passage improvements). If the permit is not issued it would be possible to continue to implement some components of the Settlement, but SJRRP managers would have to reconsider the framework for implementation of the Settlement.

4.2.2.3 Fish Eating Birds

Under Alternative 2, SJRRP production likely would continue to benefit overall foraging opportunities for fish-eating birds by increasing the numbers of salmon present in the upper San Joaquin River. However, this benefit is likely minor due to the relatively short amount of time that the outmigrating fish remain in the system, and the availability of other food sources in the upper San Joaquin River.

4.2.3 Socioeconomics

Under Alternative 2, no significant effects on the population or employment are expected. The SJRRP hatchery facilities, and the federal and state employees would continue to be funded, and the work they do would continue as planned. As discussed above in Section 3.3, the total number of staff needed to operate the field work, hatchery work, and support regulatory aspects of the SJRRP is variable, but is relatively small compared to the population of the counties where the work occurs. Therefore, the impact of Alternative 2 on regional employment and income is likely insignificant.

4.2.4 Commercial and Recreational Fisheries

4.2.4.1 Ocean Harvest

Under Alternative 2, the SJRRP would continue to reintroduce spring-run Chinook salmon to the Restoration Area. Spring-run Chinook salmon are not intended to be produced for commercial consumption, but some fish are captured in the commercial ocean fishery. Commercial fishing of Chinook and other salmon off the coast of northern and central California would continue. There would be no immediate impact to commercial fishing following the collection, transport, and release of spring-run Chinook into the San Joaquin River, as reintroduced spring-run Chinook would need to propagate over at least several successful spawning generations in order for improvements with commercial catches of spring-run Chinook to become readily apparent. Cumulative impacts to commercial fishing are believed

to be low and beneficial, and are discussed further in section 5 of this EA. Therefore, there would be no significant adverse impacts to commercial fishing.

4.2.4.2 Freshwater (Inland) Harvest

Under the proposed action spring-run Chinook would continue to be collected, transported, and reintroduced into the San Joaquin River. However, CDFW fishing regulations prohibit the targeting or retention of Chinook salmon in the San Joaquin River below Mossdale, so there is not likely to be any significant impacts to the freshwater fishery associated with this alternative.

5 CUMULATIVE EFFECTS

5.1 Introduction

The NEPA defines cumulative effects as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or non-Federal) or person undertakes such other actions" (40 CFR 1508.7). Council on Environmental Quality (CEQ) guidelines recognize that it is not practical to analyze the cumulative effects of an action from every conceivable perspective, but rather, the intent is to focus on those effects that are truly meaningful. In other words, if several separate actions have been taken or are intended to be taken within the same geographic area, all of the relevant actions together (cumulatively) need to be reviewed, to determine whether the actions together could have a significant impact on the human environment. Past, present, and reasonably foreseeable future actions include those that are Federal and non-Federal. For this EA analysis, they also include those that are hatchery related (e.g., hatchery production levels) and non-hatchery related (e.g., human development).

5.2 Habitat Restoration

5.2.1 San Joaquin River Restoration Program

In this section, the proposed action must be considered in the context of the Settlement and the SJRRP. The proposed action is inextricably connected to the SJRRP, and many of the cumulative impacts, including for habitat restoration, are discussed in that context. As explained in the PEIS/R (2011; Chapters 1.0 & 26.0), the need for the SJRRP is three fold. First, the need for action arises from the historic operation of Friant Dam, which has resulted in significant portions of the main stem of the San Joaquin River between Friant Dam and the confluence of the Merced River running dry during significant portions of the year in most water year types, with corresponding downstream impacts to the fisheries. Interim and Restoration Flows, in addition to other improvements providing for channel capacity, fish habitat, related flood protection, fish passage, and fish screening, are necessary elements to meet the Restoration Goal. Second, the Interim and Restoration Flows would create a substantial loss in water supplies to Friant Division long-term Contractors. The need for action to develop and implement water management actions is essential to reduce or avoid these adverse water supply impacts, and is equal in significance to the needs of the Restoration Goal. Third, from a legal perspective, the need for action is in response to the Stipulation of the Settlement, which was approved by the Court in October 2006. Accordingly, the need for action is justified from a biological, water supply, and legal basis.

Therefore, beyond the proposed action, the SJRRP includes a large number of other projects that are designed to restore habitat in the Restoration Area. Those projects, which are detailed in the Settlement,

include: the Reach 2B/Mendota Pool Bypass Improvement Project, modifications to channel capacity, modifications to the Reach 4B headgate, Modifications to the Sand Slough Control Structure, screening and passage projects at Arroyo Canal and Sack Dam, implementation of restoration flows, and more. Those projects, which are in varying stages of completion, implementation, and planning, would dramatically increase the quality, quantity, and accessibility of spawning, rearing, and holding habitat for various life stages of salmonids.

Rehabilitation of habitat in the cumulative effects analysis area would improve salmon and steelhead habitat under the preferred alternative, with particular benefits to freshwater and estuarine environments considered to be important for the survival and reproduction of fish. However, the low beneficial effects from watershed and habitat rehabilitation would not substantially increase survival and abundance of salmon and steelhead without the other improvements included in the Settlement. In addition, rehabilitation is dependent on continued funding, which is difficult to predict over time. Benefits from watershed and habitat rehabilitation are less clear under the No-action alternative, as the fate of the SJRRP on the whole would be less clear if the proposed actions in the permit were not permitted.

5.2.2 Additional Projects or Activities

As noted above, cumulative impacts are those that result from incremental impacts of the project when added to other past, present, and reasonably foreseeable actions within the study area. The proposed action is highly connected to the SJRRP as a whole; however, there are additional projects, programs, and activities in the action area outside the SJRRP that could contribute smaller impacts related to the proposed action. Activities that would not reasonably be expected to have an incremental impact related to the proposed action are not considered here.

San Luis National Wildlife Refuge: The San Luis National Wildlife Refuge encompasses over 26,800 acres of wetlands, riparian forests, native grasslands, and vernal pools. The refuge is located on the downstream end of the SJRRP restoration Area. The refuge has three auto tours routes with associated nature trails and observation decks for the public to view and photograph wildlife and nature. The refuge also allows fishing at designated sites and has a large waterfowl hunting program. The refuge has the potential to provide habitat for outmigrating salmonids, but management for waterfowl, including diversions, has the potential to negatively impact outmigrating salmonids. Therefore, depending on future operational management of the refuge, cumulative impacts could be beneficial, negative, or negligible.

Dos Rios Project: The 1,600-acre Dos Rios project is the result of collaboration among two local non-profit organizations, the Tuolumne River Trust and River Partners. Dos Rios comprises biologically rich floodplain including three miles of riverfront on the San Joaquin River and three miles on the Tuolumne River. The restoration of this land promises to improve habitat for outmigrating salmonids; therefore, the cumulative impacts would be beneficial.

Temperance Flat: Temperance Flat is a proposed water storage project, including a dam and reservoir upstream of Millerton Lake, which feeds water into the San Joaquin River below Friant Dam. The Temperance Flat Reservoir could provide about 1,260 thousand acre feet of additional storage capacity. The alternative plans vary based on operations (conveyance routing of new water supply, potential water supply beneficiaries, and minimum carryover storage targets) and intake feature configurations (low level or selective level). The reservoir would provide new water supply to the downstream water users. New supply would be delivered via the San Joaquin River, and exchanged for Delta supplies at Mendota Pool, where an equivalent amount of water supply would be delivered to contractors via the California Aqueduct. It should be noted that the proposed action is for a five year permit, and the timeline for beginning construction of Temperance Flat, if the project is approved, is also still to be determined. The proposed Temperance Flat Project, if approved, has the potential to affect water temperatures in the restoration area, but the nature of those effects would be dependent on operations that are still to be determined; therefore cumulative impacts could be beneficial, negative, or negligible.

5.3 Geographic and Temporal Scales

The cumulative effects analysis area is the upper San Joaquin River Basin, from the Merced River confluence to Friant Dam. NMFS considered whether the ocean, Sacramento/San Joaquin Delta, and Butte Creek should be included in the broad analysis area, but the effects analysis was unable to detect or measure effects of the Proposed Action beyond the San Joaquin River. Available knowledge and research abilities are insufficient to discern the role and contribution of the Proposed Action to density dependent interactions affecting salmon and steelhead growth and survival in the Pacific Ocean, and the proposed collection scheme for Butte Creek is protective of the population and genetic diversity of the source population. NMFS's general conclusion is that the influence of density dependent interactions on growth and survival is likely small compared with the effects of large scale and regional environmental conditions. While there is evidence that hatchery production on a large scale can impact salmon survival at sea, the degree of impact or level of influence is not yet understood or predictable, nor is there any evidence that programs of this size have effects in the ocean. Thus, direct, indirect, and cumulative impacts of the programs on the human environment outside of the San Joaquin River are not expected.

The scope of the action considered here includes the rearing and release of hatchery-origin spring-run Chinook salmon in the upper San Joaquin River Basin, the collection of natural origin broodstock from Butte Creek, and in-river monitoring associated with SJRRP activities. Adult collection, rearing, and release activities would occur in localized areas only; associated direct and indirect effects of these activities are analyzed in Section 4, Environmental Consequences. The HGMP would be in effect after the associated permit is signed, and would remain in effect for up to five years when the permit expires, or until NMFS determines that the plans are no longer effective. Cumulative effects within the analysis area are analyzed below.

5.4 Climate Change

Under either Alternative 1 (No-action) or Alternative 2 (Proposed Action), no significant effects to climate change are expected. No activities would occur under either alternative that would result in changes to greenhouse gas emissions or other pollutants that are likely to significantly contribute to environmental conditions associated with climate change.

Climate change poses a high threat to salmonids within the Action Area, particularly to spring-run Chinook salmon. Temperatures in California's Central Valley are predicted to increase between 2°C and 7°C by 2100 (Dettinger et al. 2004, Hayhoe et al. 2004, Van Rheenen et al. 2004), with a drier hydrology predominated by precipitation rather than snowfall. The cold snowmelt that furnishes the late spring-run and early summer runoff would be replaced by warmer precipitation runoff, which is particularly problematic for the San Joaquin side of the Central Valley, which is relatively snow-melt driven. Altered river runoff patterns would transform the tributaries that feed the Central Valley. This should truncate the period of time that suitable cold-water conditions persist below existing reservoirs and dams due to the warmer inflow temperatures to the reservoir from rain runoff. Summer temperatures and flow levels in some areas of the Central Valley would become unsuitable for salmonid survival. Without the necessary cold water pool developed from melting snow pack filling reservoirs in the spring and early summer, late summer and fall temperatures below reservoirs, such as Millerton Lake, could potentially rise above thermal tolerances for various life stages of salmonids.

Overall, the range and degree of variability in ambient temperature and precipitation are likely to increase in all rivers, creating long term threats to the persistence of CV spring-run Chinook salmon. Although long-term trends in climate change are likely to place additional stress on the conservation and recovery of the CV spring-run Chinook salmon ESU, NMFS does not expect that climate change would be

significant enough to have an appreciable effect on CV spring-run Chinook salmon in the SJRRP Restoration Area during the 5-year permit period.

5.5 Cumulative Effects by Resource

5.5.1 Water Resources

Flows in the San Joaquin River, and accompanying bypasses, are regulated by Friant Dam, and by a suite of inputs and diversions, including, notably: diversions from Mendota Pool and Arroyo Canal, and inputs from the Delta-Mendota Canal, Kings River, Mud Slough, and Salt Slough. Water stored in upstream reservoirs during the winter and spring is released in the summer and fall for agriculture, municipal and industrial supply, irrigation, water quality, power generation, recreation and fish and wildlife purposes. Historically, the San Joaquin River was highly responsive to periodic precipitation events and seasonal variation. Since completion of the dams, flows are now lower in the winter and spring, higher in the summer and fall, and were historically non-existent year round in Reaches 2 and 4 of the Restoration Area. As described in the Settlement, the SJRRP is charged with implementing Restoration Flows; "releases of water from Friant Dam to the confluence of the Merced shall be made to achieve the Restoration Goal".

Water diversions for irrigated agriculture, municipal and industrial use, and managed wetlands are found throughout California's Central Valley. A substantial number of small and medium-size water diversions exist along the San Joaquin River, and many of them remain unscreened. Depending on the size, location, and season of operation, these unscreened diversions may entrain and kill many life stages of aquatic species, including juvenile listed anadromous species (Mussen et al. 2014a, Mussen et al. 2014b). For example, as of 1997, 98.5 percent of the 3,356 diversions included in a Central Valley database were either unscreened or screened insufficiently to prevent fish entrainment (Herren and Kawasaki 2001). With completion of the SJRRP, some of the major diversions from the Restoration Area would be screened.

As described above in Sections 4.1.1 and 4.2.1, neither Alternative 1 (No-action) nor Alternative 2 (Proposed Action) are expected to have significant effects on water quality in the San Joaquin River. As such, neither Alternative 1 nor Alternative 2 would contribute to any significant adverse cumulative impacts to water quality in the San Joaquin River. The San Joaquin River's hydrology would continue to be dominated by the basin's natural hydrologic character and upstream management of flow volumes from Friant Dam, input from the Delta-Mendota Canal, and exports from diversions.

5.5.2 Biological Resources

5.5.2.1 Salmon and Steelhead

Salmon and steelhead abundance naturally alternates between high and low levels on large temporal and spatial patterns that may last centuries and on more complex ecological scales than can be easily observed (Rogers et al. 2013). The effects of climate change on salmon and steelhead are described in general in ISAB (2007), and would vary among species and among species' life history stages. Climate change, particularly changes in streamflow and water temperatures, would likely impact hatchery- and natural-origin salmon and steelhead life stages in various ways as summarized in Table 5-1.

Table 5-1. Examples of potential impacts of climate change by salmon and steelhead life stage under all alternatives

Life Stage	Effects
Egg	• Increased water temperatures and decreased flows during spawning migrations would increase pre-spawn mortality and reduce egg deposition for some species. • Increased maintenance metabolism would lead to smaller fry. • Faster embryonic development would lead to earlier hatching. • Increased mortality for some species because of more frequent winter flood flows. • Lower flows would decrease access to or availability of spawning areas.
Spring and Summer Rearing	• Faster yolk utilization may lead to early emergence. • Smaller fry are expected to have lower survival rates. • Growth rates would be slower if food is limited or temperature increases exceed optimal levels. • Growth could increase where food is available, and temperatures are below stressful levels. • Lower flows would decrease habitat capacity. • Sea level rise would eliminate or diminish the tidal wetland capacity.
Overwinter Rearing	• Smaller size at start of winter is expected to result in lower winter survival. • Mortality would increase because of more frequent floods. • Warmer winter temperatures would lead to higher metabolic demands, which may decrease winter survival if food is limited, or increase winter survival if growth and size are enhanced. • Warmer winters may increase predator activity/hunger, which can decrease winter survival.

Out-Migration	• Earlier snowmelt and warmer temperatures may cause earlier emigration to the estuary and ocean either during favorable upwelling conditions, or prior to the period of favorable ocean upwelling. • Increased predation risk in the mainstem because of higher consumption rates by predators at the elevated spring water temperatures.
Adult	• Increased water temperatures may delay fish migration. • Increased water temperature may also lead to more frequent disease outbreaks as fish become stressed and crowded.

Sources: (Glick et al. 2007, ISAB 2007, Beamish et al. 2009, Beechie et al. 2013)

Alternative 1 could cause an increased risk of failure for the CV spring-run Chinook salmon nonessential experimental population in the Restoration Area when added to other past, present, and reasonably forecast future actions if measures identified in the HGMP are not fully implemented. With implementation of the HMGP, biologically-based hatchery management strategies would be implemented that are expected to contribute to the conservation and recovery of the species through the realization of the SJRRP restoration goals. As described above in Section 4.2.2, full implementation of the HGMP under Alternative 2 would decrease the genetic risks of inbreeding (at the hatchery) and demographic risks of natural interbreeding (on the spawning grounds) further aiding recovery of the CV spring-run Chinook salmon ESU. Accordingly, although there are still risks from predation, competitive interactions, and interbreeding, the conservation benefits of Alternative 2 outweigh the associated risks. Implementation of the HGMP under Alternative 2 would support reintroduction of CV spring-run Chinook salmon that would otherwise be almost certain to fail. Based on these factors, Alternative 2 is not expected to contribute to any significant adverse cumulative impacts on fish species.

5.5.2.2 Other Fish Species

Similar to salmon and steelhead, other fish species such as green sturgeon and lamprey require and use a diversity of habitats. Other fish species may also be affected by climate change and development because of the potential for loss or degradation of aquatic habitat or the inability to adapt to changing conditions. In addition, climate change and development may attract non-native aquatic plants that can out-compete native aquatic plants that provide important habitat to native fish (Patrick et al. 2012). However, SJRRP habitat restoration actions may help mitigate impacts from climate change and development, and the hatchery program would provide a prey source for some fish species. Thus, the proposed action has no change compared to current conditions on other fish species when added to the other cumulative effects in the analysis area.

5.5.2.3 Fish-Eating Birds

Bald eagles and osprey have made a strong comeback from the mid-1960s and '70s when they were severely impacted by the use of Dichlorodiphenyltrichloroethane (DDT), a widely used pesticide now banned in the United States. DDT caused significant declines in fish-eating birds as the chemical was accumulated by prey and resulted in reproductive failures of the birds. Populations of these species are considered stable and expanding, and in 2007 the bald eagle was removed from the list of endangered and threatened species in the United States. In the San Joaquin River basin it is believed bald eagles are expanding their numbers and breeding and foraging ranges. Similar trends are observed with the osprey.

As described above in Sections 4.1.2.3 and 4.2.2.3, Alternative 1 would not allow for the SJRRP production of potential forage for fish-eating birds, and Alternative 2 may slightly increase the contribution that SJRRP production currently has on forage for fish-eating birds. The contribution of SJRRP production to forage for fish-eating birds, when added to other past, present, and foreseeable future actions, would result in beneficial cumulative effects on these birds.

5.5.3 Socioeconomics

Increases in agriculture, urbanization, and housing developments can impact habitat by altering watershed characteristics, and changing both water use and storm water runoff patterns. Increased growth would 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. Some of these actions, particularly those which are situated away from waterbodies, would not require Federal permits and/or authorizations. Increased urbanization also is expected to result in increased recreational activities in the region. The PEIS/R (2011) demonstrates that, while adverse impacts would occur to various resources with implementing the Settlement, benefits to numerous resources such as vegetation, wildlife, fisheries, water quality, land use, recreation, socioeconomics, and visual resources would occur.

As described above in sections 4.1.3 and 4.2.3, neither Alternative 1 nor Alternative 2 are likely to impact socioeconomics in the Action Area. As such, neither Alternative 1 nor Alternative 2 would contribute to any significant cumulative impacts to these resources.

5.5.4 Commercial and Recreational Fisheries

It is likely that the salmon and steelhead fisheries in the analysis area would change over time. These changes are likely to reduce effects to natural-origin salmon and steelhead listed under the ESA. For

example, effects to natural-origin salmon and steelhead would be expected to decrease over time to the extent that actions continue to be reviewed and approved by NMFS under the ESA, as evidenced by the beneficial changes to programs that have thus far undergone ESA review. Fisheries management program compliance with conservation provisions of the ESA would ensure that listed species are not jeopardized and that "take" under the ESA from salmon and steelhead fisheries is minimized or avoided. While current CDFW regulations prohibit fishing for salmon in the Restoration Area, in the future it may be possible that SJRRP actions improve salmon and steelhead populations to the point where they could sustain some level of fishing pressure.

5.5.4.1 Ocean Fisheries

While SJRRP Conservation Facilities do not currently produce fish intended for commercial harvest, in the future it may be possible that SJRRP actions may improve salmon and steelhead populations to the point where they could sustain some level of fishing pressure.

5.5.4.2 Inland (Freshwater) Fisheries

The current ESA-listing status of spring-run Chinook salmon limits the ability of the region to fully benefit from freshwater salmon fisheries; because harvest opportunities are limited by other non-listed runs of Chinook salmon being present during the same time of year as listed spring-run Chinook salmon. The recovery of spring-run Chinook salmon is expected to improve through hatchery operations, monitoring, and evaluation activities, as described in the approved HGMP. These efforts combined with SJRRP habitat restoration and reintroduction actions are expected to benefit regional salmon fisheries.

6 PERSONS AND AGENCIES CONSULTED

The following parties were consulted during the development of this EA:

United States Fish and Wildlife Service

Bureau of Reclamation

California Department of Fish and Wildlife Service

California Department of Water Resources

The following persons were consulted during the development of this EA:

Jeff Abrams, National Marine Fisheries Service

Amanda Cranford, National Marine Fisheries Service

Hilary Glenn, National Marine Fisheries Service

Erin Strange, National Marine Fisheries Service

Elif Fehm-Sullivan, National Marine Fisheries Service

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