TITLE OF ENVIRONMENTAL REVIEW	Final Environmental Assessment for 10(a)(1)(A), Enhancement of the Species Permit Issuance for the Collection, Transport, and Release of Spring-run Chinook salmon for the San Joaquin River Restoration Program
RESPONSIBLE AGENCY AND CONTACT	Jonathan Schram National Marine Fisheries Service California Central Valley Area Office; West Coast Region 650 Capitol Mall, Suite 5-100 Sacramento, CA 95814 (916) 930-3600
LOCATION OF PROPOSED ACTIVITIES	The Feather River Fish Hatchery, the San Joaquin Fish Hatchery with Salmon Conservation and Research Facility, the Silverado Fisheries Base, and the Center for Aquatic Biology and Aquaculture
PROPOSED ACTION	Issuance of an Endangered Species Act Section 10(a)(1)(A) permit to US Fish and Wildlife Service to collect and release Central Valley spring-run Chinook salmon eggs and juveniles collected from the Feather River Fish Hatchery and from the Salmon Conservation and Research Facility into the San Joaquin River.

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DEFINITIONS AND ACRONYMS

AADAP	Aquatic Animal Drug Approval Partnership
AIS	Aquatic Invasive Species
BKD	bacterial kidney disease
BMP	Best Management Practices
CABA	Center for Aquatic Biology and Aquaculture
CDFG	California Department of Fish and Game
CDFW	California Department of Fish and Wildlife
CDWR	California Department of Water Resources
CEC	Council on Environmental Quality
CFGC	California Fish and Game Commission
cfs	cubic feet per second
CO_2	carbon dioxide
CO_2e	CO_2 emissions
CVP/SWP	Central Valley Project/State Water Project
DO	dissolved oxygen
DPS	Distinct Population Segment
EA	Environmental Assessment
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FRFH	Feather River Fish Hatchery

FWA	Friant Water Authority
GHG	greenhouse gas
HGMP	Hatchery and Genetics Management Plan
IHNV	infectious hematopoietic necrosis virus
INAD	Investigational New Animal Drug
$lbs/ft^3/in$	pounds per cubic foot per inch
mg/L	milligrams per liter
MS-222	tricaine methanesulfonate
Mt	metric tons
NMFS	National Marine Fisheries Service
NPDES	National Pollution Discharge Elimination System
NRDC	Natural Resources Defense Council
^{o}C	degrees Celsius
PIES/R	Program Environmental Impact Statement/Environmental Impact Report
Reclamation	United States Bureau of Reclamation
RBDD	Red Bluff Diversion Dam
RM	River Mile
RST	Rotary Screw Traps
RWQCB	Regional Water Quality Control Board
SFB	San Francisco Air Basin
SJFH	San Joaquin Fish Hatchery
SJRRP	San Joaquin River Restoration Program

SJRRSA	San Joaquin River Restoration Settlement Act
SJVAB	San Joaquin Valley Air Basin
spring-run Chinook	Central Valley spring-run Chinook salmon (*Oncorhynchus tshawytscha)*
SR	State Route
SVAB	Sacramento Valley Air Basin
TMDL	Total Maximum Daily Load
USFWS	United States Fish and Wildlife Service

SECTION 1 PURPOSE AND NEED

1.1 Background

The Central Valley spring-run Chinook salmon *(Oncorhynchus tshawytscha)* (spring-run Chinook) Evolutionarily Significant Unit (ESU) is listed as threatened under the Federal Endangered Species Act (ESA). The ESU includes all naturally spawned populations of spring-run Chinook in the Sacramento River and its tributaries in California, including the Feather River as well as the Feather River Fish Hatchery (FRFH) spring-run Chinook program (June 28, 2005, 70 FR 37160). Critical habitat for spring-run Chinook was established on September 2, 2005, and became effective on January 2, 2006 (September 2, 2005, 70 FR 52488).

Historically, spring-run Chinook numbered over 600,000 in California's Central Valley, with the majority from the San Joaquin River Basin. Over the past two centuries, development of water resources transformed the San Joaquin River. Since the 1880s, large areas of the San Joaquin valley floor were converted to agricultural production whose supporting irrigation activities modified the natural flow patterns of valley's rivers. With the construction of Friant Dam on the San Joaquin River and the completion of the Friant-Kern Canal and Madera Canal, the Friant Dam diverted San Joaquin River water supplies to over 1 million acres of highly productive farmland along the eastern portion of the San Joaquin Valley. Operation of the dam ceased flow for portions of approximately 153 miles of the river and extirpated salmon runs in the San Joaquin River upstream from its confluence with the Merced River.

In 1988, a coalition of environmental and fishing groups, led by the Natural Resources Defense Council (NRDC), filed a lawsuit known as *NRDC, et al., v. Kirk Rodgers, et al.*, to challenge the renewal of long-term water service contracts between the United States and Central Valley Project Friant Division contractors. After more than 18 years of litigation, a stipulation of settlement (Settlement) was reached. On September 13, 2006, the Settling Parties, including NRDC, Friant Water Users Authority [now the Friant Water Authority (FWA)], and the United States Departments of the Interior and Commerce, agreed on the terms and conditions of the Settlement, which was subsequently approved by the District Court for the Eastern District of California on October 23, 2006. Implementation of the Settlement is accomplished through the San Joaquin River Restoration Program (SJRRP).

The Federal Implementing Agencies are authorized to carry out the Settlement by the San Joaquin River Restoration Settlement Act (Settlement Act) (Pub. L. 111-11, 123 Stat. 1349 (2009)). This legislation also mandates that 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 ESA of 1973 (16 U.S.C. 1539(j)). The collection of spring-run Chinook for use in establishing the experimental population will require permitting action pursuant to section 10(a)(1)(A) of the ESA.

The Implementing Agencies of the SJRRP are the Bureau of Reclamation (Reclamation) and the United States Fish and Wildlife Service (USFWS) from the Department of Interior, the National Marine Fisheries Service (NMFS) from the Department of Commerce and, by Memorandum of Understanding from the

State of California, the Department of Fish and Wildlife (CDFW) [formerly known as the California Department of Fish and Game], and the Department of Water Resources.

The Settlement establishes two primary goals:

Restoration Goal – 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.

Water Management Goal – To reduce or avoid adverse water supply impacts on all of the Friant Division long-term contractors that may result from the Interim flows and Restoration Flows provided for in the Settlement.

Paragraph 14 of the Settlement states that the Restoration Goal "shall include the reintroduction of spring-run and fall-run Chinook to the San Joaquin River between Friant Dam and the confluence of the Merced River." To accomplish this, Paragraph 14 of the Settlement also requires the USFWS to submit an ESA section 10(a)(1)(A) permit application to NMFS for the reintroduction of spring-run Chinook.

Section 10 of the ESA allows for the issuance of permits for direct take (section 10(a)(1)(A)) and "incidental take (section 10(a)(1)(B))." Under section 10(a)(1)(A), the Secretary may permit, under such terms and conditions as he shall prescribe, any act otherwise prohibited by section 9 for scientific purposes or to enhance the propagation or survival of the affected species. These include actions necessary for the establishment and maintenance of experimental populations. On November 20th, 2012, USFWS submitted an application to NMFS for a 10(a)(1)(A) permit to collect spring-run Chinook from the FRFH for release into the San Joaquin River under the SJRRP. This application has since been revised, and NMFS posted the final permit application for public review on December 31st, 2013 (December 31, 2013, 78 FR 79622).

Reintroduction of spring-run Chinook to the San Joaquin River would also further the objectives of the draft "Central Valley Recovery Plan for the Evolutionarily Significant Units of Sacramento River winter-run Chinook, spring-run Chinook, and the Distinct Population Segment of California Central Valley Steelhead" (Draft Recovery Plan) (NMFS 2009), which has the overarching aim of recovering listed salmonids in the Central Valley. The Draft Recovery Plan stresses actions that improve the viability of these species, such that they can be removed from Federal protection under the ESA. With respect to spring-run Chinook, re-establishing populations in its historic range in the San Joaquin River basin is a key recovery objective.

1.2 Use of Previous Environmental Documentation for the Environmental Assessment (EA)

1.2.1 San Joaquin River Restoration Program Environmental Impact Statement/Report

Implementation of the restoration program for the San Joaquin River requires an analysis of the potential environmental effects under the National Environmental Policy Act (NEPA) and for program aspects and involved parties subject to the California Environmental Quality Act. The 2011 SJRRP Program

Environmental Impact Statement/Report (PEIS/R) analyzes the SJRRP in accordance with NEPA by evaluating the potential direct, indirect, and cumulative impacts on the environment at a program level that could result from implementing the Settlement consistent with the San Joaquin River Restoration Settlement Act (PEIS/R 2011). Furthermore, program level analysis of habitat and conveyance (channel improvement) projects, the anticipated effects of water releases, and the proposed reintroduction actions of fall-run and spring-run Chinook into the San Joaquin River is also provided in the PEIS/R (PEIS/R 2011). The PEIS/R discusses the reintroduction of spring-run Chinook to the San Joaquin River and the affected environment at the programmatic level. Where appropriate, information from the SJRRP PEIS/R has been incorporated by reference in this document.

1.2.2 Final Environmental Assessment for 10(a)(1)(A) Broodstock Collection and Transport

In October 2012, NMFS completed an Environmental Assessment on the issuance of a 10(a)(1)(A) permit to the USFWS for collecting and transporting spring-run Chinook to pilot captive broodstock methods for the San Joaquin River Restoration Program (Broodstock EA). The Broodstock EA described the hatchery and quarantine facilities that will be used for the Proposed Action analyzed in this EA. It also analyzed baseline environmental conditions such as air quality, climate change, and fish populations currently existing in the San Joaquin River that could be affected by the Proposed Action. Where appropriate, information from the Broodstock EA has been incorporated by reference into this document.

1.2.3 Final Environmental Assessment for Nonessential Experimental Population Designation and 4(d) Take Provisions for the Reintroduction of spring-run Chinook to the San Joaquin River

In December 2013, NMFS completed an analysis of the environmental effects related to the specific action of the reintroduction of spring-run Chinook, which was presented in the Final Environmental Assessment for Nonessential Experimental Population Designation and 4(d) Take Provisions for the Reintroduction of spring-run Chinook to the San Joaquin River (Rule EA). Where appropriate, information from the Rule EA has been incorporated by reference into this document.

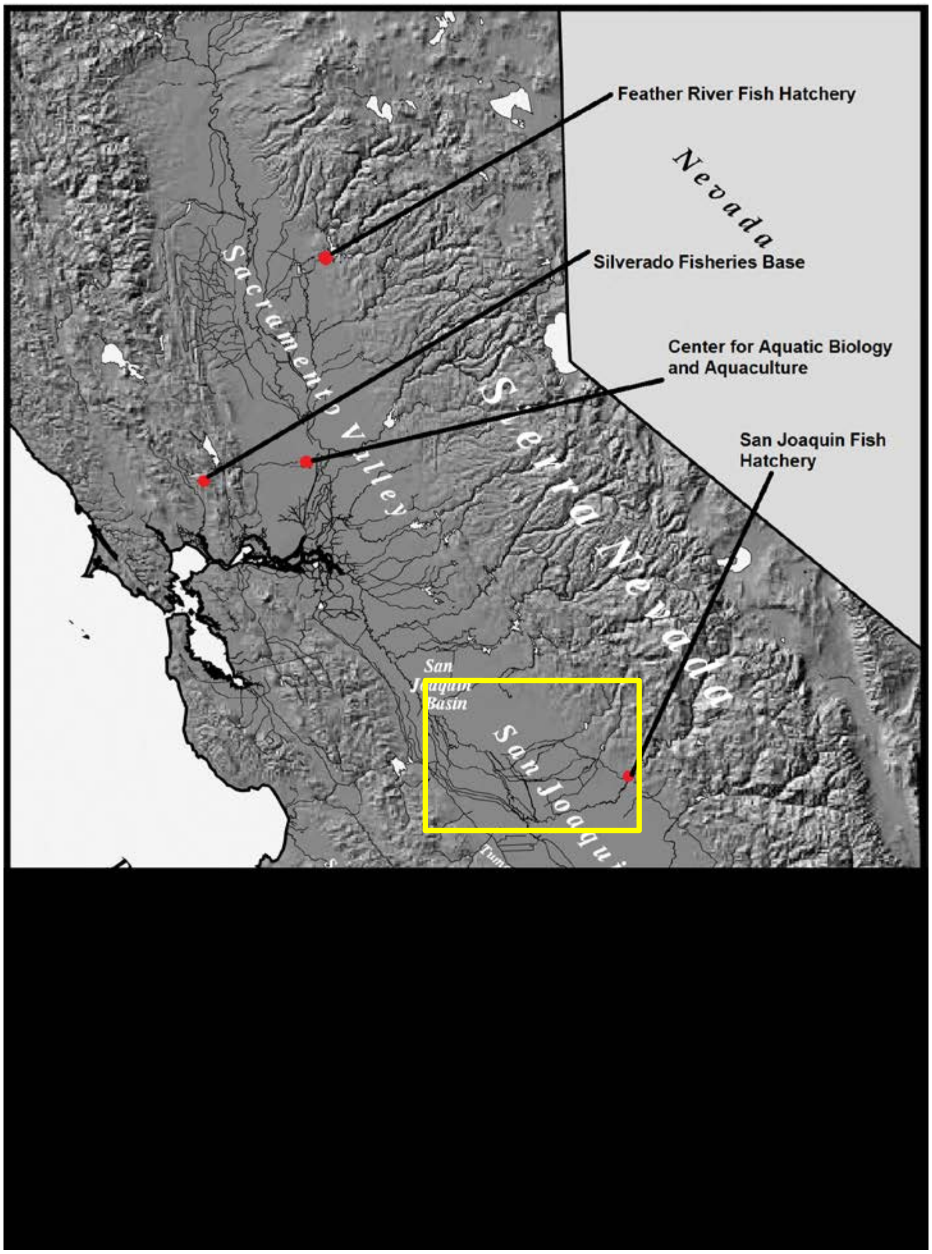
1.3 Purpose and Need Statement

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, for: 1) collection and transport of spring-run Chinook juveniles or eggs from the Feather River Fish Hatchery (FRFH) for release into the San Joaquin River; 2) collection, transport, rearing, and release of spring-run Chinook from FRFH; 3) release of spring-run Chinook which were produced or reared at the Salmon Conservation and Research Facility (SCARF) from broodstock collected under Permit #14868 into the San Joaquin River; and 4) monitor the survival and returns of these fish to the San Joaquin River. This EA will analyze the potential impacts of the Proposed Action focusing on the transport, release, and monitoring methods.

The purpose of this action is to fulfill the next chronological step in fulfilling the Restoration Goal as outlined within the Settlement, now that the actions outlined within the Broodstock EA and the Rule EA have been implemented. This next step involves the practice and implementation of transport and release methods of spring-run Chinook, which will help further enhance knowledge for best management practices involving the transporting and releasing spring-run Chinook into the wild. It is necessary to issue a permit to allow collection of spring-run Chinook for their transport and subsequent release, because spring-run Chinook is listed as a threatened species under the ESA.

1.4 Action Area

The Action Area of the Proposed Action is the Sacramento River and San Joaquin River basins of California. More specifically, the FRFH in the Feather River sub-basin of the Sacramento River and the SCARF (including the interim and full-scale facilities) located on the San Joaquin River, and the San Joaquin River below Friant Dam and above the confluence of the Merced River. Proposed Action activities may also occur at the Silverado Fisheries Base (Silverado) near Yountville, California or the Center for Aquatic Biology and Aquaculture (CABA) in Davis, California. See Figure 1 for a map of the Action Area. Monitoring activities of the Proposed Action will occur in the San Joaquin River between Friant Dam and the confluence with the Merced River. Information about fish released through the Proposed Action may be reported from incidental collection by other monitoring activities conducted by other programs, but these activities are operated and permitted separately.



Note: (Location displayed for San Joaquin Fish Hatchery includes area of San Joaquin River from hatchery to the Willow Unit). The SJRRP Restoration Area, which includes the portion of the San Joaquin River from Friant Dam to the Merced River confluence, is indicated within the yellow rectangle.

Figure 1: Action Area Locations

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SECTION 2 ALTERNATIVES

2.1 Introduction

As submitted to NMFS by the USFWS, the section 10(a)(1)(A) permit application under consideration requested the tagging and collection of FRFH spring-run Chinook juveniles and eggs, followed by their transportation to the San Joaquin River to be either reared within instream holding pens, held in stream side incubators, or to be directly released to the river. The permit application also requests that spring-run Chinook adults, juveniles, and eggs can be directly released into the San Joaquin River from the SCARF as well, and that all released fish be monitored and evaluated for up to 5 years.

Due to a SJRRP commitment that all spring-run Chinook initially released into the San Joaquin River will be tagged, eggs will not be directly released into the San Joaquin River. Eggs will be transported to stream side incubators. As they develop into juveniles they will be transferred to in-river holding pens and tagged when they reach the appropriate size.

The final rulemaking to meet the objective of establishing the experimental population under section 10(j) and 4(d) was completed in December 2013, which will allow fish to be released into the San Joaquin River consistent with the SJRSSA. The alternatives that are to be analyzed are set forth below.

2.2 Alternatives to be Analyzed

Two alternatives are considered in this EA: 1) to not issue the permit (No Action), and 2) to issue the permit with conditions (Proposed Action).

2.2.1 No Action Alternative

Under a No Action Alternative, NMFS would not issue the ESA section 10(a)(1)(A) permit to USFWS authorizing take of ESA-listed species associated with the requested activities. For the purpose of this analysis, this alternative would not allow the activities necessary for successful reintroduction of spring-run Chinook to the San Joaquin River in the manner called for in the Settlement. Under the No Action Alternative, the re-establishment of spring-run Chinook populations within the San Joaquin River basin, as identified in the Draft Recovery Plan, would require volitional recolonization from existing populations of spring-run Chinook. While occasional individuals would potentially stray into the San Joaquin River when river conditions may be suitable, it is unlikely that sufficient numbers would concurrently stray in order to meet the objective of establishing a naturally reproducing and self-sustaining population by the year 2025 as indicated by the Settlement.

2.2.2 Action Alternative: Proposed Action

The Proposed Action is to issue a permit, with conditions, under section 10(a)(1)(A) of the ESA to USFWS for a period of five years, for the following actions:

- Collection and transport of spring-run Chinook juveniles and eggs from the Feather River Fish Hatchery (FRFH) for release into the San Joaquin River.
- Collection, transport, rearing, and release of spring-run Chinook from FRFH.
- Release of release of spring-run Chinook juveniles and eggs which were produced or reared at the Salmon Conservation and Research Facility (SCARF) from broodstock collected under Permit #14868 into the San Joaquin River.
- Monitor the survival and returns of these fish to the San Joaquin River.

The 10(a)(1)(A) permit applicant is proposing to collect up to 54,400 juveniles or 80,000 eyed eggs, annually for 5 years, from the FRFH, transport and release of the 54,400 FRFH collected juveniles into net pens and then into the San Joaquin River, transport of the FRFH 80,000 collected eggs to egg boxes along the San Joaquin River and their eventual release once hatched and tagged, in addition to the release into the San Joaquin river after tagging of up to 100 adult broodstock (in years 4 and 5 only) and up to 250,000 juvenile broodstock from the SCARF may be released into the San Joaquin River. The permit conditions require application of best management practices (BMPs) in order to mitigate any potential negative effects resulting from the Proposed Action, and to ensure maximum rates of survival and return of individuals released into the San Joaquin River. These methods, and the conditions under which these methods will be carried out, are listed in Table 1 below.

Table 1: Handling, Rearing, & Monitoring Required by Permit

Method:	**Conditions/BMPs**
Passive Integrated Transponder (PIT) Tags:	• Anesthesia will be administered to juveniles during measuring and weighing activities and PIT tag implantation. • Anesthesia dosage and administration would follow protocols outlined in the FRFH HGMP (CDWR 2009a). • All processed fish will be allowed to recover before returning to the rearing tanks. • Only researches that are trained and qualified can perform PIT and acoustic tagging on ESA-listed salmonids. • The principal investigator must notify NMFS prior to tagging to confirm that researchers have been properly trained to perform PIT tagging procedures and provide documentation of training to NMFS prior to conducting research. • Only juvenile ESA-listed salmonids that are greater than 60 mm fork length (FL) and in good condition will be PIT tagged. • All marked, tagged, and subsequently recaptured fish must be documented.
Acoustic Tags:	• Acoustic tag placement will involve surgical techniques requiring an approximate ½ inch incision closed by suturing with standard

	absorbable suture material by staff experienced in the procedure. • Fish will be allowed 24 hour recovery following procedure to minimize mortality. • Only researchers that are trained and qualified can perform PIT tagging on ESA-listed salmonids. • The principal investigator must notify NMFS prior to tagging to confirm that researchers have been properly trained to perform PIT tagging procedures on juvenile ESA-listed salmonids and provide documentation of training to NMFS prior to conducting research. • Acoustic tags will only be inserted in juvenile ESA-listed salmonids that meet the 5% tag burden requirement (Adams et al. 1998) and in good condition will be acoustic tagged. • All marked, tagged, and subsequently recaptured fish must be documented.
Coded Wire Tags (CWT):	• All processed fish will be allowed to recover before returning to rearing tanks. • CWTs will be injected in the snout of the fish using a Mark IV tag injector (Northwest Marine Technology). • All standard measures and protocol measures will be taken for anesthesia and recovery times to reduce as much as possible any negative effects to the fish.
Adipose Clips:	• Adipose-fin clipping will be done manually; fish will be anaesthetized to reduce handling stress. • All standard measures and protocol measures will be taken for anesthesia and recovery times to reduce as much as possible any effects to the fish.
Calcein Marking:	• Should ≥3.5 million fish require calcein marking, FDA authorization will be requested. • The following conditions must be met when using calcein marking: - Only fish 2.0 grams or less may be used for calcein marking. - Close coordination with Ms. Bonnie Johnson on numbers of fish to be marked must occur. FWS – Aquatic Animal Drug Approval Partnership (AADAP) Phone: 406-994-9905 Fax:

	406-582-0242; bonnie_johnson@fws.gov. - Method of administration: Immersion: standing-bath treatment only. - Treatment dosage: *Option A:* 125 - 250 milligrams calcein per liter; Option *B:* 2.5 - 5.0 grams calcein per liter (finfish only). - Treatment regimen: *Option A:* Treatment duration is 1 - 6 hours. *Option B:* Treatment duration is 1 - 7 minutes. (Note: 7reatment may include a pre- treatment with a 1 - 5% salt solution for ~3.5 minutes.). Calcein may be applied as a single treatment, or repeated treatments. - Recovery period: None for fish; they may be released immediately following treatment for those treated with less than 2 grams and for federally threatened and Endangered species. - Required test parameters: Investigator must collect mark retention and mortality data. Investigator should also report general fish behavior and any adverse effects relating to treatment. - Limitations or restrictions on use: Treatment is restricted to finfish having a body weight of 2 grams or less. Repeated treatments may be conducted to establish multiple marks. However, an interval of at least 2 days should be observed between treatment events. - No discharge of calcein marking solution is allowed. Although used calcein marking solution may be stored on station in a secure, leak-proof container, it must ultimately be disposed of according to procedures detailed in a general waste-stream profile (see Investigational New Animal Drug (INAD) Study Protocol for specific instructions). - Investigator must follow all instructions in the Study Protocol for INAD 10-987 regarding drug acquisition and handling, fish treatment and disposition, and data reporting requirements. Required INAD fee: $400.00 per facility per year AADAP contact for other information: Ms. Bonnie Johnson, FWS – AADAP Phone: 406-994-9905; Fax: 406-582-0242; bonnie_johnson@fws.gov.
Net Pens/Imprinting:	• The net pen system will likely consist of 10 cages, with a maximum of 12, and up to a maximum of 8 net pens; having the capability of holding 250,000 juveniles.

	• The maximum allowable density would be 0.15 lb./ft^3/in was proposed in (Ewing and Ewing 1995) for spring-run Chinook. • Juveniles to be released will be placed in these pens below Friant Dam for a minimum of 3 days to acclimate to the San Joaquin River, after which they will be transported to other locations in the San Joaquin River depending on conditions as follows: - <u>Good River Condition:</u> Good conditions are defined as complete juvenile passage (i.e., full river connectivity, passage at structures, and stream temperatures below migration objectives of 18 °C) between Friant Dam to the confluence of the Merced River. Under good conditions, juveniles will be transported to the San Joaquin River from Silverado, Feather River Fish Hatchery, or stream side incubators between December and April, and then placed in holding pens below Friant Dam for a minimum of 3 days to acclimate to the San Joaquin River. Holding time will be dependent on the length of time "good" conditions are expected, based on daily monitoring of flow and temperature conditions. Fish will be released either volitionally or in adjacent slow moving water near the net pens and allowed to migrate downstream unassisted between January and April, or acclimated directly in Reach 5 for 3-7 days. During the holding period, fish health and temperature conditions will be carefully monitored. If stream temperatures exceed 22°C or fish mortality exceeds 2 %, juveniles will be released in areas of the river that have connectivity to the ocean to migrate downstream. - <u>Moderate River Condition:</u> Moderate conditions are defined as reduced levels of juvenile passage between Friant Dam and the Merced River confluence, as determined by flow conditions, physical barriers, and temperature or water quality barriers, which prevent full volitional migration and require juveniles to be released at a location downstream of passage barriers. Under moderate conditions, juveniles will be transported to the San Joaquin River from Silverado, Feather River Fish Hatchery, or stream side incubators from December 31 to April, and placed in holding pens below Friant Dam for minimum 3 days to acclimate to the San Joaquin River. Release location will depend on the location of juvenile passage barriers, but sites include: 1) below Mendota Pool (if volitional migration through Mendota Pool is limited by operations); 2) below Sack Dam (if volitional migration below Mendota Pool through Sack Dam is limited by release quantity, temperature, or diversions into Arroyo Canal); 3) in Reach 5, likely downstream of Hwy 165 (if flow release quantity and quality upstream limit volitional outmigration). If the release location was below Mendota

	or Sack dams, fish will be held for additional imprinting in net pens in Mendota Pool for a minimum of 3 days prior to release. If the release location were in Reach 5, fish will be held in net pens for additional imprinting in Mendota Pool for a minimum of 3 days and in Reach 5 for a minimum of 3 days prior to release. - <u>Poor River Condition:</u> Poor conditions are defined as significantly reduced juvenile passage conditions between Friant Dam and the Merced River that require release of juveniles in Reach 5 without additional holding above the release site. Under poor conditions, juveniles will be transported to the San Joaquin River from Silverado, Feather River Fish Hatchery, or stream side incubators from December through April, and placed in net pens below Friant Dam for a minimum of 3 days to acclimate to the San Joaquin River, or acclimated directly in Reach 5 for 3-7 days if progression of Reach 5 temperatures precluded additional holding below Friant Dam. Juveniles will be transported to a release location in Reach 5, below all potential barriers to outmigration, and held in net pens for 3-7 days for acclimation prior to release. During the holding period, fish health and temperature conditions will be carefully monitored. If stream temperatures exceed 22°C or mortality exceeds 2% of fish, juveniles will be immediately released to migrate downstream. - <u>Unsuitable River Conditions:</u> If conditions in the San Joaquin River are unsuitable at the time fish are to be received, fish will not be transported to the San Joaquin River. Fish from the streamside incubators will be tagged, and then placed further down the system where conditions are more favorable. Potential factors that will lead to unsuitable conditions include: 1) if high temperatures or low flows that prevent fish from being acclimated in net pens below Friant, or 2) at release sites for at least 3 days, or flow temperature conditions that are unsuitable at all potential release sites. • Monitoring will be conducted to ensure that gas bubble disease does not occur while holding below Friant Dam. If saturation levels become too high the net pens will be moved to a location with lower saturation levels.
Streamside Incubation:	• Deep matrix style incubators (Redd Zone, Astoria, OR), or vertical flow egg incubators (MariSource, Fife, WA) will be used streamside, at Friant Dam (Reclamation), or in a portable trailer to incubate eggs.

	• Fry will be held until they reach a size at which they can be tagged, as described above for PIT, Acoustic, and CWT protocols. • Release sites for instream incubation will be selected so as to provide appropriate water depth, velocity, and substrate, and cover characteristics to promote fry growth and survival. • This method essentially involves piping a gravity fed river water source, using gravity, through trays of incubating eggs. • The water is piped into the bottom of the incubator and allowed to flow out the top. Sites will be selected to provide the best conditions to successfully incubate the eggs. • Incubators will either be housed on Reclamation property near Friant Dam or in a portable trailer. The eggs themselves do not generate any waste, but may need occasional iodine application. Water from the iodine bath can be collected and disposed of properly. After eggs enter the eyed stage they will be moved to the deep matrix incubators to hatch and develop within the gravel and eventually moved to tanks for rearing. Afterwards they will be moved to instream rearing pens. • Stream side incubators will be equipped with a flow through water system, and monitored daily for dissolved oxygen (DO) and temperature. DO levels should be maintained near saturation (approximately between 80-100%), and water temperature should not exceed 20ºC. If DO levels drop below 80% saturation then the water will be oxygenated using bottled oxygen with oxygen stones and impellor driven aerators or fish densities will be lowered by, for example, thinning fish to other tanks. Both total suspended solid and carbon dioxide levels will be maintained at or below 10 mg/L. The tanks will be cleaned as needed, and the automatic feeders will be checked and reloaded once a day. The maximum allowable density index will be 0.15 lbs./ft3/in as was proposed in (Ewing and Ewing 1995) for spring-run Chinook. Depending on the number and size of fish, multiple tanks may be necessary as not to exceed the maximum density. As fish grow the density will increase, thus fish may need to be split into multiple tanks as they grow. Feeding and growth rates will be monitored, per the SJRRP HGMP. This information will be used to determine densities and when/if multiple tank(s) are necessary.
Rotary Screw Traps (RSTs):	• Rotary Screw Traps (RSTs) consist of large cones attached to a catamaran that rotate like an auger-type sieve, separating passing water and funneling fish and debris to the rear of the trap and directly into an aluminum collection box.

	• RTS's are approximately 5-8 ft. in diameter, and are positioned with the open end of the cone facing upstream. • Half of the open end of the cone is above the water. • Fish enter the open end and proceed through a corkscrew in the downstream end of the trap. The purpose of the corkscrew is to prevent the fish from escaping out the open funnel end of the trap. • The end of the corkscrew is the aluminum box for live captured fish. • ESA-listed salmonids shall be handled with extreme care and kept in water to the maximum extent possible during sampling and processing procedures. Adequate circulation and replenishment of water in holding units is required. When using gear that captures a mix of species, ESA-listed salmonids shall be processed first and be released as soon as possible after being captured to minimize the duration of handling stress. • The RSTs shall be checked at a minimum every morning of operation (or more frequently as warranted) of operation at a minimum to remove captured fish and debris. Additionally, periods of peak migration, high flows, and/or high debris levels may require the traps to be checked more frequently to minimize mortality. The traps shall be adequately removed to allow both upstream and downstream adult ESA-listed salmonids (primarily adult ESA-listed steelhead) passage during high flow events. • Additionally, during periods of operation, any adult ESA-listed salmonids captured in the downstream migrant traps shall be processed first and immediately released downstream of the trap. • Overhead cables will be approximately 10 ft. above water surface, high enough as to not impact boater traffic and safety cables will be anchored to only one side of the river bank, thereby allowing passage near the opposing shore. • All ropes and cables anchoring the RSTs and fyke nets will be marked with brightly colored flagging and flashing warning lights as to be easily seen. • Signage and/or buoys will then be placed both upstream and downstream of traps to instruct boaters on how to safely avoid the RSTs and fyke nets. • All work will be done using hand tools, although equipment transported to the RST will occur by small boat and/or kayak. • If fyke net guidance panels or hardware fence panels (i.e. corrugated

	metal flashing) are required to divert a greater percentage of the total stream volume into the RST, up to 10 t-posts per panel will be placed in the river to hold the guidance panels in place and will only be used in areas where there is no boater traffic or on the side opposite of boater traffic. • All project entry locations have been selected to provide river access via improved roads thereby minimizing habitat disturbance as well as reducing erosion/sediment to the river. New locations not already stated will also be determined in part by considering access on improved roads with consultation with NFMS. • If boater traffic may be present at a location RSTs and fyke nets will occupy a maximum of 75% of the river channel to allow boating traffic to pass. All ropes and cables used for anchoring will be marked with brightly colored flagging and flashing lights. • No trees will be removed for this project, and no Elderberry trees will be used for anchoring. When possible RSTs and/or fyke nets will be affixed to bridge abutments, retaining walls, or bedrock to minimize potential impacts to riparian habitat. • If trees must be used for anchoring, an initial survey will be conducted for nesting raptors prior to selecting the tree. If a nesting raptor is located within 500 feet from the selected tree, such trees will not be used as anchoring points. As work conducted on each RST or fyke net is expected to take place for only a limited period of time each day, it is not anticipated that project activities will interfere with mating or rearing behavior of potential raptors near RST sites. • If bridges are used as anchoring structures then they will be surveyed for nests. Bridges with known nests will not be used. • Swainson's Hawk (*Buteo swainsoni*): Project workers will have training on determining the presence of Swainson's Hawks so that they can be identified by both visual appearance and sound of their call. If a Swainson's Hawk enters the project area and exhibits behaviors such as fly-overs or repeated calling, workers will expedite their work to the extent feasible while handling fish, leave the site promptly, and contact CDFW's Streambed Alteration Unit for guidance. • Any nests that become established along the riparian access routes of the project area will be avoided as workers enter and leave those areas. To the extent possible, alternate routes will be used to allow greater clearance around nests.
Direct Observation:	

Snorkel Surveys: *Boating Surveys*:	• Snorkel survey crews will enter water along established boat ramps to avoid riparian habitat degradation, and will not disturb any redds if found. • Boating crews will use established boat ramps to enter water to avoid riparian habitat degradation. All care will be taken to avoid disturbing the river bottom.
Transport (by vehicle):	• Any juveniles requiring transport between facilities will be moved utilizing a 300-500-gallon transport tank and trailer. The tank will be filled with water from the FRFH (for transport from FRFH to egg boxes, net pens, or quarantine facilities if needed) or from the San Joaquin River (for transport from egg boxes to net pen or net pens to the San Joaquin River release sites) just prior to transport. If quarantine is required, tanks will be filled with water from the quarantine facilities (Silverado or CABA). Transport times will vary depending on the location, but may not exceed 4 hours. Before transferring fish, the water will be tempered to within 2°C of the water temperature at the receiving facility. USFWS will transport spring-run Chinook in a manner that minimizes fluctuations in water quality and the effects of handing and stress. The holding water will be monitored at all times, and requires enriched DO levels to be at or near saturation and water temperature may not vary more than 2°C (+ or -) during holding and/or transport. The maximum allowable density would be 0.15 lb./ft3/in as was proposed in (Ewing and Ewing 1995) for spring-run Chinook. • Eggs will be placed in a specialized shipping container (e.g. Styrofoam cooler) to reduce excessive movement and limit damage to the egg membrane. Eggs will be segregated in wet cheesecloth and securely tied, then placed in the shipping container, kept cool and moist using non-chlorinated ice, and transported in a dark environment. Ice will be in a separate compartment of the shipping container, so as not to be in direct contact with the eggs. The ideal temperature for transport is between 5 – 10ºC. A standard vehicle will be used to transport eggs.
Capturing and Handling:	• ESA-listed salmonids shall be handled with extreme care and kept in water to the maximum extent possible during sampling and processing procedures. Adequate circulation and replenishment of water in holding units is required. When using gear that captures a mix of species, ESA-listed salmonids shall be processed first and be released as soon as possible after capture to minimize handling stress. • Researchers shall use dip-nets with knotless nylon mesh to minimize scale and mucus abrasion and shall select the smallest mesh-size dip-net appropriate to achieve sampling objectives while reducing the possibility of smaller fish become gilled in the net. • Spring-run Chinook will be handled with extreme care and kept in

	water to the maximum extent possible during sampling and processing procedures. Adequate circulation and replenishment of water in holding units is required. • Spring-run Chinook will not be handled if water temperatures at the capture site exceed 21ºC. Under such conditions, fish shall not be collected. • When using sedation (tricaine methanesulfonate (MS-222, Aqui-S) extreme care shall be taken to use the minimum amount of substance necessary to immobilize ESA-listed spring-run Chinook for handling and sampling procedures. It is the responsibility of the researcher to determine when sedation is necessary to reduce injuries to ESA-listed spring-run Chinook during handling and sampling activities.
Direct Transfer:	*Eggs:* • Upon arrival at the release site, eggs will be tempered to the receiving water by increasing the egg temperature 1ºC per hour until matching the receiving water temperature. • Eggs then will be reared in streamside incubators and facilities adjacent to the San Joaquin, until juveniles are large enough to be tagged.
Direct Release:	*Juveniles:* • Timing of juvenile releases will occur in direct correspondence to their availability from the FRFH or the SCARF. Juveniles may be released over the same temporal window as collection or availability occurs, or placed in temporary holding pens for imprinting and additionally for acclimation prior to release into the San Joaquin River. Once SCARF is completed juveniles may also be released volitionally through a volitional release channel into the side channel of the San Joaquin River. • Preferred release sites will be near the hatchery and predicted spawning ground; however, releases may occur much farther downstream to avoid migratory hazards and predator conditioning. Transport time may be as long as 2 hours. See net pens/Imprinting row from this table for release location strategy. • Whenever possible, all release points will use existing roads and launch sites to avoid bank erosion, sedimentation, and vegetation removal. • San Joaquin River juvenile spring-run Chinook release locations may include, although are not limited to, the following locations: - Conservation Facility, River Mile (RM) 254.2. - Lost Lake Park, RM 264.5. - Ball Ranch Access Point RM 262.2. - San Joaquin River Ecological Reserve, Willow Unit, RM

	260.6. - Fort Washington Access Point, RM 257. - Vulcan Access Point/Rank Island, RM 258.5. - Sycamore Island, RM 253.3. - Scout Island, RM 250. - Highway 99 Bridge Crossing, RM 243.2. - San Joaquin River Ecological Reserve, Millburn Unit, RM 247.2. - Bifurcation Structure Access Point, RM 216.1. - Mendota Pool Access Point, RM 205. - Sack Dam, RM 182. - Firebaugh, RM 195. - San Luis Wildlife Area, RM 147.2. - Highway 165 Bridge, RM 132.9. - Highway 140 Bridge, RM 125.1. - Hills Ferry Barrier, RM 118.2. *Adults:* • Adults may be directly released into the San Joaquin River collected from the SCARF only during year 4 and 5 of this permit at which time we expect naturally returning adults to be in the Restoration Area to spawn. • Adults from the broodstock population may be released directly into the San Joaquin River to stimulate natural spawning, or due to capacity constraints in the SCARF beginning in year 4. • Adult broodstock will be transported from the SCARF using a 500 gallon transport tank typically from February through April. • Adults will be released adjacent to available holding pool habitat. • Transfer from transport tank to the river will be achieved using "in-water" purse-style stretchers that hold both fish and water (i.e., water-to-water transfer). • Direct netting of fish will be minimized to the greatest extent possible to reduce fish injury and stress.

The collected juveniles will be trucked, using the BMPs specified under the "transport (by vehicle)" row in Table 1, from the FRFH located in Oroville, CA, to a quarantine facility at either Silverado or the CABA, if necessary. Quarantine requirements, as defined by CDFW pathologists, will be followed for juveniles being directly released into the San Joaquin River. If quarantine is necessary, 60 juveniles will be used for terminal pathology assays each year. Eggs from infectious hematopoietic necrosis virus (IHNV) and bacterial kidney disease (BKD) negative females will be properly disinfected at FRFH and transported for direct translocation to the San Joaquin River for streamside incubation. After the appropriate quarantine time the juveniles will then be trucked to the streamside holding pens for acclimation prior to release.

Additionally, the Proposed Action will include to the following conditions:

- All eggs or juveniles collected from FRFH will be produced specifically for the needs of this permit, or will be from production not necessary to fulfill FRFH objectives.
- A process will be established to limit the number of eggs or juveniles that could be collected from the FRFH annually (as shown in Table 2 (section 5.5) of the application).
- Eggs or juveniles collected will be demonstrably second generation spring-run phenotype (as described on page 11 (section 5.2.1) of the application).
- Limits on the number or proportions of spring-run Chinook that could be incidentally taken as a result of carrying out the program, as shown in Appendix B, Table 2 of the application.
- Operating guidelines for all hatchery facilities will be based on widely accepted BMPs These will include, but are not limited to: maintenance of water quality discharges to those set forth in any hatchery discharge permit, and any equipment associated with the holding broodstock.
- Monitoring of the activities that occur is required.
- Regular reports on the activities authorized by the permit are required.
- For the first 3 years of the permit, only adipose fin-clipped juveniles will be released in the San Joaquin River. This will allow 3 years of assessment of growth rates, migration, timing, and collection rates at sampling and CVP/SWP facilities downstream of the Merced River.
- No adult fish from SCARF will be released to the river before spring-run Chinook that were released as juveniles could return as adults prepared to spawn. This is expected to be 3 years after the initial release of juveniles. Thus, any natural production from release of adults from SCARF will coincide with the potential for natural production from returning adults.

NMFS' conditions will ensure that the annual take of ESA-listed anadromous fish will be for the propagation and enhancement of the ESA-listed spring-run Chinook population and the associated monitoring activities only. The conditions imposed by NMFS would also ensure that the annual take would not appreciably reduce the likelihood of the survival and recovery of the species in the wild. Therefore, the Proposed Action would include terms and conditions necessary to the propagation or survival of listed spring-run Chinook pursuant to ESA section 10, including annual reporting requirements for determining whether such terms and conditions are being complied with.

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SECTION 3 AFFECTED ENVIRONMENT

3.1 Introduction

The alternatives identified in section 2 can potentially affect the physical and biological resources within the action area. The following section provides a summary of the current status of spring-run Chinook, along with a description of the affected environment. Also included is a description of the fish species currently present within San Joaquin River Restoration Area, followed by the current baseline conditions of the major components of the environment affected by this project.

A complete description of the current status of spring-run Chinook and baseline conditions of the affected environment can be found within the environmental documentation cited in section 1.2 of this Environmental Assessment (the PEIS/R, Broodstock EA, and Rule EA). These documents are incorporated by references in each of the following summaries respectively.

3.2 Central Valley spring-run Chinook salmon

Spring-run Chinook is listed as a threatened species under the ESA. Historically, spring-run Chinook were the second most abundant salmon run in the Central Valley (CDFW 1998). These fish occupied the upper and middle reaches (1,000 to 6,000 feet) of the San Joaquin, American, Yuba, Feather, Sacramento, McCloud and Pit rivers, with smaller populations in most tributaries with sufficient habitat for over-summering adults (Stone 1872, Rutter 1904, Clark 1929). The Central Valley Technical Review Team estimated that historically there were 18 or 19 independent populations of spring-run Chinook along with a number of dependent populations, all within four distinct geographic regions (diversity groups) (Lindley et al. 2004). Of these 18 populations, only 3 independent populations (Mill, Deer, and Butte creeks on the upper Sacramento River) currently exist (NMFS 2009). In addition to these three independent populations, there are other tributaries within the Sacramento River that are known to contain populations of spring-run Chinook, such as the Feather River (NMFS 2009). However, these populations all have low abundance, and/or are heavily influenced by hatchery origin spring-run fish from the FRFH (NMFS 2009). The Feather River supports wild spawning spring-run Chinook, supplemented by the FRFH. Three additional watersheds in the east Sacramento-San Joaquin Delta or San Joaquin River basin have reports of phenotypic spring-running Chinook. These are the Mokelumne River, an eastside tributary to the Sacramento-San Joaquin Delta, and the Stanislaus and Tuolumne rivers, both tributaries to the San Joaquin River. Further information regarding the possible occurrence of spring-run Chinook within these tributaries can be found throughout section 3.3.2 in the Rule EA.

The Draft Recovery Plan calls for reintroduction of spring-run Chinook to some of these formerly occupied watersheds, including some watersheds of the San Joaquin River basin. The proposed collection of eggs and juveniles from FRFH for specific utilization in the spring-run Chinook reintroduction effort will refine methodologies for handling, translocating, and releasing spring-run Chinook into the San Joaquin River with the potential for adult returns.

3.3 Hatchery and Quarantine Facilities

3.3.1 Feather River Fish Hatchery (FRFH)

The CDFW operates the FRFH near the town of Oroville, California. The spring-run Chinook mitigation program for Oroville Dam commenced with initial operation of the FRFH in 1967 (see Figure 2). In 2004, new spring-run Chinook hatchery operations went into effect, which were designed to protect this important component of the Sacramento Valley spring-run Chinook ESU as defined by NMFS (CDWR 2009b).

The objectives of the FRFH spring-run Chinook program are accomplished through carefully planned trapping, artificial spawning, rearing, and release of spring-run Chinook while conserving the phenotypic and genotypic characteristics of the population and minimizing impacts to other listed fish species (CDWR 2011). These protocols used by the FRFH include, but are not limited to, rigorous selection of broodstock to manage run timing, genetics, percent natural origin, refinement of smolt release strategies, and monitoring of harvest and escapement (CDWR 2011). Since these protocols would likely be in use during the life of the permit, they are included in this EA with the analyses of the Proposed Action's effect on spring-run Chinook. Further information with regard to FRFH, including the FRFH holding and spawning capacity, water source, and water quality, are outlined in sections 3.2.2.3 and 3.2.2.4 of the Broodstock EA.

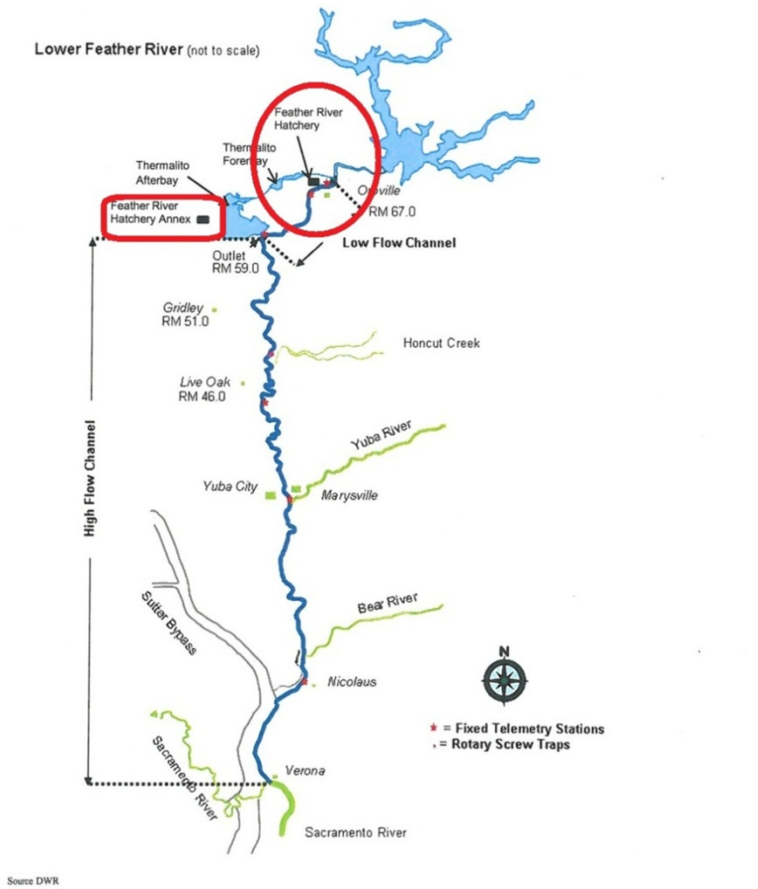


Figure 2: Feather River and Feather River Fish Hatchery Facilities (circled)

3.3.2 Quarantine Facilities

Silverado is the standard quarantine facility for all fish transfers associated with this project. If quarantine is required, juveniles for direct translocation will be sent to the Silverado for quarantine and pathology. Silverado has a capacity for hatching and rearing 100,000 Chinook eggs and juveniles to approximately 5 grams; however, fewer salmon may be reared to a larger size. Typically, salmon can be housed at the facility between mid-November through mid-May of each year. CDFW is currently working to extend this holding period by installing appropriate water refrigeration systems.

If Silverado is unable to receive the collections (i.e., when temperatures are not conducive for the transfer and holding of fish), then collections will either stay at the FRFH and be quarantined onsite at the FRFH Annex Facility or be transferred to the CABA facility located on the UC Davis Campus (Davis, CA) as a backup system for quarantine. The FRFH Annex uses about 12 cfs of well water (whereas the main FRFH uses river water) at any given time, and all raceways are 100-ft long and 10-feet wide. The FRFH Annex is part of the FRFH operations, and is located downstream from the FRFH on the west side of the Thermalito Afterbay. The FRFH Annex provides additional rearing capacity for 2.5 million fingerling salmon. The operation of the FRFH Annex is covered under the FRFH operational protocols.

CABA's fish culture tanks utilize a secure source of well water which is generally considered free of fish pathogens. CABA has a capacity for hatching a minimum of 40,000 Chinook eggs at one time and is capable of rearing them to approximately 5 grams.

Quarantine facilities may also be used for short term holding and potentially longer-term holding if the need arises. Under such circumstances, 6ft, 10ft, or 16ft circular fiberglass culture tanks would be made available at the facilities for that specific purpose.

3.3.3 San Joaquin Fish Hatchery (SJFH) and Salmon Conservation and Research Facility (SCARF)

The CDFW operates the SJFH for trout near the town of Friant, California, located approximately one mile downstream of Friant Dam, and about 20 miles northeast of Fresno (Fresno County). Water for the hatchery and the SCARF is supplied from Millerton Lake, impounded by Friant Dam, and then aerated at the hatchery from a continuous 35 cfs supply that is gravity-fed directly from Friant Dam. Further information regarding water quality for these facilities is outlined through section 3.4.3 of the Broodstock EA. The SJFH has used this water source to successfully hatch and raise trout at the site since 1955 due to favorable water temperature and water quality conditions.

The SCARF is located at the SJFH. The SCARF is expected to be fully operational by 2015. The CDFW established the interim SCARF in 2010 and has been expanding and testing the system since then. Planning and permitting activities for the full-scale SCARF are in progress with CDFW as the lead agency.

3.4 Restoration Area

This section summarizes aspects of the current aquatic habitat found in the five reaches (i.e., river segments) of the Restoration Area and the Restoration Area bypasses (see Figure 3). The Restoration Area encompasses the San Joaquin River from Friant Dam downstream to the confluence with the Merced River. Information presented in this section is compiled from the PEIS/R, the Broodstock EA, and the Rule EA. Aquatic habitat conditions vary spatially and temporally throughout the Restoration Area and the flood bypasses because of differences in habitat availability and connectivity, water quantity and quality, channel morphology, and predation risks.

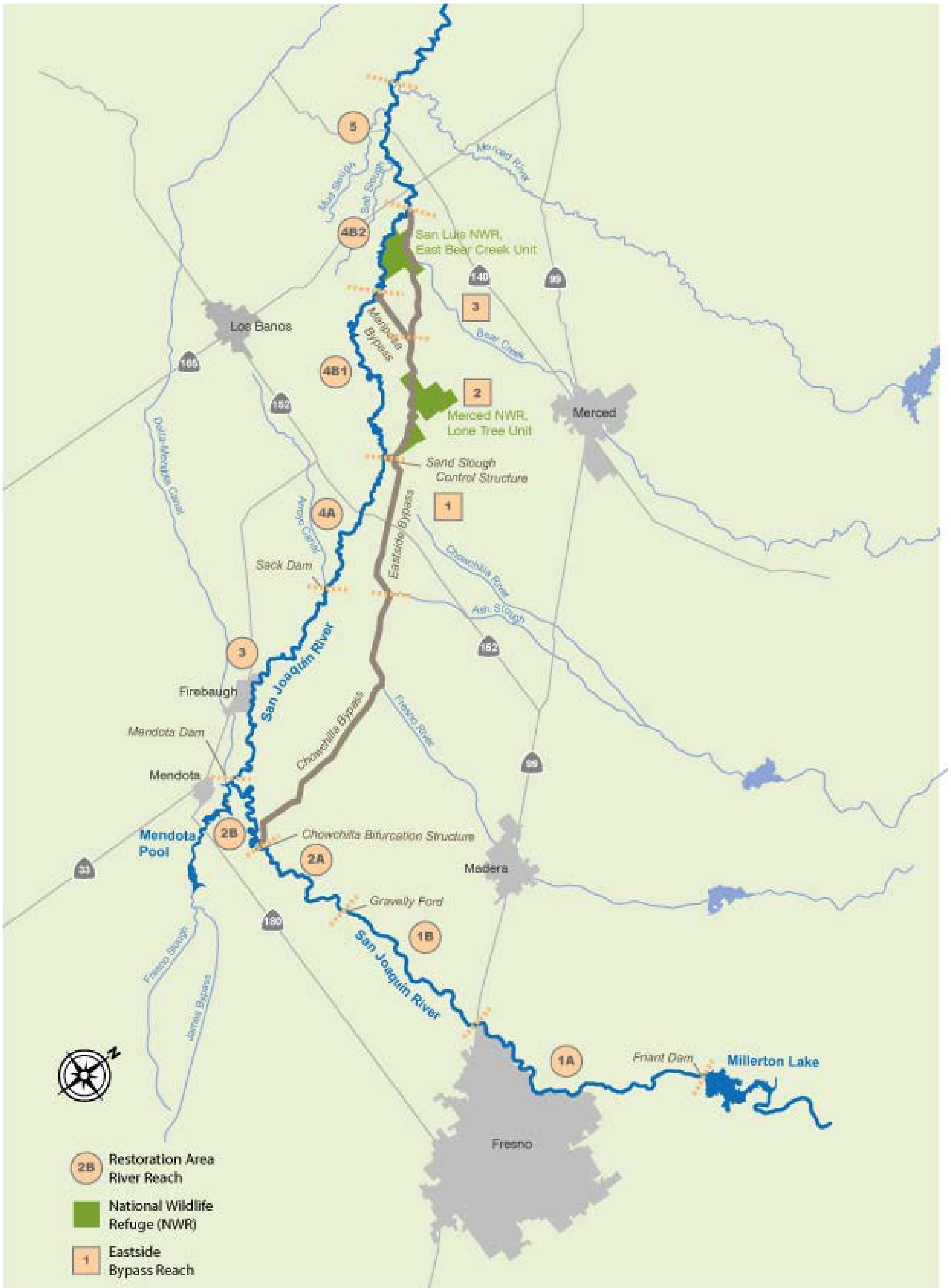
Many changes have occurred to channel morphology in the Restoration Area over time, with the most pronounced as follows:

• **Reach 1** –This reach conveys continuous flows through an incised, gravel-bedded channel. Reach 1 typically has a moderate slope, and is confined by periodic bluffs and terraces. The reach is divided into two subreaches: 1A and 1B. Reach 1A, which extends down to State Route (SR) 99, supports continuous riparian vegetation except where the channel has been disrupted by gravel mining and other development. Reach 1A also contains potential holding pool habitat that would support adult spring-run Chinook holding, and the majority of available spawning habitat. Reach 1B continues from SR 99 to Gravelly Ford where it is more narrowly confined by levees. Reach 1 has been extensively mined for instream gravel and is sediment limited.

Reach 1 is the only reach that contains potential holding pool habitat to support adult spring run Chinook holding from late spring through the summer. Draft data compiled by California Department of Fish and Game (Matt Bigelow, pers. comm. 09/01/2011 email to Michelle Workman) delineated holding pool criteria and area available for suitable adult holding. Preliminary estimates suggest that there is enough holding habitat (based on temperature, depth, velocity and cover) to support 120,000-360,000 adult fish.

• **Reaches 2 Through 5 –** Habitat conditions for fish in Reaches 2 through 5 have been substantially modified by levee/dike construction, agricultural encroachment, and water diversions. These changes have reduced the quantity of floodplain habitat, as well as reducing main channel habitat complexity and the quantity and quality of off-channel habitat in these reaches. Much of this floodplain habitat has been isolated from the river by dikes and levees, and the remaining floodplain habitat is rarely inundated under current hydrologic conditions. There are projects proposed in the SJRRP to improve habitat conditions and to support flows that would permit juvenile rearing and adult/juvenile migration. Projects in Reach 2B and Reach 4B/Eastside Bypass are currently under development. These projects are being evaluated for their ultimate potential to provide a combination of fish habitat, flood protection, and the continuance of water supply availability.

Additional analysis detailing the San Joaquin River Restoration Area’s structural migration impediments, channel migration and avulsion, spawning gravels, and sedimentation can be found in the SJRRP PEIS/R.



Source: (PEIS/R 2012)

Figure 3: San Joaquin River Restoration Area

3.5 Fish

Fish assemblages currently found in the San Joaquin River are the result of substantial changes to the physical environment, combined with more than a century of nonnative species introductions. Areas where unique and highly endemic fish assemblages once occurred are now inhabited by assemblages composed primarily of introduced species. Primary environmental conditions that currently influence native fish species abundance and distribution (and frequently favor nonnative species) include the following:

- Highly altered flow regimes and substantial flow reductions
- Substantial reductions in the frequency, magnitude, and duration of floodplain inundation
- Isolation of floodplains from the river channel resulting from channelization and levee construction
- Changes in sediment supply and transport
- Habitat fragmentation caused by physical barriers
- Creation of false migration pathways by flow diversions
- Reduced quantity and quality of riparian habitat, including increased prevalence of invasive exotic vegetation, encroachment, etc.
- Degraded water quality
- Dewatered stream reaches

Of the approximately 21 native fish species historically present in the San Joaquin River, at least 8 are now uncommon, rare, or extinct, and an entire fish assemblage – the deep bodied fish assemblage (e.g., Sacramento splittail, Sacramento blackfish) has been largely replaced by nonnative warm-water fish species (e.g., carp, catfish) ((Moyle 2002), as cited in (PEIS/R 2011)). Warm-water fish assemblages comprising of many nonnative species such as black bass species and sunfish species appear better adapted to current, disturbed habitat conditions than native assemblages. However, habitat conditions in Reach 1 (slightly higher gradient, cooler water temperatures, and higher water velocities) seem to have restricted many introduced species from colonizing Reach 1.

Native and non-native fish species found throughout the San Joaquin River basin are listed in Table 3-1 below. In addition, fall-run Chinook inhabit the Merced, Tuolumne, and Stanislaus rivers, and are supported in part by hatchery stock in the Merced River. The average annual spawning escapement (1952 through 2005) for the three major San Joaquin River tributaries was an estimated 19,100 adults. Since 1952, fall-run Chinook populations in the San Joaquin River basin have fluctuated widely, with a distinct periodicity that generally corresponds to periods of drought and wet conditions. Escapement estimates in 2006 and 2007 indicate another period of severe declines, presumably not the result of drought, with a near record low escapement in 2007 ((CDFW 2008), as cited in (PEIS/R 2011)). As discussed in the Rule

EA, there are data that support the possible presence of spring-run Chinook in the Mokelumne, Tuolumne, and Stanislaus rivers.

Table 2: Native and Non-native Fish Species found in the San Joaquin River Basin

Species	**Reach 1**	**Reach 2**	**Reach 3**	**Reach 4**	**Reach 5**	**San Joaquin River & Tributaries Merced River to Mossdale**
bigscale logperch (*Percina macrolepida*)						X
black bass species						X
black bullhead (*Ameiurus nebulosus*)						X
black crappie (*Pomoxis nigromaculatus*)	X	X	X		X	X
bluegill (*Lepomis macrochirus*)	X	X	X		X	X
brown bullhead (*Ameiurus nebulosus*)	X	X	X		X	
California roach (*Hesperoleucus symmetricus*)						X
channel catfish (*Ictalurus punctatus*)	X	X	X		X	X
common carp (*Cyprinus carpio*)	X	X	X		X	X
fall-run Chinook salmon (*Oncorhynchus tshawytscha*)						X
spring-run Chinook salmon (*Oncorhynchus tshawytscha*)						?
fathead minnow (*Pimephales promelas*)						X
golden shiner (*Notemigonus crysoleucas*)	X	X	X		X	X
goldfish (*Carassius auratus*)	X	X	X		X	X
green sturgeon (*Acipenser medirostris*)						X
green sunfish (*Lepomis cyanellus*)	X	X	X		X	X
hardhead (*Mylopharodon conocephalus*)						X
hitch (*Lavinia exilicauda*)		X	X		X	X
inland silverside (*Menidia beryllina*)			X	X	X	X
kokanee (*Oncorhynchus nerka*)	X	X	X		X	
lamprey species	X					X

Species	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5	San Joaquin River & Tributaries Merced River to Mossdale
largemouth bass (*Micropterus salmoides*)	X	X	X		X	X
longfin smelt (*Spirinchus thaleichthys*)						X
Pacific lamprey (*Lampetra tridentate*)						X
Pacific staghorn sculpin (*Leptocottus armatus*)						X
prickly sculpin (*Cottus asper*)			X		X	X
pumpkinseed (*Lepomis gibbosus*)					X	
red shiner (*Cyprinella lutrensis*)			X		X	X
redear sunfish (*Lepomis microlophus*)	X	X	X		X	X
river lamprey (*Lampetra ayresii*)						X
Sacramento blackfish (*Orthodon microlepidotus*)			X		X	X
Sacramento Perch (*Archoplites interruptus*)						X
Sacramento pikeminnow (*Ptychocheilus grandis*)	X				X	X
Sacramento splittail (*Pogonichthys macrolepidotus*)					X	X
Sacramento sucker (*Catostomus occidentalis*)	X				X	X
sculpin species	X					
smallmouth bass (*Micropterus dolomieu*)						X
spotted bass (*Micropterus punctulatus*)	X	X	X		X	
Starry flounder (*Platichthys stellatus*)						X
steelhead (rainbow trout) (*Oncorhynchus mykiss*)	X					X
striped bass (*Morone saxatilis*)						X
threadfin shad (*Dorosoma petenense*)						X
threespine stickleback (*Gasterosteus aculeatus*)	X					X

Species	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5	San Joaquin River & Tributaries Merced River to Mossdale
tule perch (*Hysterocarpus traskii*)			X		X	X
warmouth (*Lepomis gulosus*)						X
western mosquitofish (*Gambusia affinis*)	X	X	X		X	X
white catfish (*Ameiurus catus*)						X
white crappie (*Pomoxis annularis*)		X	X		X	X
white sturgeon (*Acipenser transmontanus*)						X

Native Species
Nonnative Species

Compiled from (PEIS/R 2011)

3.5.1 Federally Listed Fish Species

California Central Valley steelhead (CCV steelhead) are still present in low numbers in the Tuolumne, Stanislaus, and the Merced river systems below the major dams (PEIS/R 2011), but escapement estimates are not available. Restoration of flows to the San Joaquin River above the Merced River will also restore access for steelhead to the Restoration Area.

Several researchers have speculated that the Southern Distinct Population Segment (DPS) of North American green sturgeon (*Acipenser medirostris*) spawn within the San Joaquin River system. Numerous juvenile and larval sturgeon have been collected on the lower San Joaquin River, but these fish are believed to have entered the system from the Sacramento River through the lower Mokelumne River, Georgiana Slough, or the Three Mile Slough. CDFW concluded "based on movement of other fishes in the Delta, young green sturgeon found in the lower San Joaquin could easily, and most likely, come from the known spawning population in the Sacramento River" (Gruber et al. 2012).

Gruber, et al. (2012) states that CDFW Sturgeon Report Card data indicates six green sturgeon were caught within the San Joaquin River upstream of Stockton, five of which were caught in March and April (Gruber et al. 2012). Although the data indicates the presence of a limited number of green sturgeon, it is possible that some fish go unreported (e.g., poaching) or a proportion of the 143 reported white sturgeon may be misidentified. It remains unknown how and to what extent green sturgeon use the San Joaquin River. However, their reported presence coincides with the spawning migration of the Southern DPS of green sturgeon within the Sacramento River.

3.6 Predation and Disease

Predation is another threat to the spring-run Chinook ESU, especially in the lower Feather River, the Sacramento River, and in the Delta where there are high densities of nonnative (e.g., striped bass, smallmouth bass and largemouth bass) and native fish species (e.g., pikeminnow) prey on outmigrating salmon (NMFS 2011). Changes in predator success due to increased abundance and vulnerability of prey may occur at newly constructed or altered diversion intakes or passage structures. Many predatory fish may be more successful at locations where prey fish are artificially concentrated or stressed, such as at dams or salvage and hatchery release sites ((Buchanan et al. 1981, Pickard et al. 1982), as cited in (PEIS/R 2011)). High predation rates are known to occur below small dams, such as the Red Bluff Diversion Dam (RBDD) in the Sacramento River and Sack Dam in the Restoration Area. As fish pass over small dams, they are subject to conditions that may disorient them, making them highly susceptible to predation by fish or birds. In addition, deep pool habitats tend to form immediately downstream from such dams, such as within the Restoration Area, creating conditions that promote congregation of Sacramento pikeminnow, striped bass, and other predators. ((Tucker et al. 1998) as cited in (PEIS/R 2011)) showed high rates of predation by Sacramento pikeminnow and striped bass on juvenile salmon below the RBDD on the Sacramento River.

Naturally occurring pathogens may also pose a threat to the spring-run Chinook ESU, because artificially propagated spring-run Chinook are susceptible to disease outbreaks such as the IHNV and BKD (NMFS 2011). No disease outbreaks at the FRFH affecting spring-run Chinook have occurred between 2006 and 2011 (NMFS 2011).

3.7 Aquatic Invasive Species (AIS)

Nonnative species predominate the fish assemblages within the San Joaquin River and its tributaries. (Moyle and Light 1996), as cited in (PEIS/R 2011)) suggested that nonnative piscivorous fish are most likely to alter fish assemblages. Largemouth bass are documented predators of out-migrating juvenile anadromous salmonids (TID/MID 1992, (PEIS/R 2011)). They may also play the role of keystone predator (i.e., species that may increase biodiversity by preventing any one species from becoming dominant) in many aquatic environments because of broad environmental tolerances and their ability to forage on a wide variety of prey under many conditions. Smallmouth bass may primarily affect hardhead through competition for food resources, and may prey on juvenile cyprinids. Striped bass may be an important predator on immature life stages of river lamprey and Sacramento splittail. Inland silversides may feed on eggs and larvae of Sacramento splittail and other fish species in floodplain spawning areas. Native species expected to be the most sensitive to predation by nonnative predators include juvenile hardhead and Sacramento splittail.

As currently seen in the San Francisco Estuary, AIS can alter the natural food webs that existed prior to their introduction. Perhaps the most significant example is illustrated by the Asiatic freshwater clams (*Corbicula fluminea*) and (*Potamocorbula amurensis*). The decline in the levels of phytoplankton reduces the population levels of zooplankton that feed upon them, and hence reduces the forage base available to salmonids transiting the Delta and San Francisco estuary which feed either upon the zooplankton directly or their mature forms. This lack of forage base can adversely impact the health and physiological condition of these salmonids as they emigrate through the Delta region to the Pacific Ocean. Attempts to control AIS also can adversely impact the health and well-being of salmonids within the affected water systems. For example, the control programs for the invasive water hyacinth (*Eichhornia crassipes*) and Brazilian waterweed (*Egeria densa*) plants in the Delta must balance the toxicity of the herbicides applied to control the plants to the probability of exposure to listed salmonids during herbicide application. In addition, the control of the nuisance plants have certain physical parameters that must be accounted for in the treatment protocols, particularly the decrease in DO resulting from the decomposing vegetable matter left by plants.

3.8 Other Environmental Conditions of the San Joaquin Basin

Other baseline conditions of the San Joaquin Basin are described below. These conditions include recreational boating and fishing, commercial fishing, hatchery facilities, land use, water quality, water temperature, suspended sediment and turbidity. Portions of these discussions have been taken from the SJRRP PEIS/R. The SJRRP includes restoration actions that would address some of the conditions described here.

3.8.1 San Joaquin River Recreation

The PEIS/R describes the settings of recreation, as they pertain to implementation of the Settlement. The PEIS/R therefore contains a discussion regarding all of the recreational facilities. The following is a summary of recreational opportunities and a presentation related to fishing and other river related activities.

Recreational activities within the San Joaquin River portion of the Restoration Area include fishing, boating, nature interpretation and education, trail use, camping, hunting, picnicking, and wildlife viewing/nature observation. Fishing and boating are activities that are most directly flow-dependent, with the availability and quality of these activities closely tied to the frequency, timing, and volume of river flows. The other activities mentioned below are flow-independent but are often associated with boating and fishing, and may be enhanced by more frequent river flows.

3.8.1.1 Recreational Boating

A range of boating opportunities is possible in Reach 1 ((San Joaquin River Parkway and Conservation Trust (SJRPCT) 2010), as cited in (PEIS/R 2011)). The river, side channels, and old mining lakes provide flat-water boating opportunities. The *San Joaquin River Parkway Master Plan* ((San Joaquin River Conservancy (SJRC) 2000), as cited in (PEIS/R 2011)) describes the river as a public “canoe trail” for non-motorized boating. The river has minimal riffles and a few small rapids at Lost Lake Park ((American Whitewater Association 2007), as cited in (PEIS/R 2011)) but is generally slow enough that constant paddling is required ((San Joaquin River Conservancy (SJRC) 2000), as cited in (PEIS/R 2011)). According to American Whitewater, the river from Friant Dam to Skaggs Bridge Park is “the safest introduction to river paddling in the Fresno area” during summer low flows and “the closest whitewater to Fresno” during high flows. Some boating hazards are present and include riparian vegetation that overhangs the river and mining causeways and culverts ((American Whitewater Association 2007), as cited in (PEIS/R 2011)).

3.8.1.2 Recreational Fishing

Fishing occurs primarily in Reaches 1 and 5, which have year-round flow, and the portion of Salt Slough located in the San Luis National Wildlife Refuge ((USFWS 2010), as cited in (PEIS/R 2011)). Current California sportfishing regulations prohibit salmon fishing on the San Joaquin River from Friant Dam to Mossdale. Reach 1 is planted throughout the year with rainbow trout from CDFW's San Joaquin Fish Hatchery (SJFH) located downstream from Friant Dam and is fished year-round, primarily by local anglers ((Shaffer 2005) as cited in (PEIS/R 2011)). Public fishing access exists along the river in Reach 1(Table 3) and fishing occurs in the adjacent Lost Lake, a pit created during the construction of Friant Dam ((City of Fresno. 2002), as cited in (PEIS/R 2011)), and other similar pits created by gravel mining.

Table 3: Existing Parks and Public Lands in the San Joaquin River Parkway – Reach 1[1]

Recreation Facility/ Park Unit	**Owner**[1]	**Area(acres)**	**Primary Recreation Opportunities**					
			Fishing	**Boat Access to River**	**Outdoor**	**Trails/Trail Access**	**Camping**	**Picnicking**
Camp Pashayan	CDFW, SJRPCT	32/[2]	X	X		X		X
Coke Hallowell Center for River	SJRPCT	20			X	X		
Fort Washington Beach	Private	NA	X	X			X	X
Friant Cove	SJRC	6	X	X				X
Jensen River Ranch	SJRC	167				X		X
Lost Lake Park	City of Fresno	305	X	X	X	X	X	X
San Joaquin River Ecological	CDFW	8002			X			
Scout Island	City of Fresno	85		X	X		X	
Sycamore Island Ranch	SJRPCT	350	X	X		X		X
Wildwood Native Park	SJRPCT	22	X	X		X		
Willow Lodge (adjacent to Willow Unit of San Joaquin River Ecological Reserve)	CDFW	88			X	X		
Woodward Regional Park	City of Fresno	300				X		X

Table 3 Footnotes:

[1] Key: CDFW = California Department of Fish and Wildlife; NA = not applicable; SJRPCT = San Joaquin River; Parkway and Conservation Trust; SJRC= San Joaquin River Conservancy.

[2] Management of several of the parks is by an entity other than the owner, in some cases with the park owner. The San Joaquin River Conservancy (SJRC) owns and manages 2,541 acres in total, much of which is managed for conservation and future low-impact recreation. In addition, on land owned by the Conservancy, Islewood Golf Course is operated by a private entity. In addition to the properties providing the recreation opportunities in the table, CDFW also owns and operates the San Joaquin Hatchery, below Friant Dam, where the public can view and feed trout in the hatchery raceways. The ecological reserve is composed of several widely dispersed units in the

3.8.2 Commercial Fishing

Commercial fishing of Chinook and other salmon occurs off the coast of northern and central California during the open season. The Chinook that are targeted by this fishery are fall-run Chinook. There is an important recreational fishery for Chinook salmon in the ocean as well as in the inland waters, although more restrictive regulations apply in anadromous spawning areas to protect this important life stage. Current regulations on both the recreational and commercial fisheries include restrictions of time, place, and gear that are intended to reduce the take of ESA listed salmonids.

3.8.3 Land Use

The following summarizes the land use and agricultural resources within the Restoration Area of the SJRRP and is taken from the Environmental Setting section of Chapter 16 Land Use and Agricultural Resources (PEIS/R 2011). While there is other land uses adjacent to the San Joaquin River it is the potential use of river water by agriculture that could affect the riverine system.

Agricultural and Other Land Uses

Within the Restoration Area the SJRRP PEIS/R identified where restoration actions could affect existing land uses or agricultural resources. In addition, the SJRRP PEIS/R included a discussion of forest lands within the Restoration Area.

Most of the land in the Restoration Area is privately owned. The primary land uses are open space and agriculture. Urban land uses (e.g., residential, commercial, industrial) account for only a small percentage of land use along the San Joaquin River. This type of use is associated primarily with the small communities located near the river between Friant Dam and the confluence with the Merced River.

The Restoration Area occupies approximately 72,581 acres along the San Joaquin River (Table 4). Land uses within the Restoration Area were identified, inventoried, and placed into the following broad land use categories: agricultural, open space, and urban. Table 4 shows the approximate acreages for each land use category along the San Joaquin River (by reach) and for the bypass areas.

Table 4: Acreage of Land Uses along San Joaquin River in Restoration Area

River Reach	**Land Use (acres)[2]**			
	Agricultural	**Open Space**	**Urban**	**Total**
Reach 1	7,216 (46%)	5,195 (33%)	3,419 (22%)	15,830
Reach 2	9,107 (99%)	37 (<1%)	28 (<1%)	9,172
Reach 3	7,218 (90%)	606 (8%)	231 (3%)	8,055
Reach 4	14,439 (100%)	0 (0%)	0 (0%)	14,439
Reach 5	5,461 (100%)	0 (0%)	0 (0%)	5,461
Bypass Areas	16,306 (83%)	0 (0%)	3,317 (17%)	19,623
Total	**59,747 (82%)**	**5,838 (8%)**	**6,996 (10%)**	**72,581**

[2] The width of the Restoration Area includes an area approximately 1,500 feet from the river centerline, outward from both banks, for a total width of approximately 3,000 feet. Acreage numbers have been rounded to the nearest acre. Key: % = percent; < = less than.

Source: (PEIS/R 2011)

The SCARF is located within Reach 1 and many of the activities associated with the release of fish would occur within this Reach. Approximately 1,636 acres of Reach 1 of the Restoration Area are in the City of Fresno. Reach 1 also includes the town of Friant, as well as the unincorporated communities of Rolling Hills, Herndon, and Biola. The approximate acreage of land uses, as inventoried in Reach 1, is approximately 15,832 acres (see Table 3). The primary land use category of Reach 1 is agriculture (60 %), followed by open space (28 %), and urban land uses (12 %). Approximately 93.8 % of lands found in Reach 1 are privately owned.

Reach 1 is divided into two subreaches. Reach 1A flows to the north of Fresno and also passes near the communities of Friant and Rolling Hills and two trailer parks located adjacent to the Yosemite Freeway Bridge. Between Friant Dam and the SR 99 Bridge that crosses the San Joaquin River, several roads parallel the river in this subreach, and six bridges cross the river (North Fork Road Bridge, Yosemite Freeway Bridge, West Nees Bridge, and three unnamed bridges).

The primary nonurban land uses along the remaining areas of Reach 1A are gravel mining, agriculture, and recreation/open space. Several active gravel quarries and related roads and other infrastructure are located adjacent to the river. Agricultural land uses include vineyards, annual crops, and orchards.

In addition to mining and agriculture, several recreation areas are located in Reach 1A. The San Joaquin River Parkway extends upstream from and includes the Millerton Lake SRA and areas along both river banks of this subreach. The parkway includes multiple recreation sites and use areas, including Lost Lake Park, an approximately 273-acre recreation area along 1.8 miles of the southern bank, Fort Washington Beach, Sycamore Island Ranch, and Camp Pashayan, among others. Three private golf courses (Riverbend Golf Club, Fig Garden Golf Club, and San Joaquin Country Club) and one public golf course (Riverside Golf Course) are present in this subreach. Multiple ponds are also located in this reach. These ponds were created in abandoned mining gravel pits and are now stocked with game fish.

Forest Land

Forest land is defined as native tree cover greater than 10% that allows for management of timber, aesthetics, fish and wildlife, recreation, and other public benefits (California Public Resources Code section 12220(g)). Natural forest and woodland vegetation types in the study area typically have greater than 10% cover by native trees ((PEIS/R 2011) Appendix L, "Biological Resources – Vegetation and Wildlife"). Forest land in the Restoration Area consists of riparian forest that has been classified into four major types based on the dominant species: cottonwood riparian forest, willow riparian forest, mixed riparian forest, and valley oak riparian forest. As shown in Table 5, forest lands total approximately 4,320 acres in the Restoration Area.

Table 5: Habitats and Acreage of Forest Land in the Restoration Area

Habitat Type	**Habitat Acreage**						
	Reach 1	**Reach 2**	**Reach 3**	**Reach 4**	**Reach 5**	**Bypasses**	**Total**
Cottonwood Riparian Forest	386 (37%)	120 (12%)	452 (43%)	56 (5%)	29 (3%)	-- (0%)	1,043

Willow Riparian Forest	345 (16%)	163 (8%)	124 (6%)	777 (36%)	755 (35%)	2 (<1%)	2,166
Mixed Riparian Forest	783 (99%)	2 (<1%)	-- (0%)	6 (<1%)	1 (<1%)	-- (0%)	792
Valley Oak Riparian Forest	265 (41%)	-- (0%)	-- (0%)	23 (7%)	35 (11%)	-- (0%)	323
Total	**1,779** **(41%)**	**285** **(7%)**	**576** **(13%)**	**862** **(20%)**	**820** **(19%)**	**--** **(0%)**	**4,324**

[1] Acreage numbers have been rounded to the nearest acre.

Key: % = percent; < = less than.

Source: ((CDWR 2002), as cited in (PEIS/R 2011))

Table 5 also shows those lands formally identified as the forest types present within the Restoration Area. These lands consist of habitats associated with river systems and are not considered traditional sources of timber production.

3.8.5 Water Quality

The discussion of water quality in the Restoration Area is from the Draft PEIS/R. It should be noted that one of the actions that would result from the SJRRP is that the restoration of flows to the Restoration Area may result in changes to water quality. Any potential changes are addressed in the PEIS/R and would occur whether the Proposed Action occurs or not.

Water quality in various segments of the San Joaquin River below Friant Dam is degraded because of low flow, and discharges from agricultural areas and wastewater treatment plants. The current triennial review of the Water Quality Control Plan for the Sacramento and San Joaquin River basins (Basin Plan) is anticipated to provide the regulatory guidance for Total Maximum Daily Load (TMDL) standards at locations along the San Joaquin River (Central Valley Regional Water Quality Control Board (RWQCB). 2009).

Water quality in Reach 1 is influenced by releases from Friant Dam, with minor contributions from agricultural and urban return flows. Water quality data collected from the San Joaquin River below Friant Dam demonstrate the generally high quality of water released at Friant Dam from Millerton Lake to Reach 1. Temperatures of San Joaquin River water releases to Reach 1 are dependent on the cold-water volume available at Millerton Lake (Reclamation 2007). The reach from Gravelly Ford to the Mendota Pool (Reach 2) is frequently dry, except during flood releases at Friant Dam, because water released at Friant Dam is diverted upstream to satisfy water rights agreements, or the water percolates to groundwater.

During the irrigation season, water released at Mendota Dam to Reach 3 generally has higher concentrations of total dissolved solids than water in the upper reaches of the San Joaquin River.

Increased electrical conductivity (salinity) and concentrations of total suspended solids demonstrate the effect of the Delta's contributions to San Joaquin River flows. Water temperatures below Mendota Dam are dependent on water temperatures of inflow from the Delta Mendota Canal and, occasionally, the Kings River system via James Bypass (Reclamation 2007).

Water quality criteria applicable to some beneficial uses are not currently met within Reaches 3 and 4.

The Central Valley Regional Water Quality Control Board (RWQCB) is currently developing a Proposed Basin Plan Amendment to establish new salinity and boron water quality objectives in the lower San Joaquin River upstream from Vernalis, and a TMDL to implement the salinity and boron water quality objectives (Central California Regional Water Quality Control Board (RWQCB). 2009). In addition to these water quality impairments, a TMDL and Basin Plan Amendment for organic enrichment and low DO levels in the Stockton Deepwater Ship Channel portion of the San Joaquin River were adopted. However, the Central Valley RWQCB has not adopted a TMDL for DO for the entire San Joaquin River basin.

Water quality in the Delta is highly variable temporally (timing) and spatially (location) and is a function of complex circulation patterns that are affected by inflows, pumping for Delta agricultural operations and exports, operation of flow control structures, and tidal action.

3.8.6 Water Temperature

Most fish maintain body temperatures that closely match their environment ((Brown and Moyle 1993), as cited in (PEIS/R 2011)). As a result, water temperature has a strong influence on almost every fish life-history stage, including metabolism, growth and development, timing of life-history events, and susceptibility to disease. These effects may vary depending on a fish's prior thermal history (i.e., acclimation). Reduced growth, reduced reproductive success, inhibited movement, and mortality of fish can occur when water temperature exceeds the metabolic tolerance of a particular life stage (Hughes et al. 1978, Bjornn and Reiser 1991), as cited in (PEIS/R 2011)).

In the San Joaquin River, water temperature is primarily a concern for native fish that thrive in cooler water, such as salmon, steelhead, and rainbow trout ((Bjornn and Reiser 1991), as cited in (PEIS/R 2011)), and for those species that require cooler water for specific life stages ((Moyle 2002) as cited in (PEIS/R 2011)). Summer water temperatures in many Central Valley streams regularly exceed 77°F ((Moyle 2002) as cited in (PEIS/R 2011)). The upper preferred water temperature for spawning Chinook salmon is 55^{o}F to 57^{o}F (Bjornn and Reiser 1991, Snider et al. 2001). (Cherry et al. 1975) found preferred temperatures for rainbow trout ranged from 11°C (51.8°F) to 21°C (69.8°F) depending on acclimation temperatures (Christopher A. Myrick and Joseph J. Cech 2001). Sustained periods of increased water temperature can impact behavioral and biological functions of all fish in the San Joaquin River system, including special status species and others that are relatively tolerant of warm temperatures.

3.8.7 Suspended Sediment and Turbidity

Suspended sediments such as clay, silt, organic matter, plankton and other microscopic organisms cause turbidity in water that can interfere with photosynthetic primary productivity, water temperature, DO, and fish feeding habits. Turbidity generally reduces the efficiency of piscivorous (fish-eating) and planktivorous (plankton-eating) fish in finding and capturing their prey (as cited in (PEIS/R 2011)). Higher turbidity may occasionally favor the survival of young fish by protecting them from predators ((Bruton 1985) as cited in (PEIS/R 2011)) at the expense of reduced growth rates for sight-feeding fish ((Newcombe and MacDonald 1991, Newcombe and Jensen 1996) as cited in (PEIS/R 2011)).

Historically, The abundant cold water in the upper San Joaquin River basin presumably had high (saturated) concentrations of DO, low salinity, and neutral pH levels (PEIS/R 2011). Levels of suspended sediment and turbidity were likely low, even during high-runoff events, because of the upper basin's mainly granitic geology and the relatively low rates of primary productivity (algae growth) (PEIS/R 2011).

Presently, Friant Dam has eliminated sediment supply from the upper watershed to the San Joaquin River downstream from the dam (PEIS/R 2011). Small particles on the bed surface, such as spawning gravels less than 32 millimeters (mm), have likely been mobilized and deposited downstream since dam construction (PEIS/R 2011). In addition to altering spawning gravel dynamics, the presence of Friant Dam has likely changed sedimentation rates in areas outside the main river channel, such as floodplains and side channels (PEIS/R 2011). Benthic macroinvertebrates and algal communities are poorly documented in the San Joaquin River ((Brown 1996) as cited in (PEIS/R 2011)). However, it is certain that modifications to habitat and introduction of nonnative species (e.g., crayfish) have substantially impacted the native macroinvertebrate and algal communities ((Brown 1996) as cited in (PEIS/R 2011)).

3.8.8 Air Quality

This section provides a description of the air basins in which the Proposed Action are located and a summary table of the Attainment Status within each air basin. Description of individual pollutants and the regulatory setting are found in the SJRRP PEIS/R and are incorporated by reference.

The 10(a)(1)(A) application details the activities of collecting eggs and juveniles from the FRFH and includes pathogen and quarantine procedures for transporting eggs from the Feather River to another watershed. These procedures may require holding of juveniles at Silverado or at CABA.

The FRFH and CABA are located within the Sacramento Valley Air Basin (SVAB). Silverado is in Napa County which is within the San Francisco Bay Area Air Basin (SFB). Lastly, SCARF is within the San Joaquin Valley Air Basin (SJVAB).

The SVAB consists of the northern portion of the Central Valley of California. The SVAB contains all or part of 11 counties (Shasta, Tehama, Butte, Glenn, Colusa, Yuba, Sutter, Yolo, Placer, Sacramento, and eastern Solano). The basin is ringed by tall mountains with the Coast Range to the west, Cascade Range to the north, the Sierra Nevada to the east. Seasonally the winters in the SVAB are cool and wet with the summers being hot and dry. The SFB consists of the nine counties that surround the San Francisco Bay

(Napa, western Solano, Contra Costa, Alameda, Santa Clara, San Mateo, San Francisco, Marin, and southern Sonoma). The San Francisco and San Pablo bays are surrounded by low hills and mountains of the Coast Range. While cooler than the SVAB, the eastern portions of the basin can still be very warm in the summer months.

The SCARF is located in Fresno County, which is part of the SJVAB. The SJVAB also includes all of Madera, Merced, Kings, San Joaquin, Stanislaus, and Tulare counties, and the valley portion of Kern County. The SJVAB occupies the southern half of the Central Valley. The SJVAB is a well-defined climatic region with distinct topographic features on three sides. The Coast Range is located on the western border of the SJVAB. The Tehachapi Mountains are located on the south side of the SJVAB. The Sierra Nevada Range forms the eastern border of the SJVAB. The northernmost portion of the SJVAB is San Joaquin County. No topographic feature delineates the northern edge of the basin. The SJVAB can be considered a “bowl” open only to the north and connected to the SVAB and SFB.

Like the SVAB the inland Mediterranean climate type of the SJVAB is characterized by hot, dry summers and cool, rainy winters.

Table 6 summarizes the Attainment Status Designations for the counties of the three air basins.

Table 6: Summary of Attainment Status Designations for the Sacramento, San Joaquin and San Francisco Bay Area Air Basins

Pollutant	**Averaging Time**	**Attainment Status**
Ozone	1-hour	Nonattainment- Severe: San Joaquin Valley Moderate: Butte, Colusa, Yuba, Glenn, Tehama, and Shasta Counties Serious: Napa, Yolo, Sacramento, Sutter Counties
	8-hour	–
Carbon Monoxide (CO)	1-hour	Attainment Kern, Tulare, Fresno, Stanislaus, San Joaquin, Sacramento, Napa, Yolo, Sutter, Butte Counties Unclassified Madera, Merced, Yuba, Colusa, Glenn, Tehama, and Shasta Counties
	8-hour	
Nitrogen Dioxide (NO_2)	Annual Arithmetic Mean	-
	1-hour	Attainment
Sulfur Dioxide (SO_2)	Annual Arithmetic Mean	-
	24-hour	Attainment
	3-hour	-
	1-hour	Attainment
Respirable Particulate Matter (PM_{10})	Annual Arithmetic Mean	Nonattainment
	24-hour	
Fine Particulate Matter ($PM_{2.5}$)	Annual Arithmetic Mean	Nonattainment: San Joaquin Valley, Sacramento, Butte, and Napa Counties. Attainment: Sutter, Yuba, Colusa, and Shasta Counties. Unclassified: Yolo, Glenn, and Tehama Counties
	24-hour	-
Lead	30-day Average	Attainment
	Calendar Quarter	-
Sulfates	24-hour	Attainment
Hydrogen Sulfide	1-hour	Unclassified
Vinyl Chloride	24-hour	Unclassified/ Attainment
Visibility Reducing Particle Matter	8-hour	Unclassified

Sources: (PEIS/R 2012)

3.8.9 Odors

In addition to the discussion of the SJVAB and its air quality, the air quality section of the PEIS/R also included a discussion regarding odors. That discussion is presented below.

Odors are generally regarded as an annoyance rather than a health hazard. However, manifestations of a person's reaction to foul odors can range from psychological (e.g., irritation, anger, anxiety) to physiological (e.g., circulatory and respiratory effects, nausea, vomiting, headache).

Potential existing sources of odor include various agricultural activities in the vicinity (e.g., dairy operations, livestock operations, fertilizer use). It should be noted that the PEIS/R does not identify the existing SJFH as being an odor source.

3.9 Climate Change

Climate Change and Greenhouse Gas Emissions

Chapter 7 of the SJRRP PEIS/R describes the environmental setting for climate change and greenhouse gas (GHG) emissions. The discussion of climate change and the potential impacts of the program alternatives on climate change encompass the San Joaquin River from Friant Dam to the Merced River (the Restoration Area), the San Joaquin River from the Merced River to the Sacramento-San Joaquin Delta, and the Sacramento-San Joaquin Delta.

Scientific evidence suggests that many climatic conditions are already changing and will continue to change in the future. Expected future climate changes that have the potential to affect implementation and performance of the program were also considered in the PEIS/R. These included changes in snowpack and the timing and magnitude of snowmelt runoff and flood flows, which would in turn influence water storage and delivery. Sea level rise could affect San Francisco Bay and conditions in the Delta. Information on these considerations is included in the PEIS/R, and will be associated with future Central Valley Project/State Water Project (CVP/SWP) operations.

The affected environment for climate change analysis is global, with State and local implications. The PEIS/R discussion provided a background overview of global climate change (which has been incorporated by reference), and climate trends and associated impacts at the global and State levels are then described, followed by an overview of GHG emissions sources in California and in SJVAB.

Global Climate Trends and Associated Impacts

The rate of increase in global average surface temperature over the last hundred years has not been consistent; the last three decades have warmed at a much faster rate – on average 0.32°F per decade. Eleven of the 12 years from 1995 to 2006, rank among the warmest years in the instrumental record of global average surface temperature (going back to 1850) ((Intergovernmental Panel on Climate Change (IPCC). 2007b), as cited in (PEIS/R 2011)).

During the same period over which this increased global warming has occurred, many other changes have occurred in other natural systems. Sea levels have risen on average 1.8 mm/year; precipitation patterns throughout the world have shifted; with some areas becoming wetter, while other areas become drier. Tropical cyclone activity in the North Atlantic has increased. Peak runoff timing of many glacial and snow-fed rivers has shifted earlier, as well as numerous other observed conditions. Though it is difficult to prove a definitive cause and effect relationship between global warming and other observed changes to natural systems, there is high confidence in the scientific community that these changes are a direct result of increased global temperatures ((Intergovernmental Panel on Climate Change (IPCC). 2007b), as cited in (PEIS/R 2011)).

California Climate Trends and Associated Impacts

Maximum (daytime) and minimum (nighttime) temperatures are increasing almost everywhere in California but at different rates. The annual minimum temperature averaged over all of California has increased 0.33°F per decade during the period 1920 to 2003, while the average annual maximum temperature has increased 0.1°F per decade ((Moser et al. 2009) as cited in the (PEIS/R 2011)).

With respect to California's water resources, the most significant impacts of global warming have been changes to the water cycle and sea level rise. Over the past century, the precipitation mix between snow and rain has shifted in favor of more rainfall and less snow ((Mote et al. 2005, Knowles et al. 2006), as cited in (PIES/R 2011)), and snowpack in the Sierra Nevada is melting earlier in the spring (PEIS/R 2011). The average early spring snowpack in the Sierra Nevada has decreased by about 10% during the last century, a loss of 1.5 million acre-feet of snowpack storage (PEIS/R 2011). These changes have significant implications for water supply, flooding, aquatic ecosystems, energy generation, and recreation throughout the state. During the same period, sea levels along California's coast rose seven inches (PEIS/R 2011). Sea level rise associated with global warming will continue to threaten coastal lands and infrastructure, increase flooding at the mouths of rivers, place additional stress on levees in the Sacramento-San Joaquin Delta, and will intensify the difficulty of managing the Sacramento-San Joaquin Delta as the heart of the state's water supply system.

These trends in California's water supply could impact the SJRRP by further straining the scarce resources needed to implement appropriately-timed Restoration Flows, while balancing the need to irrigate cropland and supply drinking water to large numbers of Californians. Increased surface temperatures may affect stream quality for fish and their prey, changing the biological conditions under which the SJRRP operates. In addition, increased frequency and severity of flood events could negatively or positively impact fragile or restored areas such as gravel bars and riparian habitat by either breaking down gravel bars in one area, or building up gravel bars in another.

Greenhouse Gas Emissions Sources and Inventory

Human activities contribute to climate in many ways, but primarily by causing changes in the atmospheric concentrations of GHGs and aerosols. The largest anthropogenic contribution to climate change is the burning of fossil fuels, which releases Carbon dioxide (CO_2) and other GHGs to the atmosphere. Since the start of the industrial era (about 1750), the use of fossil fuels has increased through activities such as transportation, building heating and cooling, and the manufacture of cement and other goods. Land use changes, such as wide-scale deforestation, the use of fertilizers, and draining of wetlands also contribute to GHG emissions worldwide. The rate of increase in GHG concentrations has risen during the last century, with an increase of 70% between 1970 and 2004 alone ((Intergovernmental Panel on Climate Change (IPCC). 2007b), as cited in (PEIS/R 2011)). During this period, the two largest sectors of GHG emissions were the energy supply (with an increase of over 145%) and transportation (with a growth of over 120 %) sectors. The slowest growth during the 1970 to 2004 period was in the agricultural sector with 27% growth and the residential/commercial buildings sector at 26% ((Intergovernmental Panel on Climate Change (IPCC). 2007a), as cited in (PEIS/R 2011)).

California is the 12th to 16th largest emitter of CO_2 in the world ((California Energy Commission (CEC) 2006), as cited in (PEIS/R)). In California, the transportation sector is the largest emitter of GHGs, followed by electricity generation ((California Energy Commission (CEC) 2006), as cited in (PEIS/R 2011)). California produced 484 million gross metric tons (mt) of CO_2 equivalent in 2004. Combustion of fossil fuel in the transportation sector was the single largest source of California’s GHG emissions in 2004, accounting for 35% of total GHG emissions in the State ((California Energy Commission (CEC) 2006), as cited in (PEIS/R 2011)). This sector was followed by the electric power sector (including both in-State and out-of-State sources) (22%) and the industrial sector (21%) ((California Energy Commission (CEC) 2006), as cited in (PEIS/R 2011)). No GHG emissions inventory has been conducted for the SJVAB at this time.

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SECTION 4 ENVIRONMENTAL CONSEQUENCES

The following is an analysis of the potential environmental consequences of the "No Action" and "Action" alternatives upon the surrounding environment as described in section 3 (Affected Environment). These potential environmental consequences are organized in accordance to the alternatives outlined in section 2 (Alternatives Including the Proposed Action). This analysis considers that the life of this permit requested is five years, and would allow collection of a limited number of eggs or juveniles.

4.1 Introduction

The environmental consequences of this action are connected to the potential impacts to salmonid populations within the Central Valley (Sacramento and San Joaquin River basins) and how activities associated with the collection, transport, release, and monitoring of spring-run Chinook to the San Joaquin River may affect aquatic species and human activities along the San Joaquin River and its tributaries. The Proposed Action does not involve construction, changes in water diversions or flows in the Sacramento or San Joaquin river basins, or other physical changes to the environment beyond those associated with the collection of spring-run Chinook eggs and juveniles, their release to the San Joaquin River, and related monitoring activities. Changes in San Joaquin River flows and related projects are evaluated in the SJRRP PEIS/R (PEIS/R 2011). The Rule EA analyzed the potential impact of reintroduction of spring-run Chinook to the San Joaquin River and found that no significant impacts would occur. Should the reintroduction and expected long-term reestablishment of spring-run Chinook in the San Joaquin River be unsuccessful, the resulting impact to the human environment would be undetectable. The Experimental Population designation and 4(d) take exceptions in relation with the Proposed Action would remain in effect regardless as to whether or not the reintroduction effort was successful. Furthermore, it is important to note that whether or not the actions outlined in the specific 10(a)(1)(A) permit analyzed by this EA are carried out, the SJRRP, and the terms of the settlement will still be implemented, including restoration flows and channel work. Fall-run Chinook would also still be reintroduced into the San Joaquin River, regardless of which alternative addressed below is followed. For the purposes of this EA, this section provides an analysis of the direct and indirect environmental impacts associated with the alternatives on the resources outlined in section 3. Where applicable, the relative magnitude of impacts is described using the following terms:

Undetectable – The impact would not be detectable.

Negligible – The impact would be at the lower levels of detection.

Low – The impact would be slight, but detectable.

Medium – The impact would be readily apparent.

High – The impact would be severe.

The analysis of the environmental consequences is organized starting with the No Action Alternative, and is followed with an analysis of the Proposed Action Alternative. The alternatives analyze the effects of collecting spring-run Chinook from the FRFH in the Sacramento River Basin for transfer to, and release into, the San Joaquin River Basin. As was initially discussed in section 2, the following alternatives outlined below are analyzed under the assumption that the proposed SJRRP actions will be implemented, Proposed Action

NO ACTION ALTERNATIVE ANALYSIS

4.2 No Action Alternative

Under this alternative, there would be no collection of listed spring-run Chinook for translocation, and spring-run Chinook would not be reintroduced intentionally to the San Joaquin River.

4.2.1 Central Valley Spring-run Chinook Salmon

The No Action Alternative would result in no impact to the existing spring-run Chinook populations of the Sacramento River since there would be no collection of these fish for translocation.

4.2.2 Hatchery and Quarantine Facilities

4.2.2.1 Feather River Fish Hatchery (FRFH)

Under the No Action Alternative, there would be no changes made to the current operations of the FRFH. No spring-run Chinook would be propagated from this facility for eventual release into the San Joaquin River. There would be no significant impacts under this alternative.

4.2.2.2 Quarantine Facilities

Under the No Action Alternative, there would be no changes made to the current operations of the Silverado or CABA facilities. No spring-run Chinook would be propagated from the FRFH for eventual release into the San Joaquin River; therefore neither quarantine facility will be utilized as part of the activities analyzed under this EA. There would be no significant impacts under this alternative.

4.2.2.3 San Joaquin Fish Hatchery (SJFH) and Salmon Conservation and Research Facility (SCARF)

Under the No Action alternative, the SCARF would still be used to support existing captive broodstock operations or activities related to the re-establishment of fall-run Chinook under the SJRRP. It is unclear whether the Conservation Hatchery Facility would not be built or operated because it could have importance for the reintroduction for fall-run Chinook under the SJRRP. Therefore, there would be no significant adverse impacts to either the SJFH or the SCARF under this alternative.

4.2.3 Restoration Area

Under the No Action Alternative, there would be no impacts or changes to the aquatic habitat currently present throughout the extent of the Restoration Area as analyzed under Section 3 of this EA.

4.2.4 Fish

Under the No Action Alternative, the permit would not be issued, and there would be no changes to the current environmental conditions affecting fish assemblages within the project area. Therefore, there would be no significant adverse impacts to any of the native and non-native fish species listed in table 3-1 that are not protected under the Endangered Species Act (ESA).

4.2.4.1 Federally Listed Fish Species

CCV steelhead occurs throughout the San Joaquin River basin, and as noted earlier in section 3, there is an increased likelihood that the Southern DPS of North American green sturgeon is present in the San Joaquin River. Because CCV steelhead and green sturgeon are federally listed as threatened and have regulations ensuring their protection, which are not altered by the any of the alternatives outlined in Section 2 of this EA, there would be no significant adverse impacts to federally listed species under the No Action Alternative.

4.2.5 Predation and Disease

Under the No Action Alternative, there would be no change to the predator/prey assemblages in the Feather River, Sacramento River, San Joaquin River, or the Sacramento/San Joaquin River Delta. Therefore, there would be no significant impacts to any fish with regard to predation or disease.

4.2.6 Aquatic Invasive Species (AIS)

Under the No Action Alternative, there would be no change to the predator/prey assemblages in the Feather River, Sacramento River, San Joaquin River, or the Sacramento/San Joaquin River Delta, and therefore no significant impacts would occur.

4.2.7 Other Environmental Conditions of the San Joaquin River Basin

4.2.7.1 San Joaquin River Recreation

4.2.7.1.1 Recreational Boating

Under the No Action Alternative, there would be no change to the recreational boating opportunities on the San Joaquin River. Therefore, there would be no significant adverse impacts under this alternative.

4.2.7.1.2 Recreational Fishing

Under the No Action Alternative, there would be no impacts to recreational fishing, as no spring-run Chinook would be collected, transported, or reintroduced into the San Joaquin River. Therefore, there would be no significant adverse impacts under this alternative.

4.2.7.2 Commercial Fishing

Under the No Action Alternative no spring-run Chinook would be collected, transported, or reintroduced into the San Joaquin River. Commercial fishing of Chinook and other salmon off the coast of northern and central California would continue. The establishment of harvest rates for these fish 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.

4.2.7.3 Land Use

Under the No Action Alternative current land use activities would not change. Therefore, there would be no significant adverse impacts made to the environment through land use practices under this alternative.

4.2.7.4 Water Quality

Under the No Action Alternative there would be no changes to the current operations of the FRFH or the SJFH. Therefore there would be no change to water quality to either the Feather River or the San Joaquin River and no impact on water quality from this alternative.

4.2.7.5 Water Temperature

Under the No Action Alternative there would be no change in water temperature in either the Feather or San Joaquin rivers. Therefore, there would be no significant adverse impacts under this alternative.

4.2.7.6 Suspended Sediment and Turbidity

Under the No Action Alternative there would be no change in the suspended sediment and turbidity levels in either the Feather or San Joaquin rivers. Therefore, there would be no significant adverse impacts under this alternative.

4.2.7.7 Air Quality

Under the No Action Alternative, spring-run Chinook would not be collected or translocated and released. Therefore under the No Action Alternative there would be no air emissions from vehicles used in collecting and transporting eggs, juveniles, or adults. There would be no impacts to air quality under the No Action Alternative.

4.2.7.8 Climate Change

Under the No Action Alternative there would be no collection of eggs or juveniles that would be translocated to the San Joaquin River. Therefore, there would be no additional emissions beyond those already associated with the operations of the Hatchery and Quarantine Facilities. There would be no significant adverse impacts under this alternative.

ACTION ALTERNATIVES ANALYSIS

4.3 Action Alternative: Proposed Action

The Action Alternative includes the collection, transportation, and release of spring-run Chinook into the San Joaquin River. Spring-run Chinook that would be released into the Restoration Area as part of the designated Nonessential Experimental Population that was analyzed in the Rule EA, and would also be subject to those regulations outlined in 50 CFR 223(b). In this section, the potential impacts resulting from the issuance of the section 10(a)(1)(A) permit required for implementing the activities listed above is analyzed.

4.3.1 Central Valley Spring-run Chinook salmon

Eggs and juveniles will be translocated from the FRFH to the San Joaquin River. Broodstock adults, young and translocated juveniles may be placed directly into the San Joaquin River. The Proposed Action could have a beneficial impact to the species by increasing the understanding of handling, transport, and release methods for the species. The proposed action has the potential for adults to return and re-establish a population in the San Joaquin River. There would be no significant adverse impacts to spring-run Chinook.

4.3.2 Hatchery and Quarantine Facilities

4.3.2.1 Feather River Fish Hatchery (FRFH)

The Proposed Action would result in low, beneficial impacts to the operation and maintenance of the FRFH, as the propagation of broodstock in the facility would increase understanding in the rearing and handling of spring-run Chinook eggs and juveniles. No physical changes would be made to this facility, and therefore, there would be no significant adverse impacts originating from the FRFH.

4.3.2.2 Quarantine Facilities

The Proposed Action would result in no impacts to the operation and maintenance of the Silverado and CABA quarantine facilities. Both facilities would be potentially used to hold fish in quarantine for period of time to up to several months. The holding of fish at these locations would not require any physical changes to these facilities, and therefore there would be no significant adverse impacts originating from the Quarantine Facilities.

4.3.2.3 San Joaquin Fish Hatchery (SJFH) and Salmon Conservation and Research Facility (SCARF)

The Proposed Action would result in low, beneficial impacts to the operation and maintenance of the San Joaquin Fish Hatchery (SJFH), as the release of broodstock from this facility into the San Joaquin River would increase understanding and the success rates in reintroducing spring-run Chinook to part of its historical range. The SCARF is to be funded and constructed by the State of California and will require a separate environmental analysis.

4.3.3 Restoration Area

Under the Proposed Action, there would be no physical impacts or changes made to the aquatic habitat currently present throughout the extent of the Restoration Area as analyzed under Section 3 of this EA. Therefore, there would be no significant adverse impacts to the Restoration Area.

4.3.4 Fish

Under the Proposed Action, there would be no significant adverse impacts to any of the native and non-native fish species listed in table 3-1 that are not protected under the Endangered Species Act, as the reintroduction of spring-run Chinook is not expected to change the balance of fish populations in the San Joaquin River basin. Any cumulative impacts to these fish species over time are expected to be low and beneficial, and are discussed further in section 5 of this EA.

4.3.4.1 Federally Listed Fish Species

Under the Proposed Action, there would be no significant adverse impacts to CCV steelhead and the Southern DPS of North American green sturgeon. CCV steelhead and the Southern DPS of North American green sturgeon are federally listed as a threatened species. As such, these fish species already have regulations ensuring their protection, which are not altered by the Proposed Action.

4.3.5 Predation and Disease

Under the Proposed Action, there would be no adverse impacts to predation rates in the San Joaquin River. The reintroduction of spring-run Chinook is not expected to result in different fish assemblages than those already seen in the San Joaquin River's tributaries.

Since spring-run Chinook are being translocated into the San Joaquin River from an outside source, there is a potential for disease transmission. Translocation of eggs or fish would be subject to the required disease mitigation procedures as outlined in the previously approved 10(a)(1)(A) permit #148681. Therefore, there would be no significant adverse impacts from the Proposed Action.

4.3.6 Aquatic Invasive Species (AIS)

Under the Proposed Action, there would be no significant adverse impacts involving the propagation or translocation of Aquatic Invasive Species (AIS). All equipment used for the collection, transportation, and release of spring-run Chinook into the San Joaquin River will be properly cleaned and decontaminated to reduce the spread of invasive species and pathogens.

4.3.7 Other Environmental Conditions of the San Joaquin River Basin

4.3.7.1 San Joaquin River Recreation

4.3.7.1.1 Recreational Boating

Under the Proposed Action, there would be no change to the current recreational boating opportunities or regulations already in place. Therefore, there would be no significant adverse impacts on Recreational Boating activities.

4.3.7.1.2 Recreational Fishing

The release of spring-run Chinook does not change recreational fishing regulations. These are controlled by the Fish and Game Commission (FGC). Currently CDFW has closed all salmon fishing within the action area. Consequently, there would be no significant adverse impact to recreational fishing should the Proposed Action take place.

4.3.7.2 Commercial Fishing

Under the Proposed Action, 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.

4.3.7.3 Land Use

The Proposed Action creates no obligation for access to private property, and therefore the Proposed Action would have no significant adverse impact on private property. All fish will be collected from the FRFH. A condition of the Proposed Action is that river access sites for holding or release, which would require crossing privately held land, would require voluntary access permission from private landowners.

It is important to note that NMFS has determined that any effects to districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific, cultural, or historical resources would be negligible.

All project entry locations have been selected to provide river access via improved roads thereby minimizing habitat disturbance as well as reducing erosion/sediment to the river. New locations not already stated will also be determined in part by considering access on improved roads.

4.3.7.4 Water Quality

Under the Proposed Action the FRFH operations would not change and would remain subject to its current discharge permit. The additional number of fish or eggs needed from the FRFH is negligible in relation to normal production levels. Therefore the proposed collection of eggs or juveniles from the FRFH would not affect the water quality of the Feather River.

Similarly, the operations would not change at the existing Silverado Base or CABA as a result of the Proposed Action, so that there would be no change in their permitted discharge. No impacts to water quality from the operations of the Silverado Base and CABA are anticipated.

With the exception of occasional low DO levels in the discharge from the SJFH, there are no water quality issues along Reach 1 of the San Joaquin River where the SCARF is located. As discussed in the 2010 Hatchery and Stocking Program EIR/EIS (Hatchery EIR/EIS) prepared for all of CDFW's hatchery operations, the discharge of lowest DO level detected of 6.4 mg/L is not optimal for cold-water fish conditions, but the level of the adverse impact would be low (ICF Jones & Stokes 2010). The analyses of the Hatchery EIR/EIS are incorporated by reference into this document. Operations of the SCARF would require discharge permits that require monitoring and reporting to assure that discharged water would not impact water quality of the San Joaquin River. The discharge permit conditions established for the hatchery activities would require that discharges from either facility would not adversely affect ambient water quality. Any variance in the discharge from those levels established by the permit would have to be addressed by the hatcheries and confirmed by the State of California RWQCB. Therefore, this alternative would have a negligible effect on water quality.

4.3.7.5 Water Temperature

Under the Proposed Action, the impact of transporting and releasing fish into the San Joaquin River would be negligible, as the water temperature of the San Joaquin River is predominately determined by climate and the amount of water present at any given time.

4.3.7.6 Suspended Sediment and Turbidity

Under the Proposed Action, the impact of suspended sediment and turbidity levels in either the Feather or San Joaquin rivers would be negligible, as best management practices will be followed while implementing the action to prevent any change in these levels.

4.3.7.8 Air Quality

The transportation of spring–run Chinook to the San Joaquin River would generate air emissions from vehicles used to collect and transport fish (or eggs) and from operation of the SCARF. Since existing facilities would be used until the permanent SCARF is built by the State of California, for which a separate environmental analysis would be done, there would be no new operational emissions associated with the Proposed Action. The Proposed Action would generate air emissions from vehicles used to collect and transport the fish (or eggs) to a holding area. However, given that there would be only a small number of trips (e.g. up to100 trips per year) that would be generated to collect and transport the collected fish or eggs, the resulting emissions would have negligible impacts to air quality.

While the SJRRP PEIS/R discusses potential odors associated with construction of river restoration projects, the potential of significant odor impacts associated with the construction and operation of the SCARF related to the hatchery was too speculative for meaningful consideration. Any impacts of constructing a new hatchery or expanding an existing hatchery would need to be addressed during environmental review of the proposed hatchery. It should be noted that the current hatchery is not identified as being a source for odors and it is likely that future analysis for the proposed SCARF build out would likely determine that with proper maintenance or operation odors would also not be detectable.

4.3.7.9 Climate Change

On September 22, 2009, EPA released its final Greenhouse Gas Reporting Rule (Reporting Rule). The Reporting Rule is a response to the fiscal year 2008 Consolidated Appropriations Act (House of Representatives 2764; Public Law 110-161), that required EPA to develop "… mandatory reporting of GHGs above appropriate thresholds in all sectors of the economy…." The Reporting Rule would apply to most entities that emit 25,000 mt CO_2e (metric tonne CO_2 emissions) or more per year. Starting in 2010, facility owners are required to submit an annual GHG emissions report with detailed calculations of facility GHG emissions. The Reporting Rule would also mandate recordkeeping and administrative requirements in order for EPA to verify annual GHG emissions reports. As shown in Table 7, the amount of CO_2 generated by the transportation of fish over a five-year term would be approximately 5/10ths of one percent of the yearly reporting level of 25,000 mt CO_2e. Even adding the CO_2 emitted by electrical generation used in the operations of the hatcheries would not bring the amount of greenhouse gas emitted near the yearly threshold. Since the emissions of GHGs for the Proposed Action would be substantially lower than the 25,000 mt CO_2e reporting threshold, the impacts to Climate Change from GHG emissions of the Proposed Action would be negligible.

The analysis of potential cumulative impacts from Climate Change to the area of the Proposed Action is presented in section 5 Cumulative Impacts.

Table 7: Calculated CO2 emissions for transportation of fish between various locations

Trip	mt CO_2e per trip	Number of trips per year	Total mt CO_2e per year	Total mtCO2e for 5 years
FRFH to Silverado	0.178	48	8.583	42.913
Silverado to SJFH	0.271	48	13.030	65.152
FRFH to SJFH	0.311	4	1.242	6.212
Total	0.760	100	32.451	114.277
Percentage of 25,000 mt CO_2e threshold			0.13%	0.46%

Calculation based on the following: Mileage (determined by Google Maps): FRFH to Silverado Fisheries Base = 137 miles:

Silverado Fisheries Base to SJFH = 208 miles

FRRH to SJFH = 238 miles

CO_2 emissions 10180 grams per gallon of diesel fuel (EPA 2011)

Fuel usage mile/gallon: 7. 8 (personal com. Scott Hamelberg, Coleman National Fish Hatchery Complex 2012)

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SECTION 5 CUMULATIVE IMPACTS

5.1 Introduction

NEPA defines cumulative impacts 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). For the most part, the potential Cumulative Impacts of the Proposed Action of itself would be negligible on spring-run Chinook or on the other resources discussed in this document. All past, present, and future actions of the SJRRP, along with their potential cumulative impacts, are analyzed in greater detail in chapters 2 and 26 of the PEIS/R respectively (PEIS/R 2011).

As discussed in section 1, the Settlement established Restoration and Water Management goals. As partial fulfillment of these goals, a number of projects are proposed that will make physical changes to the San Joaquin River that will be part of the restoration of the San Joaquin River. Potential Cumulative Impacts were identified for the SJRRP in the PEIS/R and they are included here by reference. The following discussion reproduced herein analyzes the long-term cumulative impacts resulting from both the No Action, and Action Alternatives, whose immediate environmental consequences were discussed in section 4.

NO ACTION ALTERNATIVE ANALYSIS

5.2 Central Valley Spring-run Chinook Salmon

Under the No Action Alternative, there would be no cumulative impacts to existing spring-run Chinook populations. However, the limitation on re-establishing spring-run Chinook on the mainstem San Joaquin River through natural recolonization or on other tributaries would delay or prevent recovery of the species.

5.3 Hatchery and Quarantine Facilities

5.3.1 Feather River Fish Hatchery (FRFH)

Under the No Action Alternative, there are no significant direct or indirect impacts or changes made to the operation and maintenance of the FRFH. Therefore, there would be no cumulative impacts to the FRFH.

5.3.2 Quarantine Facilities

Under the No Action Alternative, there are no significant direct or indirect impacts or changes made to the operation and maintenance of the project's proposed Quarantine Facilities. Therefore , there would be no cumulative impacts to the Quarantine Facilities.

5.3.3 San Joaquin Fish Hatchery (SJFH) and Salmon Conservation and Research Facility (SCARF)

Under the No Action Alternative, there would be no cumulative impacts to the SJFH. Should spring-run Chinook not be collected, transported, and released into the San Joaquin River, it is uncertain whether the expanded SCARF would be constructed or not.

5.4 Restoration Area

Under the No Action Alternative, SJRRP actions including habitat improvements in Reach 1 in the vicinity of the Highway 41 Bridge, construction of the Mendota Pool Bypass, implementation of Interim and Restoration flows, and the reintroduction of fall-run Chinook through either natural recolonization or planting, would still occur (PEIS/R 2011). Improvements in environmental conditions for fish populations within the Restoration Area would include reduced water temperature; increased spawning, rearing, and feeding habitat; improved passage; reduced predation; and reduced mortality from diversion losses, regardless of whether or not spring-run Chinook are transported and released into the San Joaquin River (PEIS/R 2011). As a result, it is expected that the cumulative impacts to the Restoration Area under the No Action Alternative would be beneficial to fish assemblages within the Restoration Area (PEIS/R 2011). Further analysis of potential cumulative impacts within the Restoration Area relevant to both the No Action and Action Alternatives outlined in this EA can be found in Chapter 26 of the PEIS/R (PEIS/R 2011).

5.5 Fish

Under the No Action Alternative, no eggs or juvenile spring-run Chinook would be collected. However, the improvement projects of the SJRRP could be carried out; therefore, existing barriers to salmon migration could be removed as part of the SJRRP. While it is expected that under improved conditions, some spring-run Chinook would find their way into the San Joaquin River, it is likely that there would be no large scale change from the existing fish populations, based on comparison of fish assemblages in the San Joaquin, Merced, Tuolumne, and Stanislaus rivers (PEIS/R 2012).

5.6 Federally Listed Fish Species

The No Action Alternative would be beneficial to CCV steelhead as an additional 153 miles of river and riparian habitat would become available for the species under the SJRRP. During salmon spawning, CCV steelhead are known to eat loose salmon eggs. So as fall-run, and potentially eventually spring-run Chinook reestablish within the San Joaquin River, these eggs and salmon carcasses would provide additional nutrients to the local food web. The No Action alternative would be beneficial to green sturgeon as an additional 153 miles of river and riparian habitat would become available for the species over time.

5.7 Predation and Disease

Under the No Action Alternative, there are no significant direct or indirect impacts to fish assemblages within the project area regarding predation or disease. Therefore, there would be no cumulative impacts to the Feather River, the FRFH, the SJFH, or the San Joaquin River concerning changes in environmental predation dynamics or disease transmission/susceptibility.

5.8 Aquatic Invasive Species (AIS)

Under the No Action Alternative, there are no significant direct or indirect impacts resulting from unintentional reintroductions of aquatic invasive species (AIS). Therefore, there would be no cumulative impacts resulting from unintentional reintroductions of AIS.

5.9 Other Environmental Conditions of the San Joaquin River Basin

5.9.1 San Joaquin River Recreation

5.9.1.1 Recreational Boating

Under the No Action Alternative, there are no significant direct or indirect impacts to the current recreational boating opportunities and regulations already in place. Therefore, there would be no cumulative impacts upon recreational boating opportunities.

5.9.1.2 Recreational Fishing

While fishing for other species of fish would continue, the opportunity to fish for planted trout would end, as the reintroduction of fall-run Chinook to the San Joaquin River would eliminate current trout planting in the San Joaquin River per California Fish and Game Commission (FGC) policy.

Current fishing regulations prohibit salmon fishing in the San Joaquin River upstream of Mossdale County Park. While CDFW has had fishing regulations in place for the existing fish present in the San Joaquin River above the Merced River, as well as for salmon, there has been little reason to enforce any regulations for anadromous fish such as fall-run Chinook and CCV steelhead without a connection to the sea. Even with enforcement of regulations for fall-run Chinook and CCV steelhead, under the No Action Alternative, there would be low to undetectable beneficial impacts to recreational fishing opportunities. There would be no change in the recreational fishery for Chinook salmon in the ocean as well as in the inland waters.

5.9.2 Commercial Fishing

Under the No Action Alternative, there are no significant direct or indirect impacts to commercial fishing. Therefore, there would also be no cumulative impacts to commercial fishing.

5.9.3 Land Use

Under the No Action Alternative current land use activities would not change. With the SJRRP habitat improvements it is likely that spring-run Chinook and steelhead eventually would use the upper reaches of the San Joaquin River. As these fish are federally listed any take would be subject to the provisions of the rules established under 50 CFR 223(b). There would be no regulatory relief for any taking of any naturally occurring spring-run Chinook.

5.9.4 Water Quality

Under the No Action Alternative, there are no significant direct or indirect impacts to water quality, as no changes would be made to current water quality conditions. Therefore, there would be no cumulative impacts to water quality.

5.9.5 Water Temperature

Under the No Action Alternative, there are no significant direct or indirect impacts and therefore there would be no cumulative impacts to water temperature.

5.9.6 Suspended Sediment and Turbidity

Under the No Action Alternative, there are no significant direct or indirect impacts and therefore there would be no cumulative impacts resulting from changes in suspended sediment and turbidity.

5.9.7 Air Quality

Under the No Action Alternative, there are no significant direct or indirect impacts and therefore there would be no cumulative impacts to air quality.

5.9.8 Climate Change

Under the No Action Alternative, no greenhouse gases would be released from the transport of spring-run Chinook, as spring-run Chinook would not be reintroduced into the San Joaquin River apart from potential natural re-colonization. Therefore, there would be no cumulative impacts to climate change from the release of greenhouse gasses.

While existing barriers to salmon migration could be removed as part of the SJRRP allowing some spring-run Chinook or fall-run Chinook to find their way into the San Joaquin River, future impacts from climate change including increased surface and water temperatures, increased frequency and severity of flood events, and changes to local water cycles and sea level rise, are expected to make the successful natural re-colonization of spring-run Chinook, or the successful reintroduction of fall-run Chinook by either natural or anthropogenic methods into the San Joaquin River even less likely (PEIS/R 2011). Future impacts such as increased surface and water temperatures may, however, be less severe than would be evident in river systems starting at lower elevations, lending credence to the possibility that the No Action Alternative would provide cumulative beneficial impacts to fish species seeking refuge in the San Joaquin River from warmer temperatures (PEIS/R 2011).

ACTION ALTERNATIVE ANALYSIS

5.10 Central Valley Spring-run Chinook Salmon

The Proposed Action could have a beneficial impact on spring-run Chinook by restoring a population to the Southern Sierra Nevada diversity group, to further the Draft Recovery Plan objectives for the species. Spring-run Chinook reintroduced to the San Joaquin River would be imprinted on the San Joaquin River as their natal stream or through an imprinting procedure. Any fish produced through natural spawning in the San Joaquin River would also be imprinted to the river. It is possible that members of the reintroduced spring-run Chinook could stray into the Sacramento River or tributaries to the San Joaquin River. This is expected to be within natural straying rates. Because the donor stock is from a Sacramento River population, those strays would contribute, in a small way, to the abundance of that runs. Over time, evolutionary forces could favor certain genetic patterns in the reintroduction population that may be different from their Sacramento River ancestors. A natural level of straying to non-natal watersheds may enhance the species diversity and contribute to species recovery.

Even if expected survival of spring-run Chinook into the San Joaquin River is low, the use of the FRFH fish and SCARF would prevent excessive collection from wild stocks, while providing larger numbers of individuals to offset losses.

The San Joaquin River Restoration Settlement Act (SJRRSA) requires spring-run Chinook cannot be reintroduced to the San Joaquin River unless NMFS completes special rule exceptions for these fish from particular classes of take, pursuant to section 10(j) and 4(d) of the ESA. Such rules typically afford a lesser level of protection for the species than is provided through ESA section 9 take prohibitions. If these rules were applied to existing threatened or endangered populations, the impact to those populations would likely be negligible. In the case of a population reestablished in historical range of the species, but where it no longer exists, there would be no adverse impact, because any fish produced from the reintroduction would be above and beyond abundance and productivity of the existing population. A reestablished population would also increase the spatial diversity for the species, providing greater resilience and a higher likelihood for survival and recovery of the species. This would be a beneficial impact to spring-run Chinook. These take exceptions would allow the reintroduction of spring-run Chinook to have minimal impact on the regulatory environment and would provide sufficient protection for spring-run Chinook so as to not adversely impact the ESU but instead would benefit the ESU because of greater numbers and distribution and increased genetic diversity.

5.11 Hatchery and Quarantine Facilities

5.11.1 Feather River Fish Hatchery (FRFH)

Under the Proposed Action, environmental and physical impacts to the FRFH as discussed in section 4 would continue, but these cumulative impacts are not significant.

5.11.2 Quarantine Facilities

Under the Proposed Action, environmental and physical impacts to the Silverado and CABA quarantine facilities as discussed in section 4 would perpetuate, but these cumulative impacts are not significant.

5.11.3 San Joaquin Fish Hatchery (SJFH) and Salmon Conservation and Research Facility (SCARF)

Under the Proposed Action, environmental and physical impacts to the SJFH and SCARF as discussed in section 4 would perpetuate, but these cumulative impacts are not significant.

5.12 Restoration Area

Under the Proposed Action, spring-run Chinook would be transported and released into the San Joaquin River. In addition to Restoration Area experiencing the same beneficial cumulative impacts, the spring-run Chinook eggs and carcasses would provide additional marine-derived nutrients to the local food web, resulting in additional beneficial cumulative impacts to the overall health of the Restoration Area's ecosystem.

5.13 Fish

Under the Proposed Action, the reintroduction of spring-run Chinook is not expected to change the balance of fish populations in the San Joaquin River basin, such as shifting to a higher percentage of predatory fish. A return of spring-run Chinook would bring nutrients to the river that would enhance the aquatic food web, and consequently could improve food availability for all fish species. Thus, the reintroduction of spring-run Chinook would have no impact or a beneficial impact, on fish assemblages in the San Joaquin River.

5.14 Federally Listed Fish Species

During spring-run Chinook spawning, CCV steelhead are known to eat loose salmon eggs. Once salmon are reestablished as a result of the proposed action, these eggs and salmon carcasses would provide addition nutrients to the local food web. The proposed reintroductions of spring-run Chinook could have a beneficial impact on steelhead within the San Joaquin River.

Within the Sacramento River basin, the Southern DPS of North American green sturgeon coexist with spring-run Chinook. There is no evidence to suggest that these species would not also coexist in the San Joaquin River. Thus, the proposed reintroduction of spring-run Chinook would not impact green sturgeon that may occur within the San Joaquin River.

5.15 Predation and Disease

The assessment in the SJRRP PEIS/R of predation-related impacts evaluated the potential for the SJRRP to modify environmental conditions that could increase or decrease the vulnerability of special-status fishes, especially juvenile life stages, to predation by piscivorous fish. Fish assemblages on the tributary rivers to the San Joaquin River are similar to those found in the Restoration Area, except that Chinook salmon and steelhead are presently absent from the Restoration Area. While the PEIS/R does indicate that restoration actions may increase predation risks for representative special-status species, especially during their juvenile life stages, implementing special-status fish conservation measures of the Conservation Strategy in the PEIS/R would offset potential adverse effects on special-status fish species. Furthermore, the reintroduction of spring-run Chinook to the Restoration Area is not expected to result in different fish assemblages than those already seen in the tributary rivers. As a result predation rates would not be changed. The reintroduction of Chinook salmon, regardless of the run, would bring marine-derived nutrients into the system which would increase productivity of all aquatic species, with no expectation that it would differentially affect predatory species. Thus there would be no impact on predation due to the reintroduction of spring-run Chinook.

The parasite *Myxobolus cerebralis*, which causes whirling disease in salmonids, including rainbow trout, steelhead, and Chinook salmon, poses a risk to salmonid populations in the San Joaquin River. This parasite relies on tubifex worms (Tubifex tubifex) as an intermediate host ((Bergersen and Anderson 1997), as cited in (PEIS/R 2011)), and is a concern for the San Joaquin River because there is a tubifex worm farm located in Reach 1A ((Jones and Stokes. 2002), as cited in (PEIS/R 2011)). However, the tubifex worm farm has been at its current location for more than 20 years and in that time no incidents of parasitic transmission has been recorded in the rainbow trout found in the area of the farm. Therefore, the potential for the transmission of this disease, and the potential impacts to either the current fish populations or to the proposed reintroduced spring-run Chinook is considered low.

5.16 Aquatic Invasive Species (AIS)

Under the Proposed Action, where would be no changes made to Aquatic Invasive Species (AIS) prevention protocols and the action calls for these protocols to be followed, therefore there would be no cumulative impacts resulting from unintentional reintroductions of AIS.

5.17 Other Environmental Conditions of the San Joaquin River Basin

5.18 San Joaquin River Recreation

5.18.1 Recreational Boating

Under the Proposed Action, there would be no changes made to recreational boating opportunities or regulations already in place. Therefore, there would be no cumulative impacts upon recreational boating opportunities.

5.18.2 Recreational Fishing

The SJRRP PEIS/R identified that the reintroduction of fall-run Chinook under the SJRRP would lead to the end of rainbow trout stocking to Reach 1 of the Restoration Area by CDFW, regardless of whether spring-run Chinook are reintroduced. Consequently, mitigation to offset any impacts is being implemented as a measure under the SJRRP PEIS/R (REC-4) that would reduce these potential impacts to a low level, so there would be no impact to recreational fishing as a result of the Proposed Action.

5.18.2 Commercial Fishing

The impacts to commercial fishing from the Proposed Action would be low. Spring-run Chinook is a small percentage of the overall commercial harvest. Collections from donor stocks would have an undetectable to negligible impact, because of the small number of spring-run initially collected for the FRFH.

Under this alternative, the placement of spring-run Chinook in the San Joaquin River would not have an immediate impact on the commercial fishing of Chinook and other salmon. Harvest rates would still be established and would in the short-term limit the take of spring-run Chinook based on ESU conditions. Likewise, in the short-term there would be no change to management of the recreational salmon fishery, which is currently closed to angling on the San Joaquin River. However, implementation of the SJRRP is expected to restore habitat and connectivity which would allow existing fall-run Chinook to access suitable spawning areas near Friant Dam, which may provide a small increase in salmon available to the ocean fishery. In the long-term, with the restoration of spring-run and fall-run Chinook it is possible that the increased size of Chinook salmon runs would translate to improve commercial fishing.

5.18.3 Land Use

Under the Proposed Action, current land use activities would not change. Therefore, there would be no significant adverse cumulative impacts to land use.

5.18.4 Water Quality

Under the Proposed Action, any cumulative adverse impacts on water quality would be negligible, as increased flows resulting from the San Joaquin River Restoration Program would negate any waste or nutrients added to the system from reintroduced spring-run Chinook.

5.18.5 Water Temperature

Under the Proposed Action, there would be no cumulative impacts on water temperature, as water temperature is predominately determined by climate and water flow factors.

5.18.6 Suspended Sediment and Turbidity

Under the Proposed Action, any cumulative adverse impacts resulting from suspended sediment and turbidity would be negligible, as increased flows resulting from the San Joaquin River Restoration Program would negate any affect the reintroduction of spring-run Chinook would have on water quality.

5.18.7 Air Quality

Under the Proposed Action, the cumulative impacts on air quality would be undetectable, as only 100 trips per year would be permitted for transporting fish from the FRFH, and the maximum amount of emissions that could be released from vehicles used for the transportation effort could not affect surrounding air quality in any measurable level.

5.18.8 Climate Change

Climate change is predicted to bring profound changes to California’s natural environment. Hayhoe et al. 2004 describes the results of four climate change models: compared with 1960–1991, by 2070–2099 statewide average annual temperatures will be 2.3°C–5.8°C higher, average annual precipitation will be reduced by >100 millimeters, sea level will have risen 19.2–40.9 centimeters, snowpack will have declined by 29%–89%, and change in annual inflow to reservoirs will decline by >20%. (One model predicted slight increases in precipitation, snowpack, and reservoir inflow).

Changes in vegetation are also predicted (e.g., substantial decreases in the extent of alpine/subalpine forest, evergreen conifer forest, mixed evergreen woodland, and shrubland; and increases in mixed evergreen forest and grassland ((Hayhoe et al. 2004), as cited in (PEIS/R 2011)). Climate change is likely to cumulatively affect native fishes and amphibians by increasing water temperatures (hence reducing dissolved oxygen), reducing stream flows, and increasing the likelihood of drought-related fires. A rise in sea level would lead to increasing rates of erosion, sedimentation, flooding, and inundation of low-lying coastal ecosystems. With reductions in snowmelt runoff, peak flows may come earlier as rainfall contributes more, which could affect species such as spring-run Chinook that have evolved their life history based on predictable runoff patterns (Williams 2006). Increasing temperatures may increase metabolic needs of fish predators and increase predation (Lindley et al. 2007). Moyle et al. 2008 qualitatively assessed the potential for climate-related impacts on California's native salmonids (Table 8). Their analysis indicated that the majority of taxa (18 of 29, 62%) were vulnerable in all or most of the watersheds inhabited; no taxon was invulnerable to climate change.

Table 8: Qualitative Assessment of California Salmonids' Vulnerability to Climate Change

Vulnerability	**Taxon**
Vulnerable in all watersheds inhabited	Klamath Mountains Province summer steelhead[SSC]; northern California coastal summer steelhead[FT, SSC]; central California coast steelhead[FT]; south-central California coast steelhead[FT, SSC]; southern steelhead[FE, SSC]; upper Klamath–Trinity Rivers spring-run Chinook[SSC]; Central Valley late fall–run Chinook[SC, SSC]; Sacramento winter-run Chinook[FE, SE]; spring-run Chinook[FT, ST]; southern Oregon– northern California coastal Coho salmon[FT, ST]; central California coast Coho salmon[FE, SE]; McCloud River redband trout[SSC]; Eagle Lake rainbow trout[SSC]; Lahontan cutthroat trout[FT]
Vulnerable in most watersheds inhabited (possible refuges present)	Central Valley steelhead[FT]; upper Klamath–Trinity Rivers fall-run Chinook; California coast Chinook[FT]; Goose Lake redband trout[SC]; coastal cutthroat trout[SSC]
Vulnerable in portions of watershed inhabited (e.g., headwaters and lowermost reaches of coastal streams)	Northern California coastal winter steelhead[FT]; fall-run Chinook[SC]; California golden trout[SC, SSC]; Little Kern golden trout[FT]; Kern River rainbow trout[SC, SSC]; Paiute cutthroat trout[FT]; mountain whitefish
Low vulnerability due to location, cold water sources, or active management	Klamath Mountains Province winter steelhead; resident coastal rainbow trout; southern Oregon–northern California coastal Chinook
Not vulnerable to significant population loss due to climate change	None

Notes:

FE =	endangered (federal).
FT =	threatened (federal).
SE =	endangered (state).
ST =	threatened (state).
SC =	species of concern (federal).
SSC =	species of special concern (state).

Source: (Moyle et al. 2008).

The PEIS/R takes a programmatic approach to the discussion of impacts. The PEIS/R does not specifically analyze the potential impacts of specific actions such as the issuance of the 10(a)(1)(A) permit. Incremental impacts on the environment are included in the resource analyses in section 4, Environmental Consequences.

The potential cumulative effects from the issuance of the 10(a)(1)(A) permit would be as follows. As a result of future activities associated with the reintroduction effort it is anticipated that additional vehicle trips (on the order of 100 trips per year) will be required to gather donor stock and transport eggs and hatched fish to various locations. Additional vehicle trips will result in additional emissions. Likewise the holding of broodstock at the SCARF could increase the amount of waste products being discharged into the San Joaquin River. However, it is anticipated that these increased emissions and discharges would be minimal and it is anticipated that impacts to water quality or air quality, would be cumulatively negligible.

There is the potential that climate changes would increase pressures on fish habitat from warming trends. However, the reintroduction of spring-run Chinook to the San Joaquin River may have a beneficial effect to the species. Waters of the San Joaquin River start at higher elevations than those of the Sacramento River. Therefore, it is possible that even with reduced snowpack brought about by climate change, the waters generated would be cooler for longer periods than the Sacramento Branch of the Central Valley. It is possible that the reintroduced population may represent potential refugia for the ESU (PEIS/R 2011).

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