RECLAMATION

Managing Water in the West

Environmental Assessment

Shasta Dam Fish Passage Evaluation Preliminary Draft

U.S. Department of the Interior
Bureau of Reclamation
Mid Pacific Region

April 2017

Mission Statements

The Department of the Interior protects and manages the Nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

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Abbreviations and Acronyms

°F	degrees Fahrenheit
Action V	2009 NMFS Biological Opinion RPA fish passage program
AGR	Agricultural Water Supply
ASP	Anadromous Salmonid Protection
ATV	all-terrain vehicle
Basin Plan	Water Quality Control Plan for the Sacramento and San Joaquin River Basin
BKD	bacterial kidney disease
BLM	Bureau of Land Management
BMP	best management practice
BO	Biological Opinion
CAMP	Comprehensive Assessment and Monitoring Program
CART	combined acoustic-radio transmitter
CCR	California Code of Regulations
CDFG	California Department of Fish and Game
CDFW	California Department of Fish and Wildlife
CFR	Code of Federal Regulations
cfs	cubic feet per second
CNDDB	California Natural Diversity Database
COLD	Cold Freshwater Habitat
CPWR	Center to Protect Workers' Rights
CRMP	Coordinated Resource Management Plan
CTC	Cantara Trustee Council
CVP	Central Valley Project
CVRWQCB	Central Valley Regional Water Quality Control Board
CWA	Clean Water Act
dbA	A-weighted sound level in decibels
DO	dissolved oxygen
DWR	California Department of Water Resources
EA	environmental assessment
EFH	essential fish habitat
EIS	Environmental Impact Statement
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act
ESU	evolutionarily significant unit
FERC	Federal Energy Regulatory Commission
FL	fork length
FONSI	Finding of No Significant Impact
GHG	greenhouse gas
gpm	gallons-per-minute
HGMP	Hatchery and Genetic Management Plan
I-5	Interstate 5
IFPSC	Interagency Fish Passage Steering Committee
IHNV	infectious hematopoietic necrosis virus
ITA	Indian Trust Assets
LRMP	Land and Resource Management Plan

mg/L	milligrams per liter
ml	milliliters
MMWAT	Monthly Maximum Weekly Average Temperature
MUN	Municipal and Domestic Supply
MW	megawatt
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NF	Near-Term Fish Passage Actions
NFH	National Fish Hatchery
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NRA	National Recreation Area
NSR	North State Resources, Inc.
NSVAB	Northern Sacramento Valley Air Basin
NTU	Nephelometric Turbidity Units
OSHA	Occupational Safety and Health Administration
PCB	polychlorinated biphenyl
PG&E	Pacific Gas and Electric Company
Pilot Plan	Pilot Implementation Plan
PM10	Particulate Matter up to 10 micrometers in size
POW	Hydropower Generation
PWIA	Personal Watercraft Industry Association
REC-1	Water Contact Recreation
REC-2	Non-Contact Water Recreation
Reclamation	U.S. Department of the Interior, Bureau of Reclamation
RM	river mile
RPA	Reasonable and Prudent Alternative
RST	rotary screw trap
SCAQMD	Shasta County Air Quality Management District
SDFPE	Shasta Dam Fish Passage Evaluation
SHPO	State Historic Preservation Officer
SL	standard length
SLWRI	Shasta Lake Water Resources Investigation
SPWN	Spawning, Reproduction, and/or Early Development
Steering Committee	Interagency Fish Passage Steering Committee
STNF	Shasta-Trinity National Forest
Study Area	Pilot Program Study Area
SVAB	Sacramento Valley Air Basin
SWP	State Water Project
TL	total length
UC Davis	University of California, Davis
USFS	United States Department of Agriculture Forest Service
USGS	United States Geological Survey
USFWS	U.S. Fish and Wildlife Service
VOQ	visual quality objectives
WILD	Wildlife Habitat
WTA	Wild Trout Area

Section 1
Introduction

The Shasta Dam Fish Passage Evaluation (SDFPE) is an effort to determine the feasibility of reintroducing winter-run and spring-run Chinook Salmon and steelhead to tributaries above Shasta Dam. The SDFPE is part of U.S. Department of the Interior, Bureau of Reclamation's (Reclamation) response to the June 4, 2009, National Marine Fisheries Service (NMFS) Biological Opinion (BO) and Conference Opinion on the Long-Term Operation of the Central Valley Project (CVP) and State Water Project (SWP) (NMFS 2009). Reclamation has reinitiated consultation with NMFS under Section 7 of the Endangered Species Act (ESA), though will continue to implement the Reasonable and Prudent Alternative Actions (RPAs) of the 2009 BO until consultation is complete.

This preliminary draft Environmental Assessment (EA) was prepared as part of the Reclamation planning process to evaluate and disclose potential environmental effects associated with the SDFPE's implementation of a Pilot Program to reintroduce ESA listed Chinook Salmon (*Oncorhynchus tshawytscha*) in tributaries above Shasta Lake. A Shasta Dam Fish Passage Pilot Implementation Plan (Pilot Plan) has been developed in response to the NMFS 2009 BO's RPA Action V, Near-Term Fish Passage Action 3 (NF3), "Development of a Fish Passage Pilot Plan" for passage over Shasta Dam.

In 2014, NMFS published the *Final Recovery Plan for Evolutionarily Significant Units of Sacramento River Winter-Run Chinook Salmon and Central Valley Spring-Run Chinook Salmon and Distinct Population Segments of Central Valley Steelhead* (NMFS 2014). In the Recovery Plan, NMFS identified the McCloud River as a priority for reintroduction, and the Little Sacramento River (Sacramento River upstream from Shasta Dam, also referred to as the Upper Sacramento River, which will be used in this EA) as a candidate area for reintroduction.

The Pilot Program would be implemented to test the methods and tools needed for a successful Reintroduction Program. The Interagency Fish Passage Steering Committee (Steering Committee) developed the methods and tools to be tested. The Steering Committee consists of staff from Reclamation, NMFS, U.S. Fish and Wildlife Service (USFWS), U.S. Forest Service (USFS), California Department of Fish and Wildlife (CDFW), California Department of Water Resources (DWR), California State Water Resources Control Board (State Water Board), and a member of the academic community. Additional Federal and State agencies with jurisdiction in the project area were also included. Reclamation is the federal lead agency for the Pilot Program and has the primary responsibility to oversee all actions implemented under the SDFPE.

The Pilot Program involves obtaining critical data to allow the Steering Committee to weigh potential benefits (i.e., abundance, productivity, spatial structure) against risks (i.e., reduced fitness, decreased source population viability, ecological, and disease). The results will facilitate a determination by the Steering Committee as to whether it is feasible or practical to implement a full-scale and long-term reintroduction in the watershed above Shasta Lake.

Key terms used in this document are defined as follows:

- "Shasta Dam Fish Passage Evaluation" is a study to evaluate the feasibility of reintroducing Chinook Salmon and steelhead (*Oncorhynchus mykiss*) to tributaries above Shasta Lake and is in response to Action V of the June 9, 2009 BO RPA.

- "Pilot Program" is the implementation of the first phase of reintroduction of Chinook Salmon above Shasta Dam, as developed for the SDFPE and presented in the Pilot Plan.

- "Pilot Plan" is the Shasta Dam Fish Passage Pilot Implementation Plan describing the procedures and protocols for the Pilot Program.

- "Pilot studies" are specific reintroduction colonization experiments and associated monitoring activities implemented to evaluate the performance of the Pilot Program.

- "Reintroduction program" is the general term used to describe the Pilot Program and the long-term reintroduction (if deemed feasible).

The Pilot Program is framed in an adaptive management structure, which assumes iterative refinement of the Pilot Studies to meet the stated goals and objectives of the RPA as new information becomes available. This preliminary draft EA evaluates the potential environmental effects from the action alternatives, as compared to the No Action Alternative. If Reclamation determines that an action will not have significant environmental impacts, Reclamation will issue a Finding of No Significant Impact (FONSI). A FONSI is a document that presents the reasons why the agency has concluded that there are no significant environmental impacts projected to occur upon implementation of the action. If the preliminary draft EA determines that the environmental impacts of a proposed Federal action will be significant, an Environmental Impact Statement (EIS) will be prepared.

As the Pilot Program progresses, changes may be required and additional monitoring programs may be subsequently added. As a result, the Pilot Plan is considered a living document, and will be updated to reflect those changes to the Pilot Program.

Project Background

Shasta Dam and Reservoir were constructed between September 1938 and June 1945. Water storage in Shasta Reservoir began in December 1943, and Shasta Dam was fully operable in April 1949. In 1997, a temperature control device was installed to help provide cooler water for fisheries benefits downstream. Shasta Dam and Reservoir are integral elements of the CVP, with Shasta Reservoir representing about 41 percent of the total reservoir storage capacity of the CVP.

2009 NMFS Biological Opinion

Pursuant to the Endangered Species Act (ESA) Section 7, Federal agencies must ensure their actions do not jeopardize the existence of listed species or adversely modify critical habitat. Protection of listed species is typically addressed through issuance of BOs and incidental take authorization on Federal actions. The resources agencies also have the authority to provide the Federal agency with an RPA in cases where they determine that the Federal action is likely to cause jeopardy to a species. Since 1993, Reclamation and the DWR have operated the CVP and SWP (the largest state-built, multipurpose water project in the U.S.) under a series of BOs issued by the NMFS and the USFWS, resulting from formal consultations under Section 7 of the ESA.

On June 4, 2009, NMFS issued the *Biological Opinion and Conference Opinion on the Long-Term Operation of the Central Valley Project and State Water Project* (NMFS 2009). The new BO concluded that, as proposed, the CVP and SWP operations were likely to jeopardize the continued existence of four federally-listed anadromous fish species below Keswick Dam:

- Sacramento River winter-run Chinook Salmon (*Oncorhynchus tshawytscha*) evolutionary significant unit (ESU);
- Central Valley spring-run Chinook Salmon (*O. tshawytscha*)(ESU);
- California Central Valley steelhead (*Oncorhynchus mykiss*) distinct population segment (DPS); and
- North American green sturgeon (*Acipenser medirostris*)(DPS).

The 2009 BO set forth an RPA with actions that allow for continued operation of the CVP and SWP in compliance with the ESA. The RPA actions include revised water operations, habitat restoration and enhancement, and fish passage studies.

The NMFS consultation highlighted the difficulty in managing coldwater dependent aquatic species below impassable barriers because of fluctuating and inadequate coldwater pools. The egg to fry survival analysis in the Reclamation (2008) Biological Assessment predicted that in the future under the climate change scenarios egg to fry survival for winter and spring-run Chinook Salmon would be reduced. Climate change is expected to change the hydrology and coldwater pool availability in Central Valley reservoirs. With 80 percent of the historically available spawning habitat blocked in the Central Valley, increasing threats due to climate change, and difficulty managing flows with existing infrastructure to meet temperature targets in dry years, NMFS concluded that providing passage for listed species to historic habitat will be needed to maintain viability of these species so as not to jeopardized their continued existence.

Providing fish passage was listed as Action V. It is separated into near-term (NF) and long-term actions. The RPA notes that the near-term goal is to increase the geographic distribution and abundance of listed species. The long-term goal is to increase abundance, productivity, and spatial distribution, and improve the life history and genetic diversity of the target species. NMFS and Reclamation are focusing the first stages of the Pilot Plan on re-introducing Sacramento River winter-run Chinook Salmon upstream of Shasta Dam as the initial location for the Pilot Program based on: a) the imperiled status of winter-run Chinook Salmon and the resulting urgency to move these fish back into their historical habitats and a means of reducing extinction risk, and b) the good habitat conditions. NMFS has recommended the NF actions of the Pilot Program be limited to the McCloud River due to the instream habitat conditions of the McCloud River, which provide more suitable spawning, and rearing habitat than the upper Sacramento River. In addition, NMFS requires the use of federally listed winter-run Chinook Salmon, either from the wild in the Sacramento River and/or the Livingston Stone National Fish Hatchery broodstock program in order to meet the goals of the Pilot Program and RPA V (NMFS 2016)

In 2010, Reclamation formed the Interagency Fish Passage Steering Committee (IFPSC) in accordance with the RPA (NF 1). The group was limited to biologists and engineers from State and Federal agencies and academic institutions, as defined by the RPA. In 2014, Reclamation

completed a habitat assessment of the McCloud and Sacramento rivers. The habitat assessment was required by the RPA (NF 2) and has helped inform the IFPSC. The final report on the habitat assessment can be found at: www.usbr.gov/mp/BayDeltaOffice/shasta-dam-fish-pass.html

As of the release of this document, Reclamation has completed NF 1 and NF 2 of RPA Action V. The Pilot Plan (NF 3) is being evaluated in this document. Implementation of the Pilot Studies (NF 4) ends with the completion of a Comprehensive Fish Passage Report (NF 5) detailing the results. If the report indicates that long-term fish passage is feasible and desirable, then in accordance with RPA Action V, Reclamation shall develop and implement a Long-Term Fish Passage Program, which would require separate environmental documentation.

Central Valley Salmon and Steelhead Recovery Plan

The effects of Shasta Dam and Reservoir on winter-run and spring-run Chinook Salmon are described in NMFS' final *Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-run Chinook Salmon and Central Valley Spring-run Chinook Salmon and the Distinct Population Segment of Central Valley Steelhead* (Recovery Plan) (NMFS 2014a). Winter-run Chinook Salmon historically spawned in the Upper Sacramento River system (Upper Sacramento, Pit, McCloud and Fall rivers) and in Battle Creek (Yoshiyama et al. 1996). The unique life history timing pattern of winter-run Chinook Salmon, requiring cold summer flows, argues against this run occurring in drainages other than the Upper Sacramento system and Battle Creek. Watershed development has eliminated access to all historical spawning habitats above Keswick Dam, approximately 200 river miles, and approximately 47 of the 53 miles of potential habitat in Battle Creek (Yoshiyama et al. 1996).

The Recovery Plan states that because the Sacramento River winter-run Chinook Salmon evolutionarily significant unit (ESU) currently only has one population, and that population spawns outside the species historical spawning range (Sacramento River below Keswick dam), introductions into historically occupied habitat are necessary to meet requirements for recovery (NMFS 2014a). In the Recovery Plan, NMFS indicates that the recovery of winter-run Chinook Salmon is affected by the Shasta cold-water pool by stating:

> *"Currently, winter-run Chinook Salmon spawning is limited to the mainstem Sacramento River downstream of Shasta and Keswick dams where the naturally-spawning population is artificially maintained by cool water releases from the dams. Within the Sacramento River, the spatial distribution of spawners is largely governed by water year type and the ability of the CVP to manage water temperatures.*

The fact that this ESU is comprised of a single population with very limited spawning and rearing habitat increases its risk of extinction due to local catastrophe or poor environmental conditions. There are no other natural populations in the ESU to buffer it from natural fluctuations. Events such as volcanic eruption of Lassen Peak, prolonged drought depleting the cold-water pool in Shasta Reservoir, failure to manage cold water storage, a spill of toxic materials similar to the Cantra Loop spill near Dunsmuir, or a disease outbreak with effects persisting for four or more years, could result in extinction of the Sacramento River winter-run Chinook Salmon ESU as most winter-run Chinook Salmon return as 3-year old fish (Lindley et al. 2007).

After two years of severe drought, Shasta Reservoir storage would be insufficient to provide cold water throughout the winter-run Chinook Salmon spawning and embryo incubation season, resulting in partial or complete year class failure. Based on the Recovery Plan, a severe drought lasting more than 3 years could potentially result in the extinction of winter-run Chinook Salmon. The probability of extended droughts is increasing as the effects of climate change. California is currently experiencing its fourth year of dry conditions, and winter-run Chinook Salmon have experienced significant losses due to lack of available cold water throughout the spawning, incubation, and juvenile life stages.

The Recovery Plan recognized the need to reintroduce winter-run Chinook Salmon into habitats that historically supported these fish, but are currently inaccessible because of existing dams. The Recovery Plan also categorized different priority levels for watersheds for reintroduction. It classified both the McCloud River (inaccessible from dam) and Battle Creek (accessible) as highest priority watersheds (i.e., primary watersheds) for reintroduction based on the current understanding of habitat conditions and that reintroduction planning efforts were already underway when the Recovery Plan was published. Those watersheds with less potential, such as the Upper Sacramento River, were identified as candidate watersheds.

To meet the recovery goals, the winter-run Chinook Salmon ESU cannot be considered for delisting until there are at least two viable populations. To obtain long-term sustainability, ESUs need to have some low-risk populations with essentially no hatchery influence in the long-run; they could have additional populations with some small hatchery influence, but there needs to be a core of populations that are not dependent on hatchery production. Fish passage around Shasta Dam can provide one practical option to establish a second viable population.

Shasta Dam Fish Passage Evaluation

The SDFPE is the study to evaluate the feasibility of reintroducing Chinook Salmon to tributaries above Shasta Lake in response to Action V of the RPA. The Recovery Plan states that because the Sacramento River winter-run Chinook Salmon ESU currently only has one population, and that population spawns outside the species historical spawning range (Sacramento River below Keswick dam), introductions into historically occupied habitat are necessary to meet requirements for recovery (NMFS 2014a). Fish passage at Shasta Dam was selected as the first effort in response to Action V due to the limited amount of existing available habitat for winter-run Chinook Salmon, as described in the Recovery Plan and the Pilot Plan.

The near-term goal for Action V is to increase the geographic distribution and abundance of the listed fish. The long-term goal is to increase abundance, productivity, and spatial distribution of the target species, and to improve their life history, health, and genetic diversity.

The near-term fish passage actions included the formation of the Steering Committee, led by Reclamation, which coordinates and guides the overall development and implementation of the studies through interagency collaboration. In accordance with the RPA action, the Steering Committee was formulated in 2010. The RPA indicated that the Pilot Program should be operational by 2012, but that was not feasible; Reclamation, with the Steering Committee, however, did begin development of the Pilot Program before 2012.

As part of the requirements of the RPA, Reclamation, in coordination with the Steering Committee, is developing the Pilot Program as an adaptive management process to evaluate the

reintroduction of Chinook Salmon into historical habitat above Shasta Dam. The BO directs Reclamation and partner agencies to annually revise and update this plan, and states that revisions and updates shall be based on results of the Pilot Studies, construction of new facilities, recovery planning guidance, predicted annual run size, and changes in hatchery management.

Purpose and Need

RPA Action V, NF3, of the NMFS BO requires the "Development of a Fish Passage Pilot Plan" (NMFS 2009). The BO states the need and explains the rationale for instituting a Pilot Program. The need arises from projections of diminishing cold water habitat and the resulting vulnerability of Chinook Salmon below Shasta Dam.

The purpose of the Pilot Program is to evaluate the feasibility of establishing self-sustaining populations of Chinook Salmon in the Upper Sacramento and McCloud rivers above Shasta Lake. The Pilot Program seeks to do this by evaluating various aspects of reintroduction including the biological and technological challenges. The Pilot Plan is the first step of an adaptive management approach for evaluating the feasibility of reintroducing Chinook Salmon into their historical habitat above Shasta Lake.

Section 2
Program Study Area

The study area, depicted in Figure 2-1, includes Shasta Lake, the Sacramento River from Shasta Lake upstream to Box Canyon Dam, and the McCloud River from Shasta Lake upstream to McCloud Dam. This area falls within the Northeast Subregion of the Sacramento River Watershed (Sacramento River Watershed Program 2014), which includes study area river basins (Upper Sacramento and McCloud), along with the Pit River basin located east of the study area. These rivers flow generally southwest into Lake Shasta. The Northeast Subregion intersects four counties in the north and northeastern part of the Sacramento River Basin and contain large areas of unpopulated public lands (USFS and the Bureau of Land Management [BLM]) that provide habitat for large game, waterfowl, and other wildlife. The area is characterized by a natural resource–based economy, including ranching, logging, recreation, tourism, and high-quality recreational fishing (Sacramento River Watershed Program 2014). Shasta Lake and the Upper Sacramento and McCloud watersheds are described in more detail below.

Shasta Lake

Created by Shasta Dam, Shasta Lake is the largest reservoir in California, with a surface area of approximately 29,500 acres, a volume of 4.55 million acre-feet, and approximately 400 miles of shoreline. Shasta Lake was operational in 1949 as part of the CVP to provide water supply to much of California, and to provide fisheries benefits in the lower Sacramento River. The three major tributaries to Shasta Lake are the Upper Sacramento, McCloud, and Pit rivers. Many smaller tributary creeks and streams (both seasonal and perennial) flow into these major tributaries and Shasta Lake.

Upper Sacramento River

The Upper Sacramento River watershed, located in Shasta and Siskiyou counties above Shasta Dam, encompasses approximately 383,000 acres. Approximately 30 river miles of the Upper Sacramento River are included within the Upper Sacramento River watershed below Box Canyon Dam downstream to where the river enters Shasta Lake. Above Box Canyon Dam, flows into Lake Siskiyou are supplied mostly by snowmelt; and below the dam, released flows are augmented by spring discharges and rainfall-driven runoff. Between Box Canyon Dam and Shasta Lake, seven key tributaries contribute flow to the Upper Sacramento River – Castle Creek, Soda Creek, Flume Creek, Shotgun Creek, Hazel Creek, North Salt Creek, and Slate Creek.

The majority of property adjacent to the Upper Sacramento River is privately owned. Private land uses in the watershed include timber harvest, residential, agricultural, industrial, and commercial development. A portion of land in the watershed is federally-owned forestland managed by the Forest Service that is a part of the Shasta-Trinity National Forest (STNF). The BLM manages a small portion of the watershed near Shasta Lake west of Backbone Ridge. STNF, and BLM lands consist of several sections located in a patchwork of private ownership. The California State Parks agency manages Castle Crags State Park, which covers about 4,000 acres of the watershed (North State Resources [NSR] 2010).

McCloud River

The lower McCloud River watershed, located in Shasta and Siskiyou counties, is approximately 67,073 acres and consists of lands drained by the McCloud River from the McCloud Dam outlet downstream approximately 23 river miles to the McCloud Bridge, where the river enters Shasta Lake. The Hawkins Creek, Claiborne Creek, and Chatterdown Creek, and Squaw Valley Creek sub-watersheds are included in the lower McCloud River watershed.

The majority of the lower McCloud River watershed is characterized by a checkerboard land ownership pattern. Private entities own most of the property adjacent to the McCloud River in this area, as a corridor of mostly private land follows the McCloud River. Many private properties in this region were deeded via land grants associated with railroad development. Private ownership activities or designations include nature preserves, fishing clubs, a utility company, timber companies, and ranching (USFS 2011). Large blocks of National Forest land occur in the Hawkins Creek drainage and along the major ridge that forms the southwest border of the watershed. Timber management has occurred in the Hawkins Creek drainage and the upper slopes on the southeast side of the river. Most of the remainder of this portion of the watershed remains essentially without roads (USFS 2011).

The lower McCloud River watershed has a moderate level of human uses with several roads and 61 miles of hiking trails, including a portion of the Pacific Crest Trail.

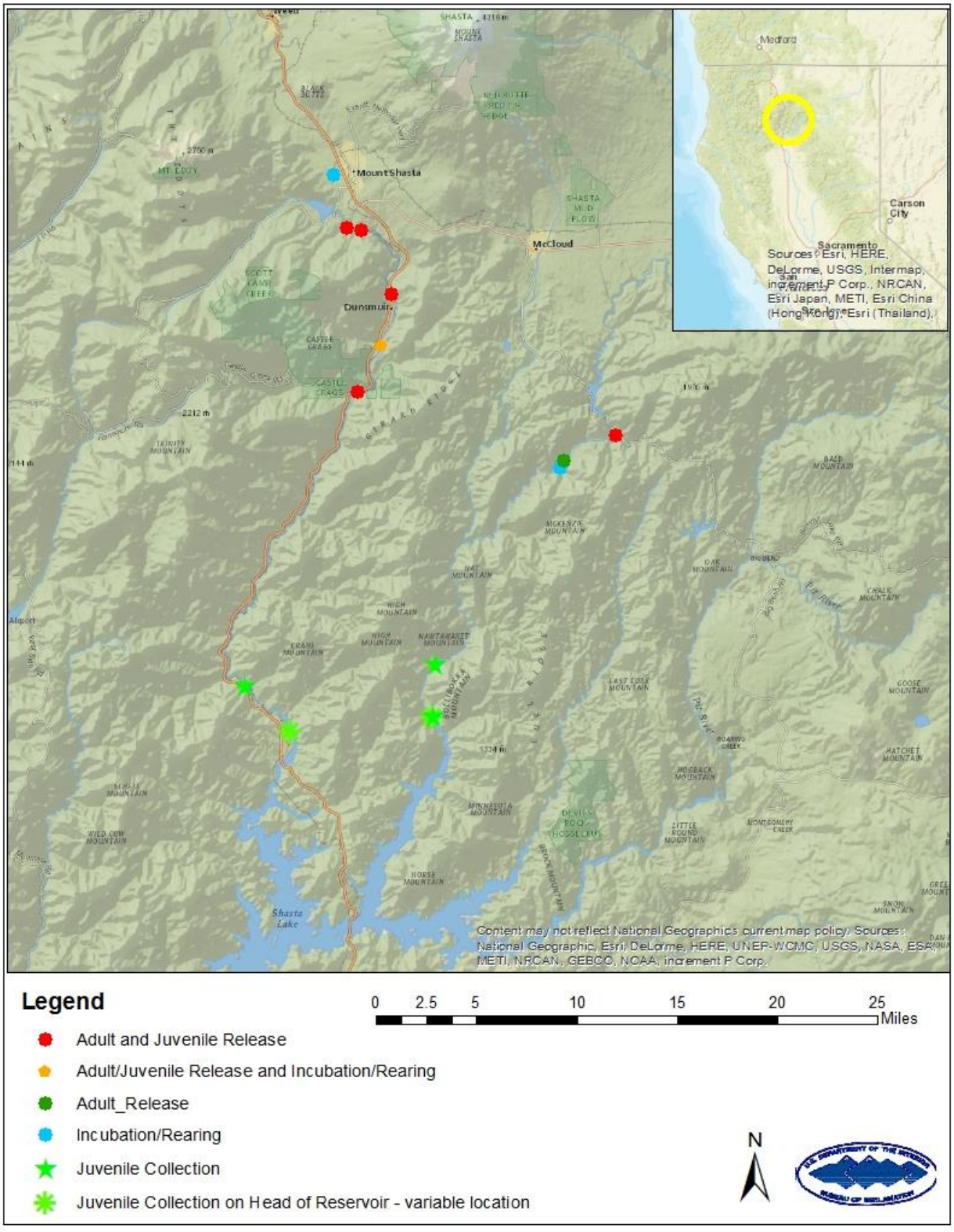

Figure 2-1. Shasta Dam Fish Passage Evaluation Study Area and Potential Fish Handling Locations

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Section 3
Alternatives Description

This section describes the No Action Alternative and the two action alternatives, which include activities described in greater detail in the Pilot Plan.

No Action Alternative

Under the No Action Alternative, the Pilot Program would not be implemented, therefore winter-run and potentially spring-run Chinook Salmon would not be transported or allowed access to the Upper Sacramento or McCloud rivers above Shasta Lake. The RPA requires Reclamation to reconsult with NMFS if the fish passage program is not feasible or not implemented. The reconsultation would identify other alternative measures to prevent jeopardy to the species.

Action Alternatives

Under the action alternatives, winter-run and potentially spring-run Chinook Salmon would be reintroduced above Shasta Dam through the Pilot Program. Although steelhead are included in the RPA action and habitat requirements are similar, steelhead are not being analyzed for reintroduction at this time because they require more stock analysis to work out potential effects of anadromous and resident trout interactions prior to reintroduction. The Pilot Program could involve introduction to each river in different years (Alternative 1) or to both the Upper Sacramento River and McCloud River at the same time (Alternative 2).

The Pilot Program would apply lessons learned from each year's introduction to increase the success of subsequent introductions. Because of this adaptive nature, many details, including the duration, of the Pilot Program would be determined based on the results of preceding years' studies. Conventional tools and methods (types of traps used, timing of releases, etc.) would be used and could be modified to achieve program objectives. These tools and methods could be applied in either of the rivers, as described below. Study methods are expected to change as collected data are evaluated and used to inform and refine protocols for the Pilot Program.

If the Pilot Program's studies indicate that additional environmental review and compliance would be needed for actions that were not previously analyzed for potential environmental impacts then separate environmental documentation would be required.

The first year of the Pilot Program would be limited to studies using fry or juveniles and the second and third years (at a minimum) would use fry or juveniles and also include eggs. The potential for unintended or undesirable evolutionary (homogenized population structure and/or reduced fitness) and demographic (depletion of source population) risks may be low because fish would be sourced from Livingston Stone NFH rather than from the wild population, and because homogenization risk is lower with the small number of hatchery-origin fish being released into an area that is unoccupied by wild winter-run or spring-run Chinook Salmon. If test fish come from other sources they would be triploid to prevent the fish from reproducing.

All hatchery-origin Chinook Salmon and any natural-origin fish in excess of broodstock requirements are returned to the Sacramento River below Keswick Dam. After the installation of a water treatment system at Livingston Stone NFH, wild adult winter-run and spring-run Chinook Salmon may be transported to the Study Area as part of the Pilot Program. A portion of hatchery-origin winter-run Chinook Salmon from Livingston Stone NFH that are in excess of the broodstock requirements (that would normally be returned to the lower Sacramento River) may be used in the Pilot Program in Year-3 or later.

The long-term goal is to increase abundance, productivity, and spatial distribution of the target species, and to improve their life history, health, and genetic diversity. If the Pilot Program indicates that a full-scale reintroduction is feasible, a detailed plan to avoid unintended consequences (e.g., effects on the source population) would be further developed and require further environmental review before being implemented. The colonization strategy for a full-scale reintroduction may rely on reintroduction of juvenile and eggs propagated at Livingston Stone NFH, with subsequent reliance on natural spawning by introduced adults in the reintroduction area. The population would continue to be demographically dependent on hatchery production until reestablishment of natural production occurs over time. The reintroduction would also need to be integrated with Livingston Stone NFH's propagation program to ensure retention of the target genetic diversity present in the founders of the captive broodstock. To reduce the potential for significant impacts to the source population, criteria for collection strategies will balance development of reintroduced stocks with minimizing risks to the source population.

In the event of a full-scale reintroduction, the length of time over which hatchery supplementation is planned would be considered. Evolutionary and ecological risks increase with the duration and magnitude of hatchery releases into the Study Area. The goal is to aim for brief releases of from one to two generations followed by cessation for a similar timeframe, accompanied by a monitoring program to track performance. Such a pulsed release would provide colonization to establish a population and subsequently permit natural and sexual selection to shape local adaptation and the expression of natural diversity patterns. Abundance targets for naturally spawned fish would be established to indicate when the incipient population has sufficient reproductive potential without supplementation.

Fish Release

Under all action alternatives, fish would be transported to release sites on the Sacramento and/or McCloud rivers (see potential release sites in Figure 2-1). Preliminary release sites have been identified

Key requirements for juvenile transport include:

- Vehicle or boat access is available at the collector sites
- Vehicles are equipped with aquacultural life support systems
- Juveniles are segregated by size within modular transport containers
- Acclimation facilities are provided when necessary, to manage and minimize stress during transitions of loading and unloading fish

Due to road conditions and limited accessibility along the McCloud River, release sites would be more limited than in the upper Sacramento River. Use of helicopter transport could expand the number of release and operation sites in the McCloud River for various pilot reintroduction studies. Aerial transport of fish is not intended as long term fish passage solution but may be used for the Pilot Program. Field monitoring sites in all rivers are expected to be accessed using four wheel drive vehicles (see following section).

The Technology Subcommittee completed site visits at several suitable locations on the Upper Sacramento and McCloud rivers. The Technology Subcommittee, along with members of the Steering Committee, would determine which sites provide the best locations for adult release, juvenile rearing, and egg incubation. For adult or juvenile release sites where truck access to the river is limited, temporary release pipes from access points to the river may be used. For juvenile rearing and egg incubation sites, details regarding equipment and water needs, and plumbing would be determined on a site-specific basis.

Mileage, drive time, and road descriptions for each of the proposed release locations are summarized in Table 3-1. The location of releases would be determined based on the numbers and life stages of salmon transported, release site accessibility, and river selection and environmental conditions. Further details are provided in the Pilot Plan.

If eggs are transplanted to the Upper Sacramento and McCloud rivers, they would likely be obtained from the Chinook Salmon spawned at Livingston Stone NFH or Coleman NFH, with eggs initially incubated there, or in streamside incubators. Eyed eggs (least sensitive stage of egg development) would be the expected stage of embryo development for outplanting either in in-stream egg boxes, such as the Whitlock-Vibert Box design, or streamside incubators. Incubation and emergence of eggs in or adjacent to the river would allow fry to emerge naturally and exhibit rearing or migratory behavior similar to naturally spawned eggs.

If adults from the Sacramento River are transported, the migrating adult Chinook Salmon would be collected at the existing fish trap at Keswick Dam and would be transported by truck to Livingston Stone NFH. From Livingston Stone NFH, adults, juveniles, or eggs would be transported to release, rearing, or incubation sites on the Upper Sacramento and McCloud rivers.

Collection and transport methods allow reintroduction to target specific sites for release. For example, spawning adults could be released into the highest quality habitat or dispersed among several upstream areas. Collection and transport options may provide a degree of flexibility to adjust release locations, depending on availability of access roads (or other means) to deliver fish to specific release locations. Maintaining water quality during transportation is also a concern with collection and transportation of fish, particularly water temperatures and dissolved oxygen. Fish may experience thermal stress if the water warms up during transport and the water temperature in the transport tanks is not close enough to the water temperatures at the release location. Therefore, emphasis would go into fish transport vessels equipped with life support systems, and acclimation facilities potentially needed at release sites.

Once the fish are captured, they would be held for a period of time. Fish could be held on or at the trapping facility, moved directly to holding ponds or tanks on shore or to a transport vehicle.

Juveniles transported to a release site downstream from Keswick would be marked or tagged if possible, depending on the size of the fish (e.g., PIT tag, fin clip, coded wire tag), in coordination

with other Federal and State programs, so that these fish can be identified as the reintroduced fish upon return to freshwater. Genetic identification methods may also be used.

Table 3-1. Estimated Mileage, Drive Time, and Road Descriptions Between Livingston Stone National Fish Hatchery and Study Release Locations, and Between Fish Collection and Post-Study Release Locations

Origin	Destination	Use Description	Location	Approximate Mileage	Estimated Drive Time	Road Description
001A Bollibokka	Caldwell Park in Redding (post-study release)	juvenile collection	McCloud River	40	2h	I-5, state, and local roads
001B Below Fenders Ferry/McCloud Bridge	Caldwell Park in Redding (post-study release)	juvenile collection	McCloud River	36	1h	I-5, state, and local roads
002 Dog Creek	Caldwell Park in Redding (post-study release)	juvenile collection	Sacramento River	30	30m	Primarily accessed via I-5
Livingston Stone NFH	003 Riverside Campground	adult/juvenile release	Sacramento River	47	1h	Primarily accessed via I-5
Livingston Stone NFH	004 Dunsmuir Wastewater Treatment Plant	adult/juvenile release - incubation/rearing facility	Sacramento River	50	1h	Primarily accessed via I-5
Livingston Stone NFH	005 Dunsmuir Tauhindauli Park	adult/juvenile release	Sacramento River	53	1h	Primarily accessed via I-5
Livingston Stone NFH	006 Cantara Loop	adult/juvenile release	Sacramento River	60	1h	Primarily accessed via I-5
Livingston Stone NFH	007 Ash Camp	adult/juvenile release	McCloud River	83	2h	I-5, local and unimproved roads (Squaw Valley Road, Hawkins Creek Road)
Livingston Stone NFH	008A Ah-Di-Nah	adult release	McCloud River	86	2h	I-5, local and unimproved roads (Squaw Valley Road,

Origin	Destination	Use Description	Location	Approximate Mileage	Estimated Drive Time	Road Description
						Hawkins Creek Road, Ah-Di-Na Road)
Livingston Stone NFH	008B TNC Property	incubation/rearing facility	McCloud River	86	2h	I-5, local and unimproved roads (Squaw Valley Road, Hawkins Creek Road)
Livingston Stone NFH	009 Mount Shasta Hatchery	incubation/rearing facility	Sacramento River	60	1h	Primarily accessed via I-5
Livingston Stone NFH	010 Ney Springs Road near Box Canyon Dam	adult/juvenile release	Sacramento River	65	1h30m	I-5, state, and local roads

Key:

I-5 = Interstate 5

NFH = National Fish Hatchery

Transporting juvenile Chinook Salmon for release is a common management practice throughout the Pacific Northwest and the Central Valley to mitigate fish passage impediments and unfavorable environmental conditions along portions of juvenile salmon emigration routes in spawning streams. Juvenile Chinook Salmon are transported downstream from hatcheries for release in California, including the Coleman NFH, and State salmon hatcheries on the Feather and Mokelumne rivers.

In-stream egg incubators could consist of perforated polypropylene boxes that are buried in streambed gravels at suitable locations for egg incubation, typically in pool tailouts, at the head of riffles, or as floating or anchored boxes located in portions of the stream with appropriate depths and flow velocities. Egg boxes would create minimal disturbance to substrate due to their small size (similar to the size of a shoebox). One or more incubator boxes could be installed per spawning female equivalent. In-stream incubation within the watershed would occur at temporary sites that are provided with a stable water supply and security from the public.

Portable streamside incubators or other methods could be installed with limited site developments, and have a structure size capable of incubating up to 350,000 Chinook Salmon eggs. They would require no ground disturbance, and whenever possible would be placed on level ground that is previously disturbed. No concrete bases or other permanent fixtures would be installed, and vegetation clearing would not be required. Approximately 200 to 400 square feet would be required for installation of two to four box incubators, with water supply capacity of 50 gallons-per-minute (gpm) to 100 gpm. Small diameter piping would be routed for water supply, drain water, and fish release from the incubators to the river. Temporary security fencing around the incubators and critical water supply features could be necessary in publicly accessible areas and to avoid vandalism and exclude large predators.

In the Upper Sacramento River, the proposed life stage identified for the study year would be released primarily between river mile (RM) 28 (near the Dunsmuir wastewater treatment facility) and Box Canyon Dam (RM 37). In the McCloud River, releases would likely be restricted to the upper five to six miles on USFS lands and the Nature's Conservancy's McCloud River Preserve. All potential release sites were identified based on habitat suitability.

For adult or juvenile release sites where truck access to the river is limited, temporary release pipes would be used. The temporary release pipes would not require any ground disturbance. Measures would be taken to design release pipes so that they do not serve as an attractant to wildlife predators that could take fish, e.g. muffling sound, impeding access. The size and installation method for these pipes would be determined on a site-specific basis. For all juvenile rearing and egg incubation sites, details regarding equipment and water needs, and plumbing would also be determined on a site-specific basis. The incubation sites would not require any ground disturbance.

Since some handling and transport-related mortality of outplanted hatchery-reared juvenile fry and parr salmon can be expected, samples of fish from each release group would be carefully netted in the receiving water at the end of release pipes and retained in floating net-pensin protected location with gentle current speeds for 48 hours.[1] The size of the release groups would

[1] A 48-hour post-release observation period was selected based on intervals of 12h-24h cited in the scientific literature as that required for physiological stress to subside in fish subjected to handling and transport (e.g., see Maule et al. 1988).

be determined on a year to year basis, in coordination with State and Federal endangered species recovery efforts, and depending on availability of fish. Fish in the net pens would be examined daily by qualified biologists and mortalities removed before release.

Released fish are expected to distribute throughout the rivers to where the most suitable habitat occurs in the Upper Sacramento and McCloud rivers below impassable barriers and dams.

Monitoring

Pre-Spawning (Adult) Survival, Movement, and Spawning Monitoring Fish telemetry would be used to obtain information on adult Chinook Salmon movement, habitat use, and survival. The general technical approach for both the Upper Sacramento River and McCloud River would be the same. Before transport from Livingstone Stone NFH, adult Chinook Salmon would be fitted with radio-only or combined acoustic-radio transmitter (CART) tags, with pressure/motion sensors (to detect potential mortality) configured to provide at least 100 days of transmitter life. To monitor the locations and movement of tagged salmon, fixed-station radio and acoustic datalogging receivers would be located strategically along the study reaches of the rivers and within portions of the Sacramento and McCloud arms of Shasta Lake. Mobile telemetry tracking would be periodically performed by land and air (helicopter) along the river channels and by boat in Lake Shasta. The frequency and type of mobile tracking and downloading of fixed station dataloggers would be dictated by access restrictions specific to each river, and to some degree by fish-specific movements and responses in any one river and year. Aerial telemetry surveys could be conducted concurrently with spawning survey flights (weekly or biweekly aerial from May through September).

Upper Sacramento River Fixed-station radio-telemetry datalogging receivers could be installed at four to five locations between five and ten miles apart along the Upper Sacramento River. Sites in the vicinity of Fenders Ferry Bridge, Sims Road Bridge, Riverside (Castella) Road Bridge, Dunsmuir Interstate 5 (I-5) Bridge, and Cantara Loop railroad bridge would be considered as preliminary sites (with access permission obtained from counties, Caltrans, and Union Pacific Railroad, as necessary). Fixed-station radio and or acoustic datalogging receivers could be installed in the Sacramento arm of Shasta Lake near Antlers, Sugarloaf, and O'Brien marinas. This equipment will be installed and secured to bridges to avoid ground disturbing construction. Acoustic receiver installation in Shasta Lake would require applicable georeferencing and marking of receiver locations with buoys. Secure installations would need to be tailored for each site.

A combination of mobile telemetry surveys using road and land access, raft floats, and aerial flights would be conducted to obtain the locations of tagged fish.

McCloud River Access to the McCloud River could potentially be available through lands owned by the USFS and The Nature Conservancy's McCloud River Preserve in the upper six to seven miles of the river below McCloud Dam, and through the Bollibokka Club in the lower three to four miles of the river near its confluence with Shasta Lake. The reach between these areas is privately owned, and inaccessible for roaded access to conduct Pilot Studies.

Fixed telemetry stations may be installed on the McCloud River, with one near Shasta Lake, one at the upstream end of the Bollibokka Club near Tuna Creek, and one at the downstream end of the McCloud River Preserve near Ladybug Creek. Either or both fixed-station radio and acoustic

datalogging receivers could be installed in the McCloud River Arm of Shasta Lake near Ellery Creek, Jennings Creek, and Hirz Bay campgrounds. Similar to the Upper Sacramento River, this equipment will be installed and secured to bridges or existing structures to avoid ground disturbing construction.. Sites can be accessed by driving or hiking. Acoustic receiver installation in Shasta Lake would require applicable georeferencing and marking of receiver locations with buoys.

Telemetry surveys in the McCloud are expected to be primarily aerial (helicopter flights in concert with weekly or biweekly redd surveys).

Identification of Spawning Areas When adults are released, weekly or biweekly aerial surveys could be conducted from May through September to locate and enumerate Chinook Salmon redds. If greater precision is needed ground surveys would be conducted. The Pilot Plan provides more details.

Spawning Habitat Monitoring When adult Chinook Salmon are transported and released in the Upper Sacramento and/or McCloud rivers and spawning locations for these fish are determined, general water quality parameters at the time of release would be recorded at these sites. Data collection would include water depth, velocity, turbidity, temperature, and dissolved oxygen levels. Specific technical and analytic methods would vary but would be minimally invasive.

Juvenile Salmon Life Stage Monitoring Transport and handling survival for outplanted juveniles, size and growth rates, relative abundance, habitat use, and movement in the study reach would be monitored and measured using a combination of different monitoring and analytical techniques.

Spatial distribution, habitat use, and size and growth of hatchery-reared and outplanted and naturally-produced juveniles during the period of rearing in the study area would be monitored using direct observation techniques, primarily snorkel surveys, supplemented by electrofishing and/or seining. Pre-selected monitoring sites would be 400 to 800 feet long and strategically located along the rearing reach of each river. Sites would occur throughout the length of the Upper Sacramento River, where access is allowed. In the McCloud River access is currently restricted to the reach from McCloud Dam downstream for five to six miles through USFS-owned land and the McCloud River Preserve and from Shasta Lake upstream to about Tuna Creek through the Bollibokka Club. Specific site locations would be selected in consultation with State and Federal fishery management agencies, based on reach characterizations provided in Reclamation's (2014) habitat assessment and access and personnel safety considerations. If preselected sites do not prove useful, additional evaluation would be undertaken by the Steering Committee to identify better monitoring locations.

Movement and distribution of rearing juvenile Chinook Salmon would be accomplished by establishing one to two survey stations within each of the six homogeneous geomorphic study reaches in each river. Surveys would be conducted by multiple State and Federal personnel (specific number of personnel would be dependent on site size) per site at monthly or biweekly intervals from August through November, or as conditions and presence of salmon dictate. Each site would require one day to survey.

Direct observation by snorkeling is expected to be the primary technique used for *in situ* monitoring of juvenile salmon. Supplemental electrofishing or seining may be conducted near suitable shallower stream margins at each snorkeling site to verify species identifications and to obtain a representative number of fish for verifying lengths and to measure weights.

Snorkeling techniques would follow those outlined by Thurow (1994), Dolloff et al. (1996), O'Neal (2007), and NMFS (2000). Snorkeling surveys would be conducted during the day and be scheduled to occur when lighting and visibility are best for underwater observations at each site. The number of snorkelers and width of snorkeling lanes would be determined by channel width and visibility at each survey site.

Electrofishing and seining used to supplement snorkel surveys, would follow procedures presented by Meador, et al. (1993), Reynolds (1996), Stangl (2001), and Temple and Pearsons (2007). A field crew lead operating a backpack or raft-mounted electrofisher would be accompanied by one to three netters. Captured fish would be retained in aerated buckets and monitored until processed. Fish would be identified to species, measured for fork length (FL), and total length (TL), and weighed. Additionally, any mortalities and fish condition (e.g., spinal trauma, burning) would be recorded. Captured fish would be released back into the stream following processing and recovery.

Water quality data and physical habitat conditions would be measured and recorded during the surveys, following Habitat Inventory Methods described in the *California Salmonid Stream Habitat Restoration Manual* (Flosi et al. 2010).

Additional details on outplanting and monitoring are provided in the Pilot Plan.

Fish Collection

For the Pilot Program, juvenile migrant collection was initially conceived as a system of nets and rotary screw traps located at the downstream end of the tributaries just upstream from Shasta Lake. Since rotary screw traps are designed for sampling portions of a population and not 100 percent collection, other technologies that may provide higher collection efficiencies were investigated. Concept development continued through 2015 and 2016. Juvenile collection in the Pilot Program would focus, at least initially, on collection in or near the mouths of the tributary rivers. The initial configuration involves testing of pilot juvenile collection methods both at the head of the reservoir and in the tributaries. With the uncertainty in collection efficiency for pilot juvenile collection methods, both locations would be tested concurrently to maximize collection efficiency and learning opportunities. The general technical approach for both the Upper Sacramento River and McCloud River would be the same.

The Technology Subcommittee and Steering Committee completed site visits in June 2015 and selected locations which would be suitable for trap installations on both the Upper Sacramento River and McCloud River.

Head-of-reservoir Juvenile Salmon Collection

The juvenile collection system for the head-of-reservoir would consist of an inclined plane collector with guidance nets and a temperature curtain that would collect juveniles within approximately one-half mile of where they enter the reservoir from the river. This system would

be installed within the lake impoundment. The collector, nets, and temperature curtain would be mobile. The system would be moved to maintain proper hydraulic conditions as the head-of reservoir location moves with changes in reservoir water surface elevation, perhaps at roughly quarter-mile increments. The initial collection season is expected to be approximately August through December and would be adjusted as needed based on migratory timing of the juvenile salmon. During this period the reservoir elevation would be dropping in the first part of the collection season so the collector would be incrementally moved in a downstream direction. As the reservoir fills the collector would subsequently be moved in an upstream direction.

Shasta reservoir is stratified in the late summer and fall with the surface water temperature higher than the optimal temperature for salmonids. The temperature curtain is intended to retain cold water entering from the tributary river upstream of the curtain providing cooler surface water conditions than would otherwise exist. This is intended to enable salmonids to utilize the surface water where the trap is located. Once captured the water temperature at the trap would be cool enough to ensure their survival. The temperature curtain would only be used when needed to maintain suitable temperatures or water velocities past the trap. The stratification near where tributaries enter the lake is variable depending on tributary flow, local topography and weather conditions such that the temperature curtain may not be needed in some years. Drawings of this system are shown in Figures 3-2 through 3-5. Flexibility is being designed into the system so that configuration changes can be made as needed to achieve desired trapping efficiency.

Key features of the head of reservoir juvenile collection system include:

- A debris boom upstream of the trap
- A guidance net to block 100% of the reservoir cross-section and guide juveniles into the trap
- A floating trap that would have:
    - a deflector to help keep debris out the live box
    - a vertically adjustable inclined plane entrance
    - a live box area that can be adjusted to have several different configurations of live boxes (upper and lower and/or front and back) with slots for gates, separators, etc.
    - juvenile refuge baskets in the live box
    - a removable back panel to allow for ease of cleaning
    - a large working platform with hatches to allow for easy access to all areas of the trap
- Upstream and downstream passage features for resident fish species
- A temperature curtain, if needed, at or downstream of the collector to keep warmer reservoir water downstream and cooler river water upstream of the trap

Portability - as the debris boom, net, trap, and temperature curtain would need to be moved periodically as the reservoir elevation drops or rises during the collection "season"

Collector live box features unique to the design include:

- Predator exclusion immediately upon entry through the "horizontal separator." This separator would be a rack with small spaces between the bars to allow juvenile salmon to pass, but not some of the larger predators. Constructing multiple separators, each with a different spacing (perhaps 1/2", 5/8", and 3/4"), would allow testing to determine which spacing works best.

- Larger predators and debris are directed along the separator and through a 6" opening and into the upper live box. Also within this box would be juvenile refuge baskets for any salmon that did not pass through the horizontal separator.

- Juveniles pass through the separator into the lower area of the trap, and move downstream through the mesh cone into the lower live box. The lower box also contains refuge baskets, to allow juvenile salmon to escape other fish that were able to pass through the separator.

- Both live boxes in this concept would be 18 inches deep, 4 feet long, and 3 feet wide.

- The general idea for trap servicing is:

    - Sliding gates are installed at the front and back of the separator.

    - Predators and debris are removed from the upper rear live box, and then the refuge baskets in this box are slowly removed, allowing the juvenile salmon to swim out and be collected.

    - After clearing the upper live box, the larger fish are removed from the area above the separator. Then the horizontal separator is removed and the remaining fish are collected or crowded towards the mesh cone.

    - To access the lower live box and process the fish, the floor of the upper live box and the mesh cone are removed. Then the remaining fish are collected and separated. The live box could be outfitted with a false mesh bottom or something similar that could be raised to reduce the depth of water from which the juveniles would be collected.

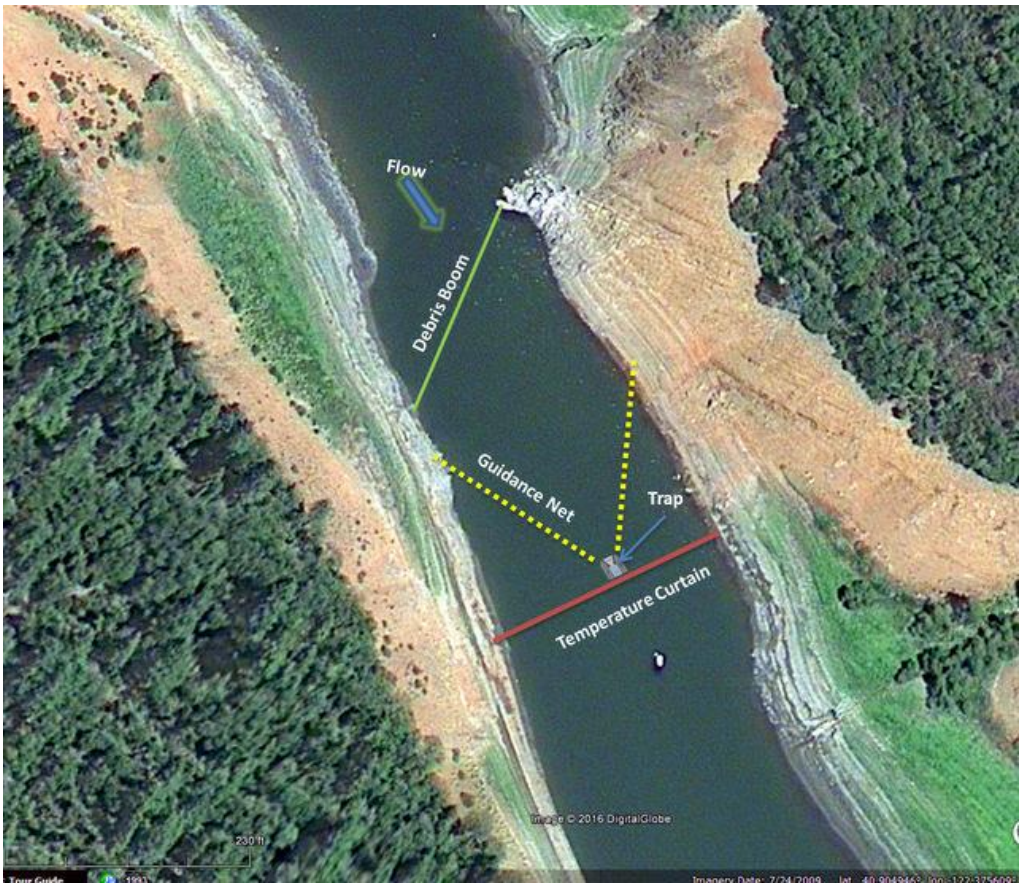

Figure 3-1. Aerial view of head of reservoir juvenile collection system configuration.

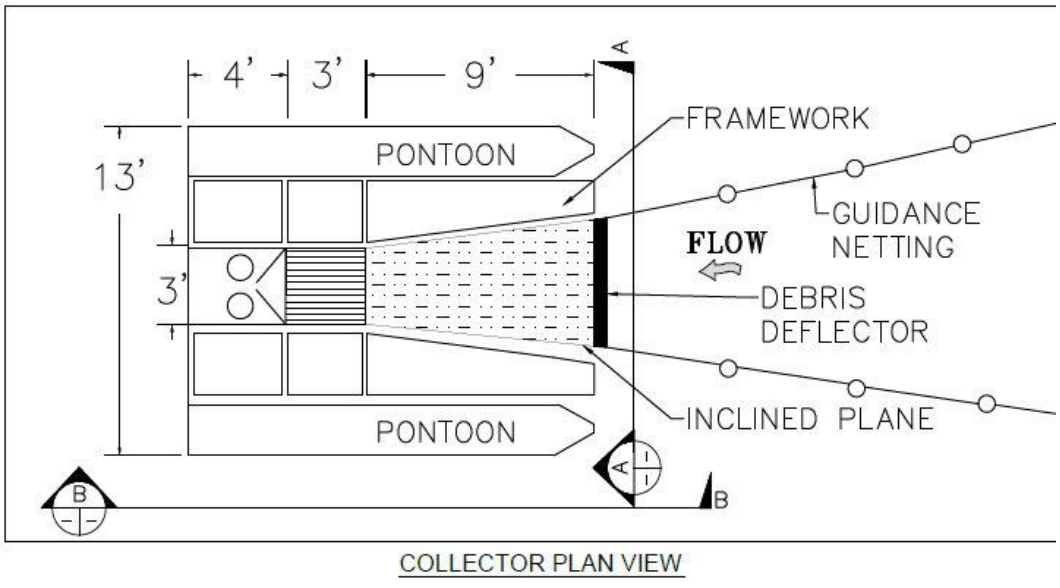

Figure 3-2. Juvenile collection trap plan view (looking down from above).

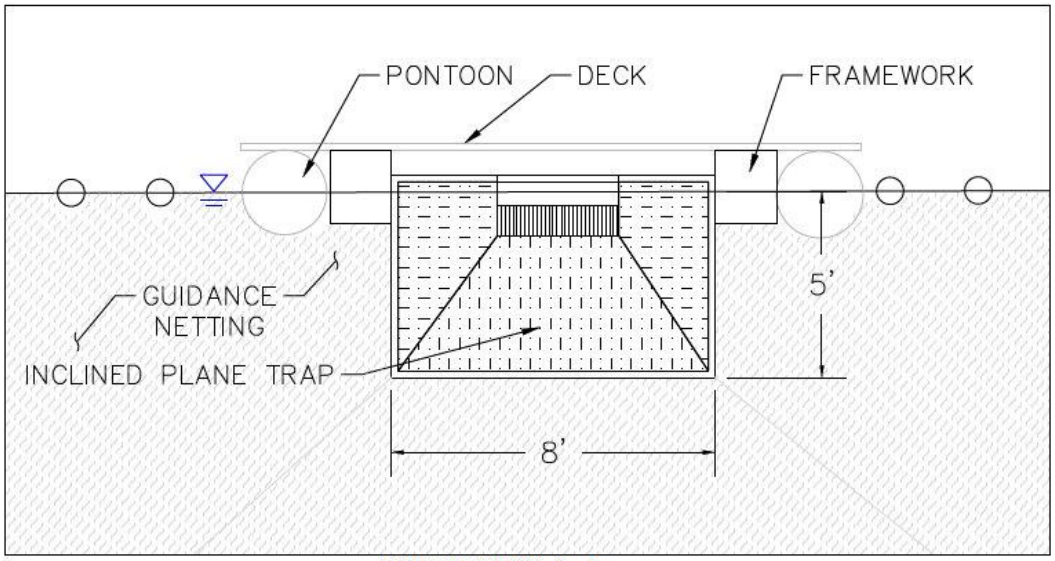

Figure 3-3. Juvenile collection trap profile view from the front.

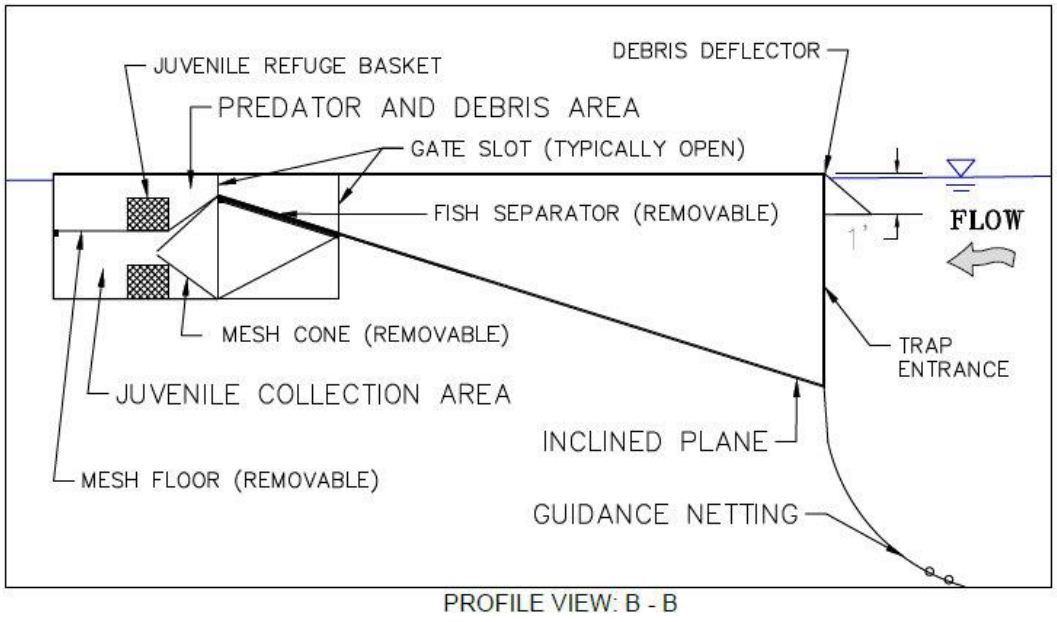

Figure 3-4. Juvenile collection trap profile view from the side.

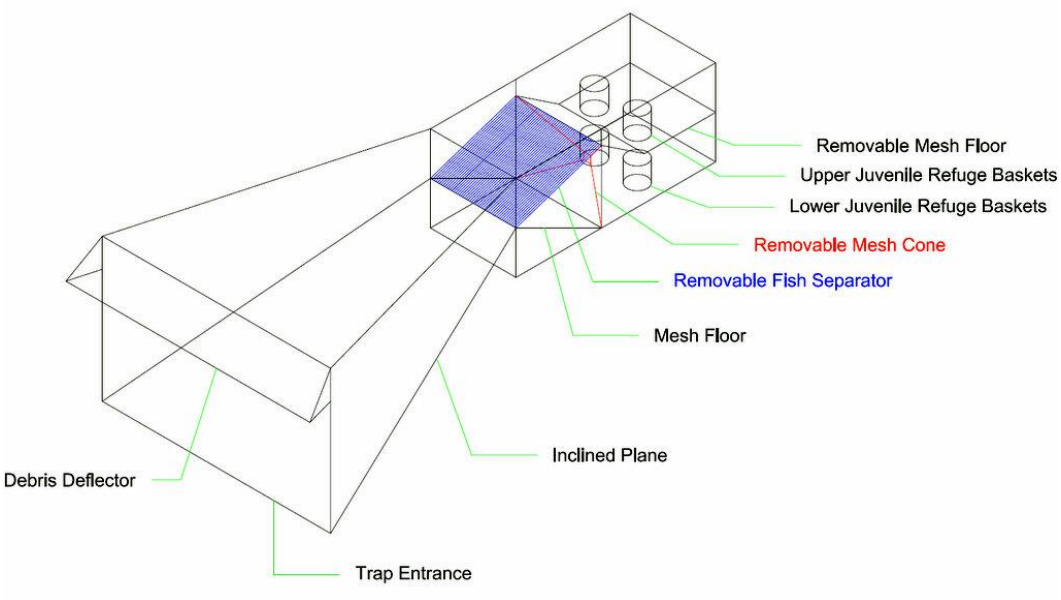

Figure 3-5. Juvenile collection trap schematic.

In-river Juvenile Collection

The in-river juvenile collection system would be of the same general design as the head of reservoir collection. The scale would be smaller with a smaller trap and no temperature curtain would be needed. Factors considered in site selection include reservoir elevations, river geomorphology, cultural resources, and access. The in-river collection system would target collection of juveniles at river flows up to at least 500 cubic feet per second (cfs). When flows exceed 500 to 1,000 cfs it is expected that the netting would need to be removed and the primary collection would occur at the head of reservoir location. The system would be flexible so that the configuration can be modified to maximize juvenile collection efficiency.

The collector would consist of guidance nets leading from either bank to a small floating fish trap located in the center of the river. A floating debris boom would extend across the channel upstream of the guidance nets to help deflect debris away from the trap (Figure 3-6). Debris would be collected from the end of the boom and released on the downstream side of the guidance net. The trap itself would consist of a net transition cone that leads into a live box (similar to a fyke trap), with pontoons on both sides to keep it afloat (Figure 3-7). Passage for resident fish is not shown in the figures, but is included in the design to minimize impacts to the fishery and comply with the requirements of the State McCloud River resource protection code. With this simple design, launching and retrieving the trap is anticipated to be low-impact. All materials used during trapping would be temporary, and could be pulled from the river or to the side of the river before anticipated high flow events and at the end of the trapping season.

Rotary screw traps would be operated upstream and downstream of the in-river trap to enable accurate estimation of trapping efficiency through the system. Passive Integrated Transponder tag detectors would be utilized to test in-river survival and monitor resident fish populations in the vicinity of trapping locations.

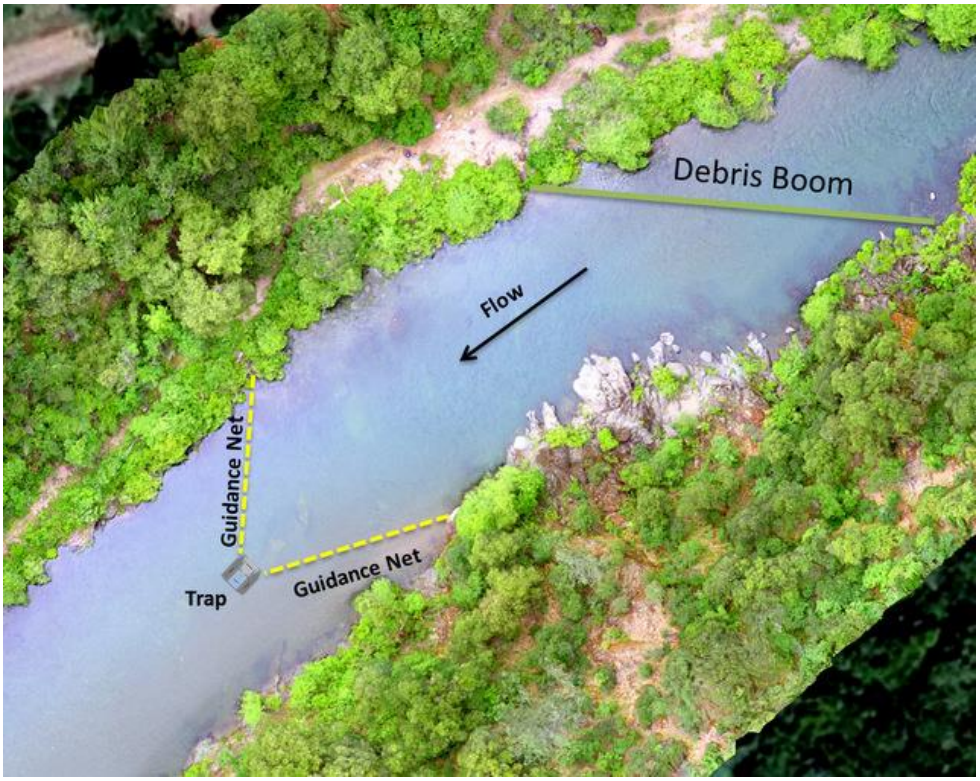

Figure 3-6. In-river collection configuration.

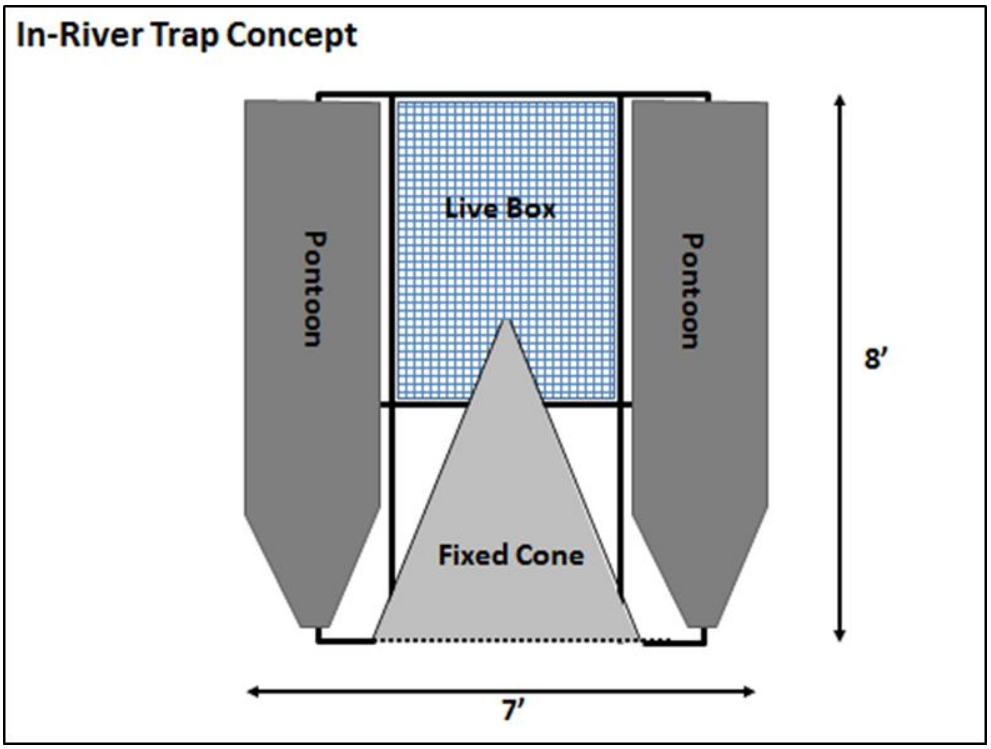

Figure 3-7. In-river trap diagram.

Features common to both collection systems:

- Debris boom upstream of collector to reduce floating debris reaching the guide nets and trap. Debris would be removed from the boom as needed to maintain trapping operations

- Upstream and downstream fish passage around the installation for resident fish species.

- Provisions for recreation users to safely pass the sites. Warning signage would be provided. If safe boating conditions exist upstream of the in-lake site then passage for boaters would be provided. If water depth precludes safe boating upstream then boat passage may not be allowed. Portage may be needed for kayakers and rafters passing the in-river site.

- Provisions for moving captured juvenile salmon from the trap to the transport vehicle or vessel.

- Provisions for marking or otherwise identifying juvenile salmon passed downstream of Keswick upon their return as adults

Additional Alternatives Considered

Additional alternatives, including volitional passage, were considered but eliminated for near term implementation as pilot study actions. The purpose of the Pilot Program is to evaluate the feasibility of establishing self-sustaining populations of ESA listed Chinook Salmon in the Upper Sacramento and McCloud rivers above Shasta Lake. The Pilot Program seeks to do this by evaluating various aspects of reintroduction including the biological and technological challenges. The Pilot Plan is the first step of an adaptive management approach for evaluating the feasibility of reintroducing ESA listed Chinook Salmon into their historical habitat above Shasta Lake. Potential long-term action alternatives that have been discussed include volitional passage around Shasta and Keswick dams.

An alternative that utilizes Sacramento River tributaries downstream of Keswick Dam as an upstream and downstream passage route for adults and juveniles has been proposed. Stillwater Creek, Cow Creek, Little Cow Creek, or Dry Creek could potentially provide a volitional adult passage route to the McCloud River via connection to Shasta Lake. Churn Creek could potentially provide volitional adult passage to the Upper Sacramento River via connection to Shasta Lake. A seasonal dam, collection facility, and pipe constructed across or around Shasta Reservoir could potentially provide volitional juvenile salmon passage from the Upper Sacramento and McCloud River to below Shasta Dam (through a tributary creek).

On February 1, 2016, the Winnemem Wintu submitted comments on the Pilot Plan including a draft proposal. Details on the draft *Winnemem Wintu Salmon Restoration Plan* proposal can be found online and a conceptual diagram of routing fish and water between lower Sacramento River tributaries, Shasta Reservoir, and McCloud River is shown in Figure 3-8.

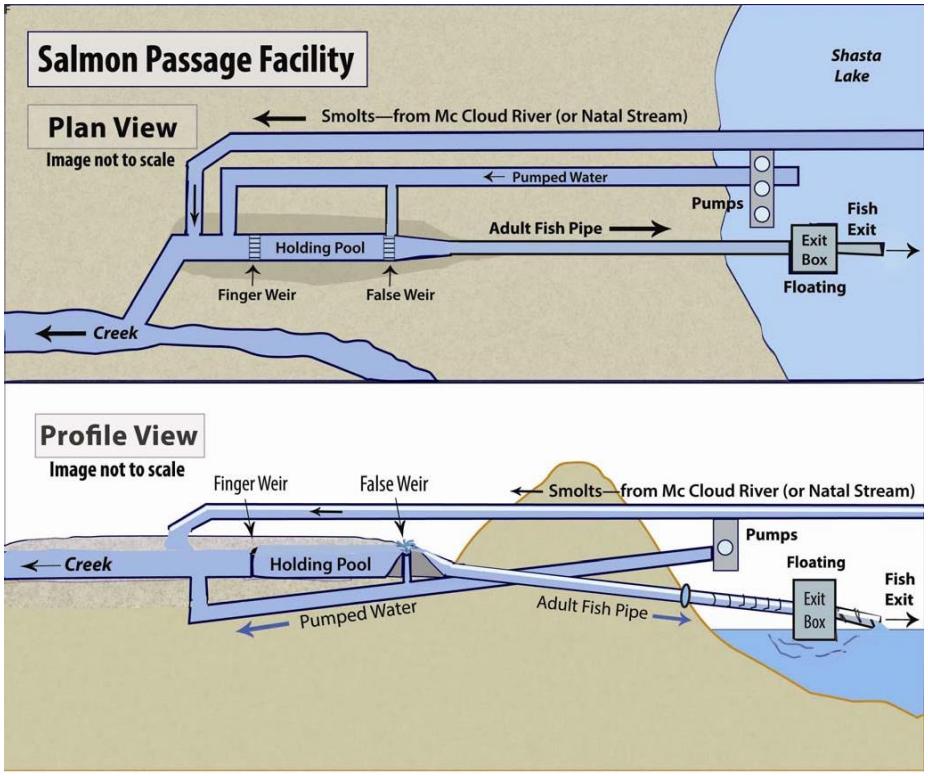

Figure 3-8. Volitional salmon passage facility concept (Winnemem Wintu 2016).

In RPA Action V, NMFS included the objective of identifying volitional downstream passage scenarios. If these options are not considered technically and economically feasible and biologically justified, Reclamation and the steering committee shall identify interim non-volitional alternatives that are determined to be technically and economically feasible and biologically justified.

The Steering Committee hopes the Pilot Program will answer whether the existing state of the habitat and the species present upstream of Shasta Dam would enable a productive salmon population to be sustained over time if a successful passage route can be provided. Moving directly into a fish passage project would not allow the Steering Committee to test different passage methods and designs and would not provide data on whether sustained passage is feasible.

Shasta Dam provides several unique challenges (height of 602 feet; large, fluctuating reservoir, temperature stratification). No salmonid fish passage projects at high head storage dams (i.e. dams higher than about 200 feet hydraulic head and without flowing water through the upstream body of water) have successfully been completed in California. The implementation of the Pilot Studies under the Pilot Program would provide the information required to determine the next steps of a long-term action including the design and implementation of a fish passage project as appropriate.

Alternative 1 – Introduction to Sacramento River or McCloud River Separately

Under Alternative 1, Chinook Salmon would be introduced to either the Sacramento River or the McCloud River at different times. Under this alternative, it is possible that only one river would

be used for the duration of the Pilot Program. It is also possible that the both rivers could be used, but only one river would be used in a given year.

Alternative 2 – Introduction to Sacramento River and McCloud River Concurrently

Under Alternative 2, Chinook Salmon would be reintroduced to both the Upper Sacramento and McCloud rivers at the same time. Many elements of the Pilot Program for introducing fish to both rivers simultaneously would be similar to a single-river introduction. The location and timing of activities described for each river under Alternative 1 would be the same under Alternative 2. Simultaneous introductions into both rivers would require more labor and driving mileage per season since twice as many survey sites would be visited as compared to a single river introduction. The release of fewer fish in each river under simultaneous introduction would also mean that analyses for each river would be more challenging since fewer fish would be released for studies in each river.

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Section 4
Affected Environment and Environmental Consequences

This section provides an overview of the physical environment and existing conditions and identified environmental resources that could potentially be affected by the alternatives.

Resources Eliminated from Further Analysis

Effects on several environmental resource categories were examined and found to be non-existent or below the level of measurement. The No Action and action alternatives do not involve any significant ground-disturbing activities, and all activities would be consistent with USFS management plans and other relevant Federal, State, and local requirements; therefore, the following resources were eliminated from further discussion: Hydrology, Groundwater, Geology and Soils, Agricultural Resources, Socioeconomics, Land Use, Utilities, and Public Services.

Department of the Interior Regulations, Executive Orders, Council on Environmental Quality National Environmental Policy Act (NEPA) regulations, and Reclamation guidelines require a discussion of the following items when preparing environmental documentation.

Environmental Justice

Executive Order 12898 requires each Federal agency to identify and address disproportionately high and adverse human health or environmental impacts, including social and economic effects of its program, policies, and activities on minority populations and low-income populations. Although there are known gathering places in the vicinity of the Pilot Program as well as minority communities, the proposed activities would not result in disproportionately high and adverse human health or environmental impacts as a result of the action.

Indian Trust Assets

Indian Trust Assets (ITA) are legal interests in assets that are held in trust by the United States for Federally-recognized Indian tribes or individuals. There would be no adverse impacts to ITA's.

Indian Sacred Sites

Executive Order (EO) 13007 requires Federal agencies to accommodate access to, and ceremonial use of, Indian sacred sites by an Indian tribe (or a member of an Indian tribe) or Alaska Native tribe, nation, pueblo, village, or community that the Secretary of the Interior acknowledges to exist as an Indian tribe pursuant to Public Law No. 103-454, 108 Stat. 4791 and to avoid adversely affecting the physical integrity of such sacred sites. Sacred sites are defined in the EO as "any specific, discrete, narrowly delineated location on Federal land that is identified by an Indian tribe, or Indian individual determined to be an appropriately authoritative representative of an Indian religion, as sacred by virtue of its established religious significance

to, or ceremonial use by, an Indian religion; provided that the tribe or appropriately authoritative representative of an Indian religion has informed the agency of the existence of such a site."

Reclamation contacted federally recognized Indian tribes with a known or presumed interest in the project area regarding the SDFPE Pilot Program. Through written correspondence, these Indian tribes were invited to share concerns related to Indian sacred sites on Federal land, or access to such sites, potentially affected by proposed SDFPE Pilot Program activities. To date, Reclamation has received no responses regarding access or effects to sacred sites pursuant to EO 13007. Prior to implementation of activities, follow up calls to federally recognized Indian tribes will be conducted.

Surface Water Resources

Affected Environment

The Upper Sacramento and McCloud River watersheds are subject to compliance with the Water Quality Control Plan for the Sacramento and San Joaquin River Basin (Basin Plan) (Central Valley Regional Water Quality Control Board [CVRWQCB] 2011). The Basin Plan applies to the entire geographic extent of the Sacramento and San Joaquin river watersheds, covers 27,210 square miles, and includes the entire area drained by the Sacramento River. State law defines beneficial uses of California's waters that may be protected against quality degradation (California Water Code Section 13050(f)). The Upper Sacramento River, McCloud River, and Shasta Lake share a number of designated beneficial uses including:

- Agricultural Supply (AGR). Uses of water for farming, horticulture, or ranching including, but not limited to, irrigation, stock watering, or support of vegetation for range grazing.

- Water Contact Recreation (REC-1). Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, white water activities, fishing, and use of natural hot springs. Canoeing and rafting is a separate subcategory.

- Non-Contact Water Recreation (REC-2). Uses of water for recreational activities involving proximity to water, but where there is generally no body contact with water, nor any likelihood of ingestion of water. These uses include, but are not limited to, picnicking, sunbathing, sightseeing, or aesthetic enjoyment in conjunction with the above activities.

- Cold Freshwater Habitat (COLD). Uses of water that support cold water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

- Spawning, Reproduction, and/or Early Development (SPWN). Uses of water that support high-quality aquatic habitats suitable for reproduction and early development of fish. Two subcategories, warm and cold, are included to further describe spawning habitat type, but coldwater spawning habitat use is designated only for both the Upper

Sacramento River and McCloud River; while Shasta Lake is also designated for warmwater spawning habitat use.

- Wildlife Habitat (WILD). Uses of water that support terrestrial or wetland ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats or wetlands, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.

The McCloud River from McCloud Dam to Shasta Lake and Shasta Lake include the following additional beneficial uses:

- Municipal and Domestic Supply (MUN). Uses of water for community, military, or individual water supply systems including, but not limited to, drinking water supply.

- Hydropower Generation (POW). Uses of water for hydropower generation.

	Municipal	**Agriculture**		**Recreation**			**Freshwater**		**Spawning**		**Wild**	**Industry**
	MUN	**AGR**		**REC 1**		**REC 2**	**Habitat**		**Habitat**			**POW**
River	**Municipal & Domestic Supply**	**Irrigation**	**Stock Watering**	**Contact**	**Canoeing and Rafting**	**Other Non-Contact**	**Warm**	**Cold**	**Warm**	**Cold**	**Wildlife Habitat**	**Power Generation**
Sacramento		E	E	E	E	E	X	E	X	E	E	
McCloud	E			E	P	E		E		E	E	E
Shasta Lake	E	E		E		E	E	E	E	E	E	E

Source: Adapted from CVRWQCB (2011)
Key:
AGR = Agricultural Water Supply
E = Existing beneficial use
MUN = Municipal and Domestic Supply
P=Potential for beneficial use
POW = Hydropower Generation
REC = Recreation
X = Not suitable for use
Blank cells indicate that no beneficial use has been designated

The designated beneficial uses of the three main water bodies within the environmental study area are compared in Table 4-1.

Table 4-1. Designated Beneficial Uses of the Upper Sacramento River (Box Canyon Dam to Shasta Lake), the McCloud River (McCloud Reservoir to Shasta Lake), and Shasta Lake

The Basin Plan identifies both numeric and narrative water quality objectives applicable to the waters of the Upper Sacramento River watershed, including the McCloud River and Shasta Lake. Table 4-2 summarizes these water quality objectives by categories that have been established by the Regional Water Board to protect the designated beneficial uses.

Table 4-2 Water Quality Objectives for the Upper Sacramento and McCloud Rivers

Category	Objective Threshold
Bacteria	In waters designated for contact recreation (REC-1), the fecal coliform concentration based on a minimum of not less than five samples for any 30-day period shall not exceed a geometric mean of 200/100 ml, nor shall more than 10 percent of the total number of samples taken during any 30-day period exceed 400/100 ml.
Biostimulatory substances	Water shall not contain biostimulatory substances in concentrations that promote aquatic growths to the extent that such growths cause nuisance or adversely affect beneficial uses.
Color	Water shall be free of coloration that causes nuisance or adversely affects beneficial uses.
Chemical constituents	Waters designated for use as domestic or municipal supply shall not contain concentrations of chemical constituents in excess of the limits specified in Title 22 of California Code of Regulations (CCR).
Dissolved oxygen	The monthly median of the mean daily dissolved oxygen (DO) concentration shall not fall below 85 percent of saturation in the main water mass, and the 95th percentile concentration shall not fall below 75 percent of saturation. The dissolved oxygen concentrations shall not be reduced below the following minimum levels at any time: Water designated as COLD 7.0 mg/l When natural conditions lower DO below this level, the concentrations shall be maintained at or above 95 percent of saturation
Floating material	Water shall not contain floating material in any amounts that cause nuisance or adversely affect beneficial uses.
Oil and grease	Waters shall not contain oils, greases, waxes, or other materials in concentrations that result in a visible film or coating on the surface of the water or on objects in the water, or otherwise adversely affect beneficial uses.
pH	Shall not be depressed below 6.5 nor raised above 8.5. Changes in normal ambient pH levels shall not exceed 0.5 in fresh waters with designated COLD or WARM beneficial uses.
Pesticides	No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses. Discharges shall not result in

Category	Objective Threshold
	pesticide concentrations in bottom sediments or aquatic life that adversely affects beneficial uses. Total identifiable persistent chlorinated hydrocarbon pesticides shall not be present in the water column at concentrations detectable within the accuracy of analytical methods approved by the EPA or Executive Officer. Waters designated for use as domestic or municipal supply shall not contain concentrations of pesticides in excess of the limiting concentrations set forth in CCR. Pesticide concentrations shall not exceed those allowable by applicable anti-degradation policies (State Water Resources Control Board Resolution No. 68-16 and 40 C.F.R. Section 131.12)
Sediment	The suspended sediment load and suspended sediment discharge rate of surface waters shall not be altered in such a manner as to cause nuisance or adversely affect beneficial uses.
Settleable material	Water shall not contain substances in concentrations that result in the disposition of material that causes nuisance or adversely affects beneficial uses.
Suspended material	Waters shall not contain suspended material in concentrations that cause nuisance or adversely affect beneficial uses.
Tastes and odors	Water shall not contain taste- or odor-producing substances in concentrations that impart undesirable tastes or odors to fish flesh or other edible products of aquatic origin, or that cause nuisance, or otherwise adversely affect beneficial uses.
Temperature	**Sacramento River:** At no time or place shall the temperature of any WARM or COLD water be increased by more than 5˚F above the natural receiving water temperature. From 1 December to 15 March, the maximum temperature shall be 55˚F. From 16 March to 15 April, the maximum temperature shall be 60˚F. From 16 April to 15 May, the maximum temperature shall be 65˚F. From 16 May to 15 October, the maximum temperature shall be 70˚F. From 16 October to 15 November, the maximum temperature shall be 65˚F. From 16 November to 30 November, the maximum temperature shall be 65˚F. **McCloud River:** The natural receiving water temperature of interstate waters shall not be altered unless it can be demonstrated to the satisfaction of the Regional Water Quality Control Board that such alteration in water temperature does not adversely affect beneficial uses. Increases in water temperatures must be less than 5˚F above natural receiving-water temperature.
Toxicity	All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life.
Turbidity	Waters shall be free of changes in turbidity that cause nuisance or adversely affect beneficial uses. Increases in turbidity attributable to controllable water quality factors shall not exceed the following limits: Where natural turbidity is less than 1 NTU, controllable factors shall not cause downstream turbidity to exceed 2 NTU.

Category	Objective Threshold
	Where natural turbidity range is 1–5 NTUs, increases shall not exceed 1 NTU. Where natural turbidity range is 5–50 NTUs, increases shall not exceed 20 percent. Where natural turbidity range is 50–100 NTUs, increases shall not exceed 10 NTUs. Where natural turbidity range is greater than 100 NTUs, increases shall not exceed 10 percent.

Source: CVRWQCB (2011)
Key:
°F = degrees Fahrenheit
CCR = California Code of Regulations
DO = dissolved oxygen
EPA = United States Environmental Protection Agency
mg/L = milligrams per liter
ml = milliliters
NTU = Nephelometric Turbidity Unit

Shasta Lake

Water quality in Shasta Lake generally meets the standards for beneficial uses identified in the Basin Plan (CVRWQCB 2011). A favorable inflow-outflow relationship of 1.4 to 1 results in good water quality throughout the reservoir (USFS 1996). One of the primary factors controlling water quality in Shasta Lake is operation of Shasta Dam; the other is the region's climate. Shasta Lake's flood control, water storage, and water delivery operations typically result in declining water elevations during the summer through the fall months, rising or stable elevations during the winter months, and rising elevations during the spring months and sometimes into the early-summer months, while storing precipitation and snowmelt runoff. Seasonal and annual variations in water surface elevation are functions of reservoir releases for water demand and water quality requirements, tributary inflow, and carryover storage from year-to-year. Shasta Lake is classified as a cool-water, mesotrophic, monomictic reservoir.

Nutrient inputs and bacteria are not of concern in the Sacramento River and McCloud River arms of Shasta Lake (USFS 1998); however, they can be an issue in the Pit River Arm of the lake as a result of runoff from agricultural and range lands in the upper Pit River watershed. Data suggest that sediment and turbidity locally affect beneficial uses, mainly contact recreation (Reclamation 2013). Shasta Lake is listed as impaired by mercury throughout the lake under the Clean Water Act (CWA) Section 303(d) (State Water Board 2010). Within Shasta Lake, some areas exist where the water quality does not meet Basin Plan objectives during periods of storm runoff because of past management activities, or as a result of drainage from historic mining and mine processing operations. These watercourses include West Squaw Creek below the Balakala Mine, lower Little Backbone Creek, lower Horse Creek, and Town Creek, which are all listed by the United States Environmental Protection Agency (EPA) as impaired water bodies under CWA Section 303(d) for heavy metal accumulations and low pH (State Water Board 2010, Reclamation 2013).

Upper Sacramento River

The Basin Plan divides the Upper Sacramento River into three segments: (1) headwaters to Box Canyon Reservoir (Lake Siskiyou), (2) Lake Siskiyou, and (3) from Box Canyon Dam to Shasta Lake. This section focuses on the segment of the Upper Sacramento River from Box Canyon

Dam to Shasta Lake. The water quality of the Upper Sacramento River and its major tributaries supports nearly all beneficial uses most of the time (Domagalski et al. 2000). In general, water quality is exceptional in the watershed. Most of the water in the Upper Sacramento River and its tributaries is derived from snowmelt and runoff from typically abundant winter rainfall at lower elevations; as a result, the water in the system is relatively pure and low in dissolved minerals (Domagalski et al. 2000).

The Upper Sacramento River above Shasta Lake has no listed water quality impairments of beneficial uses as defined under Section 303(d) of the CWA (State Water Board 2010). The Upper Sacramento River supports all of the designated beneficial uses identified in the Basin Plan (Table 4-1); however, a report by the University of California, Davis (UC Davis) in 2010 (as cited in NSR 2010) listed all the beneficial uses of the Upper Sacramento River as threatened. The UC Davis report described this threatened status as being related to the suspicion that heavy metals occurring in urban runoff and storm sewers are degrading water quality, but most notably, that heavy metal contamination continues to occur in the form of acid mine drainage from abandoned mines in the historic mining districts surrounding Shasta Lake. While the surface water quality of streams and lakes draining STNF and adjacent private lands feeding into the Upper Sacramento River generally meets standards for beneficial uses defined by the Basin Plan, some areas exist where the water quality does not meet the standards during periods of storm runoff because of past land management activities, or as a result of drainage from historic mining and processing operations. These watercourses include West Squaw Creek below the Balakala Mine, lower Little Backbone Creek, lower Horse Creek, and Town Creek (all draining into Shasta Lake), which are all listed by the EPA as impaired water bodies under CWA Section 303(d). Surface water of the Upper Sacramento River upstream from Shasta Lake does not exceed any of the Basin Plan thresholds for important metal pollutants, including dissolved cadmium, copper, or zinc (NSR 2010).

The water quality objectives for sediment are described in Table 4-2. There are no suspended sediment or bedload data available for the Upper Sacramento River upstream from Shasta Lake. There are, however, some turbidity data commonly used as a surrogate for suspended sediment. The turbidity data available for the Upper Sacramento River at the United States Geological Survey (USGS) gage at Delta (above Shasta Lake) and for Hazel Creek, a tributary midway between Box Canyon Dam and Shasta Lake, suggest that since 1998, during low-flow conditions, the water clarity has met the Basin Plan objective for turbidity.

Water temperature is an important water quality parameter affecting the beneficial uses of the Upper Sacramento River and its tributaries. Water temperature in the Upper Sacramento River fluctuates seasonally and spatially between Box Canyon Dam and Shasta Lake. As listed in Table 4-2, six seasonal water temperature objectives are identified for Upper Sacramento River between Box Canyon Dam to Shasta Lake. The water temperature objectives are numeric and account for seasonal fluctuations in water temperatures. The longest water temperature record for the Upper Sacramento River is limited to the location of the USGS gage at Delta, located immediately upstream from Shasta Lake. Seasonal patterns of average daily and maximum water temperatures for Water Years 2000 to 2014 are shown in Figure 4-1 and Figure 4-2. An examination of daily average and annual maximum water temperatures indicated that the Basin Plan's seasonally-specific water temperature thresholds are regularly exceeded at that location (NSR 2010).

Beginning in 2011, Reclamation installed and operated thermographs at nine locations along the Sacramento River between Box Canyon Dam (RM 36) and Gibson (RM 9). These thermographs indicate that maximum water temperature objectives in Water Year 2012 were met in each season upstream from Gibson Road, where water temperatures approached, but did not exceed 70°F during the May through October time period (Figure 4-3). The thermal regime along much of the Upper Sacramento River (upstream from Shasta Lake), except in the immediate vicinity of the Delta gage and the head of Shasta Lake, appears to be highly suitable for coldwater fishes and generally meets Basin Plan objectives for coldwater fishery beneficial uses. The longitudinal temperature record, to date, for the Upper Sacramento River, suggests that optimal temperature conditions for Chinook Salmon egg incubation (less than or equal to 56.0°F (13.3°C)) may be limited during the summer months to the upper nine miles of the river below Box Canyon Dam (Reclamation 2014).

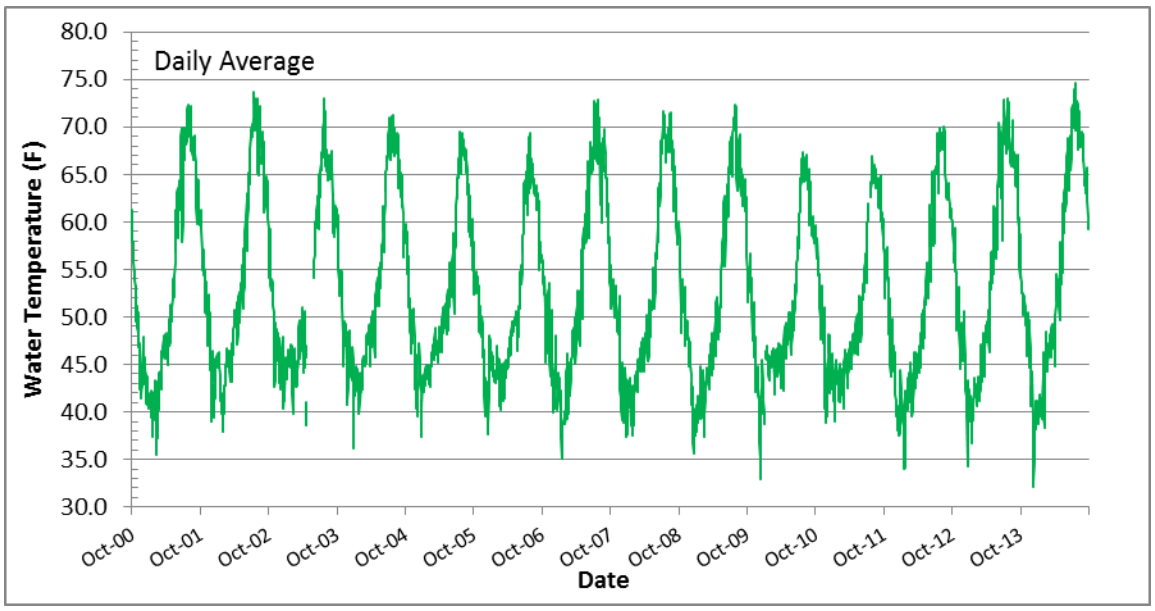


Figure 4-1. Average Daily Water Temperature Record for Water Years 2000 to 2014 at the U.S. Geological Survey Stream Gage at Delta on the Upper Sacramento River (USGS Gage Number 11341500)

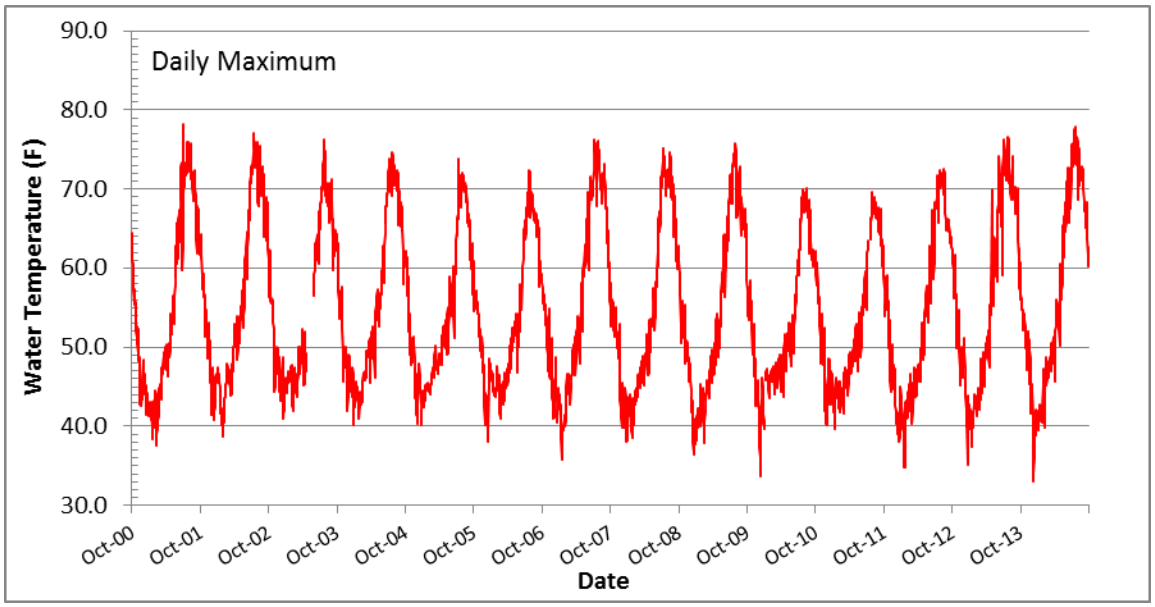
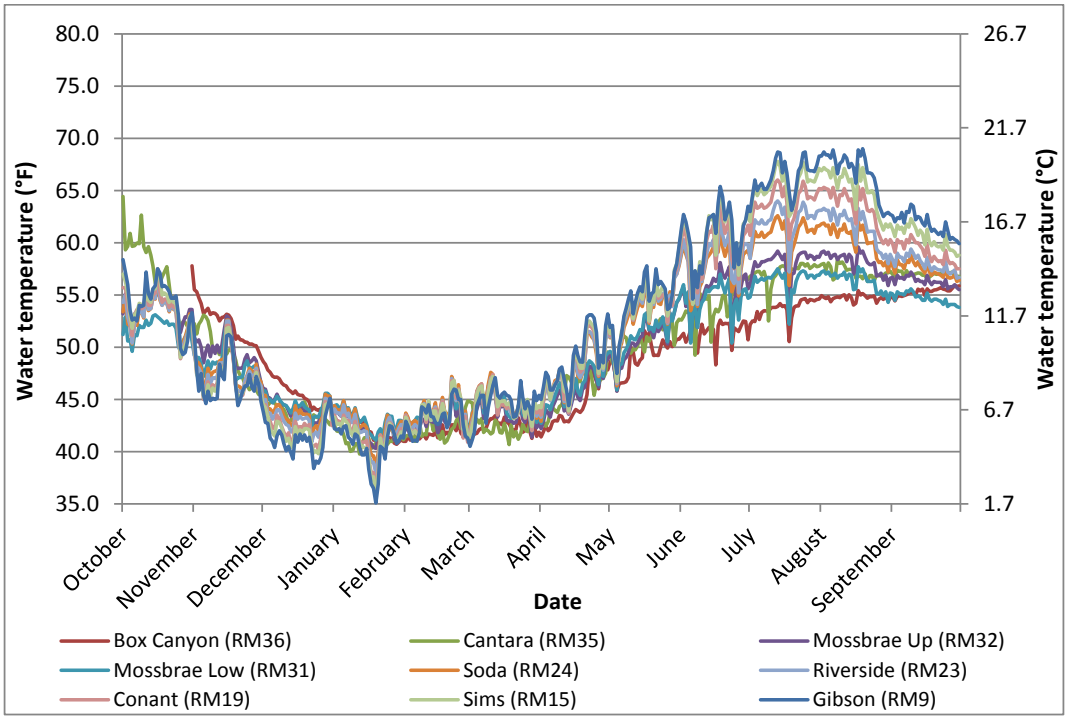


Figure 4-2. Daily Maximum Water Temperature Record for Water Years 2000 to 2014 at the U.S. Geological Survey Stream Gage at Delta on the Upper Sacramento River (USGS Gage Number 1134150)



Source: Reclamation, unpublished data.

Figure 4-3. Daily Maximum Water Temperature During WY2012 at Nine Locations on the Upper Sacramento River between Box Canyon Dam and Gibson Road

The available thermographic record indicates that thermal conditions remain within the suitable range for juvenile Chinook Salmon growth and survival throughout the summer, not exceeding a Monthly Maximum Weekly Average Temperature (MMWAT) of 66.0°F (19.0°C),[2] for 28 miles of the Upper Sacramento River from Box Canyon Dam downstream to Gibson Road (RM 9).

On July 14, 1991, near the city of Dunsmuir, a Southern Pacific train derailed along a section of track known as the Cantara Loop. A chemical tank car containing the herbicide metam sodium fell into the Sacramento River and released 19,000 gallons of the chemical into the river. As the metam sodium mixed with the water, highly toxic compounds were created. Virtually all aquatic life in the Upper Sacramento River between the Cantara Loop and Shasta Lake was destroyed. Ecological recovery efforts were implemented shortly after this spill incident, and populations of fish, aquatic macroinvertebrates, and the vegetation adjacent to the stream have attained levels that appear to be in a natural dynamic equilibrium consistent with full recovery, although some amphibian and mollusk population remained depressed at least 15 years later (Thomas R. Payne and Associates 2005, Cantara Trust Council (CTC) 2007).

Nonpoint source regulations cover other types of ground-disturbing activities. Most relevant to the assessment area are construction; timber harvest; and mining regulations and best management practices (BMP).

Mount Shasta's sizable snowpack and glacial meltwater percolate through its porous volcanic geologic structure, eventually emerging as hundreds of springs which input cold, clear water into the Upper Sacramento River. These inflows occur mostly as springs and provide an abundance of high quality (clean, cool) water into the Upper Sacramento River. These springs are located mostly upstream from Soda Creek along the Upper Sacramento River.

The Livingston Stone NFH is located immediately downstream from Shasta Dam and produces winter-run Chinook Salmon. Water is supplied to the hatchery from Shasta Dam for the USFWS's propagation and captive broodstock programs for endangered winter-run Chinook Salmon.

McCloud River

The water quality of the McCloud River supports all of its designated beneficial uses most of the time. In general, water quality is exceptional in the watershed. The McCloud River has no listed water quality impairments to its designated beneficial uses under CWA Section 303(d).

Mud Creek, a tributary upstream from McCloud Dam, adversely affects water clarity in the McCloud River by periodically delivering large amounts of fine volcanic sediment from the Konwakiton glacier on Mount Shasta directly into McCloud Reservoir. Mud Creek provides sustained transport of sand and coarser material into McCloud Reservoir during all periods of active transport. During a Mud Creek event, the highest density sediment plume enters McCloud Reservoir and travels rapidly along the reservoir bottom to the low level outlet located near McCloud Dam. As the event pulse moves through the reservoir, a process of diffusion takes place where turbidity spreads and disperses into the greater reservoir water column, reducing its density and spreading into the upper hypolimnion and metalimnion in areas with neutral density that can suspend the plume at mid-depths. Depending on the size of the event and associated

[2] This basis and rationale for this temperature criterion is described in the habitat assessment accompanying the Pilot Implementation Plan (see Reclamation 2014).

turbulent mixing and upward current induced by surface winds, the mid-depth, lower density plume can, at times, reach the surface layer and become visible. Depending on the size of the Mud Creek wasting event, the post-event "cleansing" period can last anywhere from a few days to more than a week. Turbidity levels typically spike on the day the event pulse reaches the dam outlet and then decline significantly over the next several days (typically 4-8 days) (PG&E 2011).

Under base-flow conditions, suspended sediment values typically range from less than 2.0 to 4 milligrams per liter of total suspended solids (0.5 to 3.6 Nephelometric Turbidity Units (NTU)) in the McCloud River. Continuous monitoring of turbidity over five events in August-October 2007, and August-September 2008, showed downstream turbidity levels in the McCloud River ranging from 65 to 300 NTU below McCloud Dam, 12 to 155 NTU above Claiborne Creek, and 5 to 72 NTU above Shasta Lake (PG&E 2011).

Water quality contaminants (e.g., metals, bacterial, biostimulatory, chemical) have not been reported to occur in the McCloud River. Heavy metal contamination, as described previously for the Upper Sacramento River, is an issue in the greater Sacramento watershed, but is restricted to the vicinity of Shasta Lake, and is not identified as a water quality impairment of the McCloud River upstream from Shasta Lake.

Nonpoint pollution sources in the largely undeveloped McCloud River watershed are limited, but typically include transient events of high turbidity from controllable sediment discharge sources such as road failures and less often, but significant, uncontrolled runoff discharge sources, such as large forest areas affected by intense wildfires.

Temperatures in McCloud Reservoir and the McCloud River downstream from McCloud Dam reflect the large volume of cold water entering the reservoir from the spring-fed upper McCloud River and the relatively short residence time of water in the reservoir. Groundwater springs provide a large and relatively stable source of cold water to the upper McCloud River. Flow in the McCloud River is regulated by releases from McCloud Dam, but receives significant inflow in the form of groundwater discharge from springs and runoff from tributaries; both contribute to a water temperature regime that supports year round coldwater fish habitat throughout much of the length of the lower river. This cold water supports a viable trout fishery throughout the entire 24-mile-long reach of the McCloud River (PG&E 2011).

No additional, watershed-specific water temperature objectives for the McCloud River are identified in the Basin Plan. The Basin Plan states that increases in water temperatures must be less than 5°F (2.8°C) above natural receiving-water temperature. Temperatures vary seasonally in the McCloud River, increasing from June to mid-July, remaining warmest in mid-summer, and declining from mid- to late-August through September. Typically, daily average water temperature in the McCloud River remains below 68°F (20°C).[3] Seasonally, water temperature in the lower reaches of McCloud River can rise to around 68°F (Figure 4-4 and Figure 4-5), especially in hot, critically dry water years, under both the previous and new hydropower operating licenses (FERC 2011).

[3] A 20°C criterion for coldwater fishes is based on the thermal requirements and tolerances of rainbow trout and is considered a conservative threshold for water temperatures, above which, may be adverse for trout growth and survival.

Similar to the Sacramento River, the thermal regime along much of the McCloud River (upstream from Shasta Lake), except in the immediate vicinity of the head of Shasta Lake, appears to be highly suitable for coldwater fishes and generally meets Basin Plan objectives for coldwater fishery beneficial uses (Figure 4-6). Based on a limited set of long-term thermographic records and Pacific Gas and Electric Company's (PG&E) (2008) temperature modeling for the McCloud River below McCloud Dam, optimal temperatures for Chinook Salmon egg incubation through the summer months is limited to approximately 11.6 miles of the upper reaches of the river below McCloud Dam under both the previous and new hydropower licenses (Figure 4-5) (FERC 2011, Reclamation 2014). Thermal conditions remain within the suitable range for juvenile Chinook Salmon growth and survival throughout the summer, not exceeding an MMWAT of 66°F (19°C), for all 23 miles of the McCloud River from McCloud Dam to Shasta Lake (Reclamation 2014). Upstream from McCloud Reservoir, considerable coldwater spring inflows maintain relatively cold and consistent water temperatures (Figure 4-6).

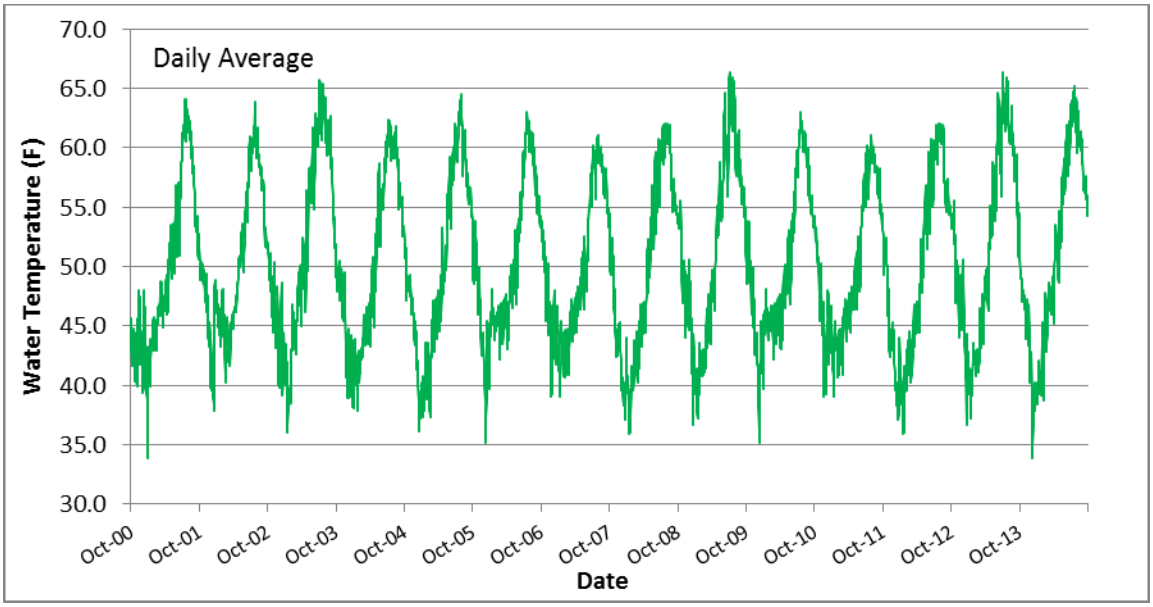


Figure 4-4. Average Daily Water Temperature Record for Water Years 2000 to 2014 at the U.S. Geological Survey Stream Gage Above Shasta Lake on the McCloud River (USGS Gage No. 1136800)

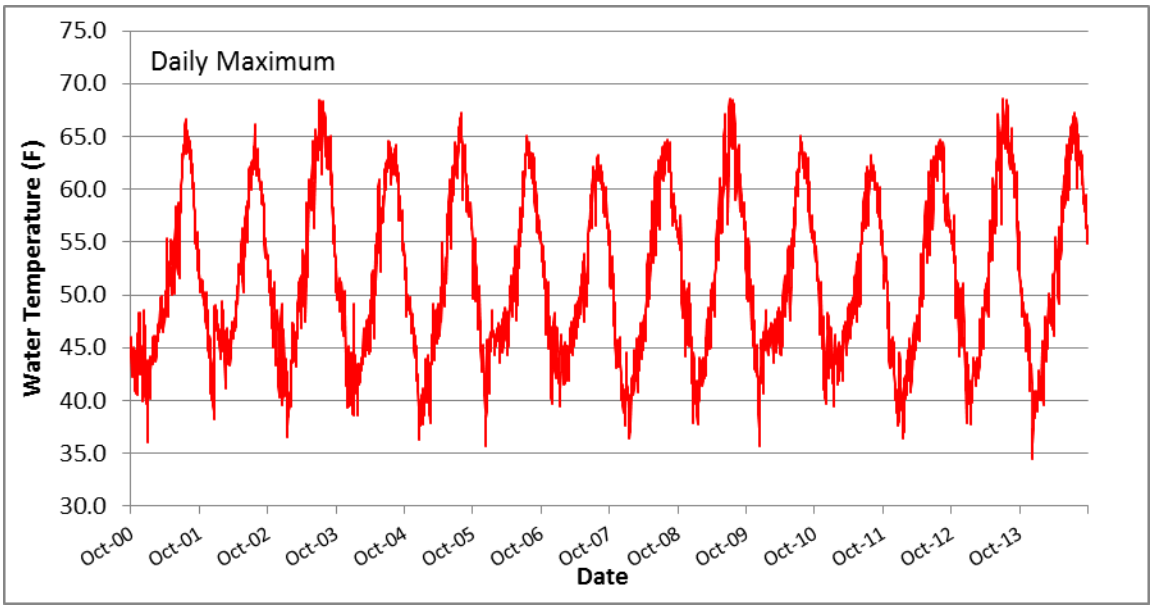
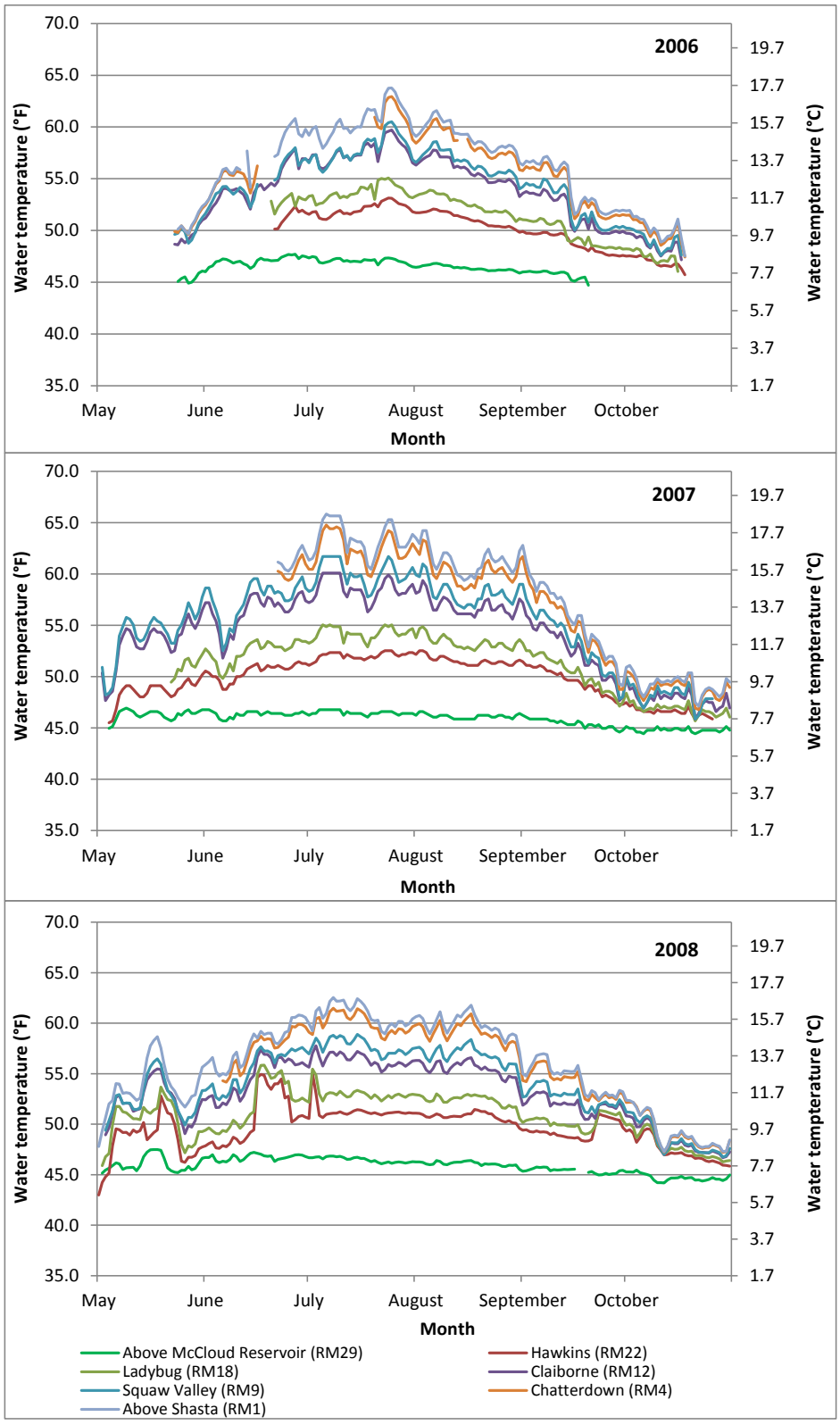


Figure 4-5. Daily Maximum Water Temperature Record for Water Years 2000 to 2014 at the U.S. Geological Survey Stream Gage Above Shasta Lake on the McCloud River (USGS Gage No. 1136800)



Source: PG&E 2008, PG&E, unpublished data.

Figure 4-6. Average Daily Water Temperature Along the McCloud River from Above McCloud Reservoir (RM 29) to above Shasta Lake (RM 1)

Environmental Consequences

No Action Alternative

There would be no implementation of the Pilot Program under the No Action alternative; therefore, there would be no effects on water quality.

Action Alternatives

Alternative 1 – Introduction to Sacramento River and McCloud River Separately Pilot Program recolonization experiments would require the transport of Chinook Salmon of various life stages to various release sites along the Upper Sacramento and McCloud rivers. Stocking these salmon would involve the discharge of water from transport tanks when the fish are released. Fish culture handling practices would be similar to those already used by CDFW for stocking trout in both rivers, which typically involves withholding feed for 24 to 48 hours, in advance of transport, to reduce fecal production and ammonia production by the fish. These procedures and the use of clean, cold water reduce stress on transported fish.

Despite these measures, stocking operations have the potential to affect receiving water quality in the short-term as a result of discharge of differing constituents and chemistry of the water from the hatchery used to transport fish to the release locations. However, the potential effects of Pilot Program reintroduction releases are considered to be short-term and minimal based on the negligible volumes of the anticipated transport water to be used (e.g., less than or equal to 1,000 gallons, depending on the life stage and number of fish transported) compared with the volume and available dilution provided in the rivers at release sites. Additionally, because the releases of salmon would be intermittent and dispersed throughout the study areas on the rivers during each year of the Pilot Program studies and the amount of transport water released each time would be small, the potential short-term water quality effects would be limited to the near-shore mixing zone at the release site, until it is diluted and dispersed, and therefore, would not cause substantial adverse effects on any of the designated beneficial uses of the Upper Sacramento or McCloud rivers.

Releases of adult Chinook Salmon as part of Pilot Program recolonization experiments would result in the eventual death of these fish as part of the natural spawning cycle. It is expected that the decay of spawned salmon carcasses would release and enrich nutrient constituents of the rivers and possibly contaminants (e.g., polychlorinated biphenyls [PCB]) assimilated by the fish during their ocean life phase. The release of nutrients and chemicals to rivers from salmon carcasses could locally increase total loads of these constituents in the river; but, because of the small number of adult salmon proposed to be used in the Pilot Program, no adverse effects of salmon carcass-enriched nutrient levels on beneficial uses would be expected. Moreover, the reintroduction of anadromous salmonids and the return of marine-derived nutrients to the Upper Sacramento and McCloud rivers are anticipated to begin to restore nutrient cycling processes that are part of the natural phenomenon of the salmon life cycle that historically occurred and supported a productive and diverse ecosystem in these upper Sacramento River Basin watersheds.

Installation and operation of egg incubation equipment, traps, and monitoring activities have the potential to disturb and re-suspend streambed sediments causing localized and short-term turbidity and redistribution of sediments in the Upper Sacramento and McCloud rivers. The

potential release of suspended sediment to surface receiving water bodies is a concern for aquatic life if concentrations rise to a level that affects an organism's ability to sight-feed and obtain oxygen, or causes abrasion to tissues such as the gills of fish or macroinvertebrates. Recreation and general aesthetic appeal of water bodies can be impaired by reduced water clarity, particularly those waters where background concentrations of suspended solids, including sediment, and turbidity are low, resulting in high water visibility. Suspended mineral-based sediment, if present at sufficient levels, could increase the rate of stream sedimentation allowing particles to deposit. Sedimentation can adversely affect fish spawning gravels and can block or clog agricultural/municipal water intake pipes.

Any increase in suspended sediment would be temporary and would return to background levels following each disturbance. Further, any material disturbed would not be of sufficient magnitude to result in water quality related impacts.

Installation of the temporary fish collection structures and fish collection and release activities are not anticipated to significantly alter hydrodynamics in the river channel or head of reservoir given the anticipated flows over which monitoring could occur. While increases in turbidity may occur during installation of the structures; these impacts are anticipated to be minor and would be temporary in nature and would not result in impacts to water quality in the Upper Sacramento and McCloud River watersheds.

Alternative 2 – Introduction to Sacramento River and McCloud River Concurrently
Effects related to water quality under Alternative 2 would be minimal and similar to those under Alternative 1.

Hazardous Materials (Including Petroleum Products)

Affected Environment

Shasta Lake

As stated above (see Water Quality section) Shasta Lake generally meets the standards for beneficial uses identified in the Basin Plan (CVRWQCB 2011).

Shasta Lake supports a high level of motorized boating, and accompanying fuel use and storage provides some risk of release of petroleum products to the environment. The Regional Water Quality Control Board prohibits discharge of oil or other petroleum product to the waters of the State, except in accordance with waste discharge requirements or other provisions of Division 7, California Water Code (CVRWQCB 2011). As a result, substandard underground storage tanks statewide have been upgraded to reduce potential for contamination from leak and spills, and most floating gas tanks are now double-walled and are monitored by the Regional Water Quality Control Board (USFS 2010).

Upper Sacramento River

The Upper Sacramento River in the study area is relatively undisturbed, with no indications of recent hazardous contaminations; however, I-5, Union Pacific Railroad line, and several major surface routes are used for the transportation of hazardous material throughout the region (Reclamation 2013).

McCloud River

The McCloud River in the study area is relatively undisturbed, with no indications of hazardous contaminations. No major hazardous contaminant spills have been documented in the McCloud River portion of the study area.

Environmental Consequences

No Action Alternative

Under the No Action Alternative, there would be no implementation of Pilot Program; therefore no additional driving for fish transport or monitoring would be necessary. No change in hazardous material use would occur as compared to existing conditions.

Action Alternatives

Alternative 1 – Introduction to Sacramento River and McCloud River Separately No large quantities of hazardous materials would be used or transported in conjunction with Alternative 1. There is potential for very small amounts of fuel or lubricant leakage related to vehicle use during fish release, collection, or monitoring, but this would be minimized by implementation of BMPs. BMPs would include regular vehicle inspections and maintenance of vehicles (trucks, boats, helicopters) to avoid motor oil or other vehicle fluid drips and leaks. Utilization of maintained roads and minimization of off-road driving would decrease the potential for a fuel release to the environment. Additionally, during construction within the 100-year or more frequent flood plain, staff and contractors would implement the following BMPs:

- Use containment facilities, booms, and an environmental inspection program;
- Prevent any significant release of hazardous materials from harming the aquatic environment;
- Store all equipment above the 100-year flood level;
- Steam clean equipment used in contact with a water course prior to use and use soy-based hydraulic fluid when possible; and
- Report any release immediately to the Central Valley Water Board and CDFW.

Hazardous material effects from fish release are expected to be minimal and similar in both the Upper Sacramento and McCloud rivers.

Alternative 2 – Introduction to Sacramento River and McCloud River Concurrently
Effects related to hazardous material under Alternative 2 would be minimal and similar to those under Alternative 1.

Fisheries and Aquatic Species

Affected Environment

Shasta Lake

Shasta Lake supports popular coldwater and warmwater fisheries consisting of a combination of native and non-native species, which are dominated by introduced warmwater and coldwater species (Weidlein 1971; Reclamation 2013). Warmwater species, such as largemouth bass (*Micropterus salmoides*), smallmouth bass (*M. dolomieui*), spotted bass (*M. punctulatus*), and other sunfishes (*Lepomis* spp. and *Pomoxis* spp.), were introduced into Shasta Lake and have become well established, with naturally sustaining populations. Spotted bass are currently the dominant warmwater species in Shasta Lake (Reclamation 2013), providing outstanding recreational fishing opportunities year round. The warmwater fish habitats of Shasta Lake occupy two ecological zones: the littoral (shoreline/rocky/vegetated) and the pelagic (open water) zones. The littoral zone lies along the reservoir shoreline down to the maximum depth of light penetration on the reservoir bottom and supports populations of native and non-native warmwater fishes.

Shasta Lake and its tributaries also provide very productive habitats for coldwater fish species, which typically prefer or require temperatures cooler than 70 °F. During the cooler months, coldwater species, such as rainbow trout (*Oncorhynchus mykiss*) and brown trout (*Salmo trutta*), may be found rearing throughout the lake; however, these species do not spawn in the lake, preferring to spawn in tributary streams. During the summer months, these coldwater species may be found rearing in association with the cold, deep hypolimnion and metalimnion layers within the reservoir, although the fish may make frequent forays into the epilimnion to feed on small prey fish and return to cooler depths to digest their prey (Finnell and Reed 1969, Koski and Johnson 2002, Moyle 2002, Quinn 2005). Trout may also congregate near the mouths of the reservoir's tributaries, including the Upper Sacramento River, McCloud River, Pit River, and Squaw Creek, at various times of the year seeking thermal refuge, foraging, and spawning, when conditions are favorable for these species. Other native species such as white sturgeon (*Acipenser transmontanus*), hardhead (*Mylopharodon conocephalus*), riffle sculpin (*Cottus gulosus*), prickly sculpin (*Cottus asper*), Sacramento sucker (*Catostomus occidentalis*), and Sacramento pikeminnow (*Ptychocheilus grandis*) tend to reside in cooler water strata in the reservoir and in and near tributary inflows (Moyle 2002).

Hatchery- and pen-reared trout are stocked in Shasta Lake several times each year to support the sport fishery. About 60,000 pounds of juvenile rainbow trout are planted annually, which have been part of a put-grow-and-take coldwater fishery for many years. Chinook Salmon are stocked as part of this sport fishery, with triploid fall-run Chinook Salmon used for stocking since fall 2014[4] (Baumgartner 2014).

Special-status aquatic species potentially occurring in the study area, including Shasta Lake, are listed in Table 4-3. These include animals (fish, amphibians, reptiles, and invertebrates) that are legally protected or are otherwise considered sensitive by Federal, State, or local resource

[4] CDFW temporarily suspended stocking Chinook Salmon for the sport fishery in 2010 during evaluation of state-wide fish stocking programs, then resumed the practice, using triploid fall-run Chinook Salmon to eliminate potential influence on downstream anadromous populations, in the fall of 2014 (M. Currier, CDFW, personnel communication, 2015).

conservation agencies and organizations, and fish species of primary management concern (recreationally and/or commercially important species). The presence, abundance and distribution of these species vary within the reservoir temporally and spatially depending on species' life histories, and climactic and hydrologic conditions.

Table 4-3. Special-Status Aquatic Species Potentially Occurring in the Study Area

Species				Status [1]			Habitat
	Sacto. River	McCloud River	Shasta Lake	USFWS/ NMFS	CDFW	USFS	
Hardhead *Mylopharodon conocephalus*	●	●	●		SSC	S	Spawning occurs in pools and side pools of rivers and creeks; juveniles rear in pools of rivers and creeks, and willow to deeper water of lakes and reservoirs.
Rough sculpin *Cottus asperrimus*			●		T/FP		Prefers sand or gravel substrate in cool streams or reservoirs. Spawns in streams.
Rainbow trout *Oncorhynchus mykiss*	●	●	●				Requires cold, freshwater streams with suitable gravel for spawning; rears in seasonally inundated floodplains, rivers, tributaries.
Redband trout *Oncorhynchus mykiss stonei*		●			SSC	S	Requires cold, freshwater streams with suitable gravel for spawning; rears in seasonally inundated floodplains, rivers, tributaries. Occurs in headwater tributaries of the upper McCloud River.
Bull trout *Salvelinus confluentus*		●		T	E		Requires cold, freshwater streams with suitable gravel for spawning; rears in seasonally inundated floodplains, rivers, tributaries.

Species				Status [1]			Habitat
	Sacto. River	McCloud River	Shasta Lake	USFWS/ NMFS	CDFW	USFS	
Tailed frog *Ascaphus truei*	●	●			SSC		Requires perennial freshwater streams.
Foothill yellow-legged frog *Rana boylii*	●	●			SSC	S	Requires aquatic habitat for breeding; also uses a variety of other habitat types including riparian and upland areas.
Northwestern pond turtle *Actinemys marmorata marmorata*	●	●	●		SSC	S	Potentially occurring in stream or other wetland habitats. Adjacent upland habitats are potential nesting areas.
California floater *Anodonta californiensis*	●	●	●			S	Potentially occurring in willow areas of clean, clear ponds, lakes and rivers with silty substrate
Nugget pebblesnail *Fluminicola seminalis*	●	●				S/M	Potentially occurring in mixed conifer and conifer/woodland habitats (seeps, springs, and/or riverine habitats)
Potem pebblesnail *Fluminicola* sp.	●	●				M	Potentially occurring in mixed conifer and conifer/woodland habitats (seeps, springs, and/or riverine habitats)
Flat-top pebblesnail *Fluminicola* sp.	●	●				M	Potentially occurring in mixed conifer and conifer/woodland habitats (seeps, springs, and/or riverine habitats)
Shasta pebblesnail *Fluminicola* sp.	●	●				M	Potentially occurring in mixed conifer and conifer/woodland habitats (seeps, springs, and/or riverine habitats)

Species				Status [1]			Habitat
	Sacto. River	McCloud River	Shasta Lake	USFWS/ NMFS	CDFW	USFS	
Disjunct pebblesnail *Fluminicola* sp.	●	●				M	Potentially occurring in mixed conifer and conifer/woodland habitats (seeps, springs, and/or riverine habitats)
Globular pebblesnail *Fluminicola* sp.	●	●				M	Potentially occurring in mixed conifer and conifer/woodland habitats (seeps, springs, and/or riverine habitats)
Scalloped juga *Juga (Calibasis) occata*	●	●				S	Potentially occurring in mixed conifer and conifer/woodland habitats (seeps, springs, and/or riverine habitats)
Kneecap lanx (limpet) *Lanx patelloides*	●	●				S	Prefers fast, cold, well-oxygenated water in cobble and boulder substrates.
Montane peaclam *Pisidium (Cyclocalyx) ultramontanum*	●	●				S	Potentially occurring in mixed conifer and conifer/woodland habitats (seeps, springs, and/or riverine or lentic habitats).
Canary duskysnail *Lyogyrus* sp.	●	●				M	Potentially occurring in mixed conifer and conifer/woodland habitats (seeps, springs, and/or riverine habitats)
Knobby rams-horn *Vorticefex* sp.	●	●				M	Potentially occurring in mixed conifer and conifer/woodland habitats (seeps, springs, and/or riverine habitats)

Sources: PG&E 2011; Reclamation 2013; Reclamation 2014b.

Notes:

[1] Legal Status Definitions

Federal Listing Categories (USFWS & NMFS)
- E Endangered (legally protected)
- T Threatened (legally protected)

State Listing Categories (CDFW)
- E Endangered (legally protected)
- SSC Species of Special Concern
- T Threatened (legally protected)
- FP Fully Protected

U.S. Forest Service (USFS)
- M Survey and Manage
- S Sensitive

Key:
CDFW = California Department of Fish and Wildlife
NMFS = National Marine Fisheries Service
Sacto. = Sacramento
USFS = U.S. Forest Service
USFWS = U.S. Fish and Wildlife Service

Upper Sacramento River

The lower reaches of the tributaries draining to the reservoir provide spawning habitat for adfluvial fishes (i.e., fish that spawn in streams, but rear and grow to maturity in lakes) residing in Shasta Lake, as well as stream-resident fishes. Rainbow trout is the primary game species (Reclamation 2013). Historically, the fish population of what is now considered the Upper Sacramento River included a range of native resident fishes, several large seasonal runs of anadromous salmonids (i.e., salmon and steelhead (*Oncorhynchus* spp.)), and migratory populations of sturgeon (*Acipenser* spp.). However, anadromous fishes have been blocked from access to the Upper Sacramento River since the completion of Shasta Dam in 1943, and sturgeon are limited to a small resident white sturgeon population in Shasta Lake. The current fish assemblage in the watershed is composed primarily of native, introduced, and regularly stocked resident coldwater and warmwater fishes (NSR 2010).

The Upper Sacramento River is a highly productive, coldwater, freestone mountain stream for most of its length. This quality is due in part to the cold, nutrient-rich, and well oxygenated water emanating from Lake Siskiyou and numerous tributary streams and springs downstream from Box Canyon Dam (CDFG 2000). Riverine habitat types are variable and representative for a stream of this type, and include pools, runs, riffles, cascades, and pocket-water. The relative abundance of habitat types, habitat dimensions, and environmental conditions vary along the length of the river (Thomas R. Payne and Associates 2005, NSR 2010, Reclamation 2014). The upper river is generally swifter and of steeper gradient, with longer riffles and shorter, shallower pools than the lower river. These differences in river characteristics result in variation in relative species abundance, productivity, and biomass along the length of the river (CDFG 2000).

The Upper Sacramento River provides suitable habitat for Federal and State special-status aquatic species (Table 4-3). State special-status amphibians and reptiles (i.e., foothill yellow-legged frog and Northwestern pond turtle) have been identified throughout the watershed (NSR 2010). Several species of hydrobiid "spring snails" are known to inhabit the upper reaches of the Sacramento River upstream from Shasta Lake in spring complexes and associated headwater areas. These snails require clear, cold water streams with cobble-gravel beds and tend to be associated with submergent vegetation.

The Sacramento River is renowned for its high-quality recreational trout fishery (Dean 2000). Native rainbow trout are the dominant salmonid species in the Upper Sacramento River, comprising approximately 99 percent of the wild trout population; introduced brown trout make up the remainder (Thomas R. Payne and Associates 2005, Weaver and Mehalick 2008). Other native fish species present include hardhead, Sacramento pikeminnow, California roach

(*Hesperolecus symmetricus*), riffle sculpin, Sacramento sucker, and speckled dace (*Rhinichthys osculus*) (Weaver and Mehalick 2008).

Non-native species such as smallmouth bass, spotted bass, and channel catfish (*Ictalurus punctatus*) are also found in the Upper Sacramento River, primarily in the lower reaches near the delta gauge. Along the length of the Upper Sacramento River, species distribution varies, with upstream areas inhabited almost exclusively by trout and sculpin. Other fish species increase in abundance downstream, making up approximately 45 percent of the fish population near the mouth of Dog Creek. Smallmouth and spotted bass, channel catfish, speckled dace, and California roach inhabit the quieter areas of the lower river (Thomas R. Payne and Associates 2005, NSR 2010, Reclamation 2014). As recently as 2008, fishery surveys in the Upper Sacramento River documented non-native warmwater species occurring immediately upstream from Dog Creek, but they were not observed at any upstream survey sites where the fish communities were comprised of native fishes (i.e., trout, sculpin, Sacramento sucker and Sacramento pikeminnow) (Weaver and Mehalick 2008).

CDFW manages the fishery resources in the Upper Sacramento River under the goals and objectives specified in the Fishery Management Plan for the Upper Sacramento River (CDFG 2000). This management plan identifies resource management practices, fish population characteristics, fish management and harvest criteria, and habitat protection objectives for monitoring and managing the river to insure the fishery and its associated benefits are maximized for the public. The general fishery management plan goals are to maintain a diversity of angling opportunities in the Upper Sacramento River; maintain quality trout habitat; maintain a trout monitoring plan; and insure an adequate number of angler access points (CDFG 2000). To meet the objectives of this plan and provide desired angling opportunities for a range of anglers while maintaining a healthy wild trout population, CDFW uses several distinct fishery management zones, providing each zone with its own angling regulations. These zones would not be affected or changed.

McCloud River

Similar to the Sacramento River, the McCloud River provides spawning habitat for adfluvial fishes residing in Shasta Lake, as well as stream-resident fishes. The current fish assemblage in the McCloud River is composed primarily of native and non-native coldwater fishes, including rainbow and brown trout, which support important recreational fisheries. A combination of non-salmonid native fishes and introduced warmwater fish species (specifically, smallmouth and spotted bass) regularly occur lower in the McCloud River close to Shasta Lake (Reclamation 2003 and 2013, PG&E 2011). The McCloud River is historically reported to have been the location of the southernmost and only bull trout (*Salvelinus confluentus*) population in the State of California until it was thought to have been extirpated in 1975 (PG&E 2011). The river also historically supported Chinook Salmon and steelhead before completion of Shasta Dam in 1943 (Rode and Dean 2004, PG&E 2011, Reclamation 2013).

Federal and State special-status aquatic species are known to inhabit the McCloud River (Table 4-3). Rainbow trout are abundant and widely distributed in the McCloud River. Hardhead minnow, a State species of concern and USFS sensitive species, is known to inhabit the mainstem of the McCloud River, although it has not been documented in recent surveys (PG&E 2007, Reclamation 2013). McCloud River redband trout (*Oncorhynchus mykiss stonei*), also a State species of concern and USFS sensitive species, predominantly occur in headwater

tributaries to the upper McCloud River, upstream from McCloud Reservoir. Bull trout, were last confirmed in the McCloud River in 1975, but are currently considered to be extinct in California (Rode and Dean 2004). Surveys for special-status amphibians and reptiles (i.e., foothill yellow-legged frog and Northwestern pond turtle) have recently documented both species in the McCloud River (PG&E 2009b). Similar to the Sacramento River, several species of hydrobiid "spring snails" are known to inhabit the upper reaches of the McCloud River upstream from Shasta Lake in spring complexes and associated headwater areas (Reclamation 2013). Recent surveys for special-status mollusks in the McCloud River documented the USFS sensitive aquatic nugget pebblesnail, *Fluminicola seminalis*, in the McCloud River at the confluence of Chatterdown Creek (PG&E 2008).

Groundwater springs provide a continuous and abundant source of cold water to the upper McCloud River, above McCloud Dam. Flow in the McCloud River is regulated by releases from McCloud Dam, but receives significant inflow in the form of groundwater discharge from springs and runoff from tributaries; both contribute to a water temperature regime that supports year round coldwater fish habitat throughout much of the length of the lower river (PG&E 2011). This cold water supports a viable trout fishery throughout the entire 24-mile-long reach of the McCloud River. The lower reaches of the McCloud River also support a native fish community characterized as the Sacramento sucker/pikeminnow assemblage just above Shasta Lake (Moyle 2002); these species are typically associated with foothill elevations and transitional zone water temperatures and probably enter the lower river from Shasta Lake (PG&E 2011, Reclamation 2003 and 2013).

The McCloud River hydrograph indicates a relatively stable base-flow regime, with little annual variance outside of natural high flow events driven by snow melt or prolonged, moderately intense rainfall (PG&E 2011). The McCloud River is a mixed bedrock-alluvial channel, with high transport capacity relative to sediment supply and generally low volumes of active sediment storage. Channel reach morphology in the McCloud River broadly transitions from one that is predominantly step-pool upstream from Ah-Di-Na Campground to an alternating plane-bed and pool-riffle channel downstream from Ah-Di-Na, reflecting an overall decrease in channel slope and confinement and an increase in mobile sediment supply (PG&E 2011).

The McCloud River is renowned for its high-quality, recreational trout fishery. The McCloud River's exceptional trout fishery was evident and became widely known as early as 1879, when Livingston Stone established the first rainbow trout egg-taking station in California (Rode and Dean 2004). The McCloud River supports one of the premiere wild trout fisheries in California. During the past decades, catch rates have been consistently high (greater than 1 trout/hour). The average size of both creeled and released trout has remained large and, a significant portion of the catch has consisted of trophy-sized trout (approximately 14 inches) (Rode and Dean 2004). The quality of the wild trout fishery has been maintained even though trout growth is lower than in most other northern California streams and fishing pressure has increased over the years (Rode and Dean 2004). Recent fishery surveys identified trout as the numerically dominant fish species throughout the McCloud River, with rainbow and brown trout observed in similar proportions (PG&E 2009a).

Currently, a 7.3 mile portion of the McCloud River is managed by CDFW as a wild trout area (WTA), which includes The Nature Conservancy's McCloud River Preserve.[5] The WTA is not stocked with hatchery fish; however, CDFW continues to stock hatchery-reared rainbow trout in Shasta Lake. It is assumed that a portion of the trout stocked in Shasta Lake migrate upstream into portions of the McCloud River. Monitoring conducted in the 1970s and 1980s at a fish counting weir near Ladybug Creek indicated that brown trout appear highly migratory in comparison to rainbow trout within the McCloud River (CDFG 1994). In addition, CDFW released 127,252 Chinook Salmon in Shasta Lake as part of a mark/recapture study funded by PG&E in 2005-2006 (PG&E 2011). However, no Chinook Salmon were observed as upstream spawning migrants during fall fish surveys on the McCloud River in 2007 (PG&E 2009a), nor has Chinook Salmon spawning been subsequently documented.[6]

Designated wild trout waters are required to have a management plan and angling regulations that emphasize unique values and diversity of opportunity in the geographic area. The CDFW is responsible for the development of the specific management plans and angling regulations. Within the McCloud River, the CDFWs goals for the wild trout management program, which are outlined in their Lower McCloud River WTA Fishery Management Plan (Rode and Dean 2004) are to: 1) protect the aquatic environment, including maintenance or improvement of existing optimal habitat conditions for trout; 2) perpetuate all native aquatic species; 3) prevent or minimize the incursion of undesirable non-game fish into the WTA; 4) maintain a trout population and size structure capable of producing outstanding wild trout angling; 5) maximize the opportunity to catch trophy trout (greater than 14 inches); 6) preserve the natural character of the stream; and 6) provide for recreational use of wild trout while minimizing uses not compatible with wild trout angling (Rode and Dean 2004).

Environmental Consequences

No Action Alternative

There would be no implementation of the Pilot Program under the No Action alternative; therefore, there would be no effects on fish or aquatic species.

Action Alternatives

Alternative 1 – Introduction to Sacramento River and McCloud River Separately The Pilot Program is not expected to result in adverse effects on donor or source populations of Chinook Salmon. First, the Pilot Program would be limited to reintroduction experiments and investigations using Chinook Salmon eggs and juveniles in Years 1 and 2 and adding adults in Years 2 and/or 3. Secondly, all of the salmon used for pilot reintroduction purposes would be obtained from a hatchery source or be the progeny of hatchery sources. Finally, all aspects of the Pilot Program would be integrated with recovery hatchery operations and practices, along with other additional appropriate protocols that may be identified as the Pilot Program progresses (based on reviews and input from agency geneticists, pathologists, and restoration biologists). Therefore, the potential for unintended or undesirable demographic and evolutionary risks and

[5] The McCloud River Preserve includes privately held lands along the McCloud River owned and managed by The Nature Conservancy to protect native fish and habitat. Two and a half miles of the McCloud River are open to catch-and-release fishing; the remainder is managed as a natural area and locale for scientific research.

[6] Few Chinook Salmon stocked in Shasta Lake have ever been observed to spawn in the reservoir tributaries (Reclamation 2013)

consequences (e.g., depletion of source population, homogenized population structure, and/or reduced adaptive fitness) would be low because fish would be sourced from the hatchery propagation program rather than the wild population, and because demographic and genetic homogenization risk is largely avoided with a small number of hatchery-origin fish being released into an area that is unoccupied by a wild population of fish (as would occur in the proposed pilot reintroduction studies).

The Pilot Program has the potential to affect existing fish communities, resident trout populations, and special-status species occurring in the study area through the ecological effects of stocking and reintroduction of anadromous salmon to the Upper Sacramento and McCloud rivers and through investigation and monitoring activities that are proposed as part of the program. The ecological effects could be beneficial or detrimental, or both, and would be primarily mediated through the potential for disease transmission, competition, and predation interactions between stocked salmon and resident fishes. The effects of monitoring activities would consist mostly of non-lethal periodic disturbance of fish by snorkeling surveys and electrofishing within the river reaches and potential live capture and release of fishes at trapping sites in the rivers near their confluences with Shasta Lake.

No significant adverse effects on the fish communities and resident trout populations in study streams are expected as a result of Pilot Program implementation. Monitoring and investigation of ecological interactions with resident fish species are proposed as part of the Pilot Studies, and the numbers and densities of salmon that would be stocked as part of the pilot reintroduction studies are relatively low. The potential for transmission of disease-causing pathogens between the stocked salmon and resident fishes, particularly between resident trout and salmon was investigated by State and Federal fish health specialists in advance of the Pilot Program. Resident trout in the McCloud and Sacramento Rivers were tested for pathogens that could be transmitted by the introduction of anadromous salmon. No indicators of potential for adverse effects were found in the pathogen testing (Foott et.al. 2015).

Experimental reintroduction releases of Chinook Salmon of various life stages in the Upper Sacramento and McCloud rivers as part of the Pilot Program is expected to involve low risk of adverse impacts to existing fish communities, resident trout populations, and special-status aquatic species because of the relatively low numbers of fish to be authorized and used in the various studies and the minimal disturbance to the surrounding habitat. The spawning capacities for both the Upper Sacramento and the McCloud rivers are shown in Table 4-4.

Juvenile salmon densities near stocking sites could be temporarily higher than typical trout population densities in the study rivers,[7] resulting in a potential for competition, until the juvenile salmon disperse after release. However, multiple release sites can be used to release fish within suitable habitats, via helicopter if needed, and releases of experimental fish would likely occur over several weeks or months, which would disperse and reduce initial densities of experimentally reintroduced salmon. Additionally, monitoring of juvenile salmon and resident fish behavior, distribution, and size and growth following release would be used to provide information to inform and refine reintroduction release strategies to reduce documented adverse reactions of resident fish or responses of introduced salmon over the course of the Pilot Program.

[7] Although some trout density data exist for the upper Sacramento and McCloud rivers, they are not standardized or easily converted for comparison. However, estimated catchable trout densities in the upper Sacramento range from 1,071-21,617 fish per mile and in the McCloud River from 264-2,560, depending on location and year (Weaver and Melachik 2008; PG&E 2009)

Figure 2-1 shows the potential fish release sites. Access roads along the Sacramento River would provide flexible release opportunities. Access to release sites in the McCloud River are more limited, so aerial releases may be needed.

In addition to re-establishing passage to access important habitat for the conservation of anadromous salmonid runs and to assist with recovering imperiled salmon stocks, reintroducing key members of the historic fish fauna to the Upper Sacramento and McCloud rivers would provide a number of other ecosystem benefits. Passage of adult Chinook Salmon, their spawning and egg-laying, and ultimate post-spawning deaths would provide an important additional food source and marine-derived nutrients to these typically nutrient-limited, and, particularly, phosphorus-limited, upper watershed river habitats. Adult salmon carcasses are important food for aquatic and terrestrial invertebrates, fish, herpetofauna, birds, and mammals, including several special-status species. A growing body of evidence shows that salmon-derived nutrients in soil, vegetation, algae, and insects are important to productivity of streams and riparian zones (Stockner and Ashley 2003).

Table 4-4. Historic and Present Estimates of Potential Chinook Salmon Spawner Capacity in Reaches of the Upper Sacramento River and McCloud River, with Summer Water Temperatures Within the Optimal Range for Spawning and Egg Incubation

			Estimated Spawner Capacity (Number of Females)[b]			
River	River Length (miles)	Length of Reach Thermally Optimal (miles)[a]	Historic (Hanson et al. 1940)	6 m^2 Spawning Territory	10 m^2 Spawning Territory	20 m^2 Spawning Territory
Sacramento	37.0	9.0	1,919[a]	224	134	68
McCloud	23.2	11.6	4,360[c]	3,382[d]	2,029[d]	1,014[d]

Notes:
Optimal water temperature conditions for Chinook Salmon egg incubation were considered to be less than or equal to 56.0°F (13.5°C) daily average water temperature
a the length of the rivers with suitable temperatures will vary somewhat from year to year; these estimates are based on available thermographic records for normal to below normal water years and as such represent conservative estimates of thermally-suitable reach lengths.
b based on Reclamation (2014) habitat assessment.
c includes historic spawning area from Flume Creek to Cantara Loop (approx.. 15 mile, or 6 miles in addition to the optimal thermal reach)
d includes historic spawning area from Squaw Valley Creek to McCloud Dam, based on an interpolation of an estimate for the entire historic reach from Squaw Valley Creek to Lower Falls.

Key:
m^2 = square meters.

This species inhabits shallow flowing water in small to moderate-sized streams with some cobble-sized substrate (Jennings and Hayes 1994) in a variety of habitats including valley-foothill hardwood, valley-foothill hardwood-conifer, valley-foothill riparian, ponderosa pine, mixed conifer, coastal scrub, mixed chaparral and wet meadow from sea level to 6,000 feet in elevation (Zeineret al. 1988). The proposed activities include in-river activities under the alternatives and therefore the species would not be present in the action area/s or the surrounding area/s as there is no suitable habitat.

Northwestern pond turtles could be present within the rivers action areas during project activities. Pond turtles can easily move out of the area during the in-river and monitoring activities. Breeding habitat would not be impacted as all activities would be within the river channel and/or shoreline.

Species of hydrobiid "spring snails" require clear, cold water streams with cobble-gravel beds. The proposed activities include in-river activities on both the Upper Sacramento and McCloud rivers, which do not provide suitable habitat for the species as they are known to inhabit the upper reaches of the Sacramento River and McCloud River upstream from Shasta Lake in spring complexes and associated headwater areas.

Activities associated with the Pilot Program would be implemented outside any areas where habitat could be present for the above species during their life stages. In addition, access would be through existing roads and trails that are currently utilized often. Activities would not impact any potential breeding areas for these species and would not impact their foraging areas as all activities would be enclosed within the footprint of the river area and would also be temporary. No staging would occur within upland habitat and there would be no need to remove any vegetation.

Effects of monitoring activities could include some temporary and localized disturbance and resuspension of riverbed sediments during installation of portable egg incubation boxes in locations at the upper ends of the study rivers where egg incubation experiments would be conducted, and during installation of fish collection systems at trap sites in the lower reaches of the study rivers and at the head of Shasta Lake. Installation of each of these types of monitoring equipment would be performed using mostly hand-tools, truck-mounted cranes, boat, and perhaps helicopter sling load. Activities would not result in more than localized and transient increases in turbidity around work sites. No removal or discharge of fill or sediment to the study rivers is anticipated from these activities. As a result, turbidity would not be expected to rise to levels that could cause adverse effects on aquatic life in the vicinity of the proposed activities, i.e., turbidity is not expected to exceed water quality objectives identified in the Basin Plan (CVRWQCB 2011, Table 4-2).

Snorkeling and electrofishing surveys and use of fish collection traps are non-lethal sampling methods that would be used to monitor salmon and resident fishes for behavior, distribution, migration patterns, and size and growth studies. Standard procedures for these surveys would be used, and all current NMFS guidelines for electrofishing in waters containing ESA-listed anadromous salmonids would be followed to minimize injury to fish and avoid adverse effects to experimental salmon and resident fishes. Radio and acoustic fish telemetry surveys would occur from land, air, and water. On-water telemetry surveys could be conducted using rafts in the river channels and powerboats on Shasta Lake. In either case, all Federal, State, and local boating operation and navigational regulations would be followed and would not be expected to cause adverse effects to aquatic resources.

Because of the relatively large numbers of fish needed to obtain the desired high levels of statistical precision required, periodic collection efficiency testing of fish traps may require the use of Chinook Salmon stocks other than the ESA-listed winter-run, if the number of hatchery-reared winter run available for Pilot Reintroduction studies are limited. In such instances, juvenile fall-run or late-fall run Chinook Salmon from Federal- or State-operated hatcheries that typically supply salmon for the inland reservoir fisheries stocking program within the region

(including Shasta Lake) would be used. All salmon raised for stocking as part of the State's inland fisheries program are induced chromosomal triploids[8] and are screened and culled for transmittable diseases prior to stocking in State reservoirs[9]. Additionally, triploid juvenile salmon used for trap collection efficiency testing as part of these Pilot Studies would be differentially marked to identify them as hatchery-origin, experimental fish.

Because marked fish releases for these tests would be confined to the vicinity of the fish collection traps, a high proportion of marked trap efficiency test fish would be recaptured or would pass downstream into Shasta Lake. Marked efficiency fish recaptured in the traps would be transported and released in Shasta Lake at Hirz Bay boat launch on the McCloud River Arm to contribute to the reservoir salmon sport fishery. Use of juvenile triploid salmon for this purpose will be integrated with the inland sport fishery stocking program; therefore, it is not anticipated to significantly affect reservoir fisheries. Additionally, localized use of juvenile triploid salmon in the vicinity of the fish collection traps near the head of Shasta Lake, with a majority of fish recaptured and passing into the reservoir would not be expected to significantly affect the river fishery. No adverse impacts to special-status fisheries or aquatic species would be expected to occur from the Pilot Program activities.

Alternative 2 – Introduction to Sacramento River and McCloud River Concurrently
Under Alternative 2, effects to fish and aquatic species would be similar to those under Alternative 1.

Wildlife

Affected Environment

The study area is primarily undeveloped, forestland, which supports a variety of upland and riparian wildlife species. See the following sections for descriptions of species by river.

Table 4-5 lists sensitive wildlife species identified by the California Natural Diversity Database (CNDDB) as occurring within 100 feet of the study area. None of these species are currently Federally- or State-listed. The bald eagle (*Haliaeetus leucocephalus*) (delisted) is protected under the Federal Bald and Golden Eagle Protection Act.

A query of the USFWS website identified Federal endangered and threatened species with potential to occur in USGS quadrangles intersecting the study area. Of the species listed, valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*), northern spotted owl (*Strix occidentalis caurina*), western yellow-billed cuckoo (*Coccyzus americanus occidentalis*), and fisher (*Martes pennanti*) are upland species that frequently occur in riparian areas. Only the fisher, a Federal candidate, has been documented in the habitat surrounding the area of the proposed activities (Table 4-5). Critical Habitat for spotted owl occurs along the McCloud

[8] Triploidy induction is a safe and approved fish culture technique used to create reproductively sterile fish with high growth potential. The State of California has adopted this technique as part of its inland sport fisheries program for all salmon used to stock State reservoirs that discharge to anadromous salmon-bearing streams to prevent unintended effects on genetic structures of downstream anadromous salmon populations.

[9] A description of CDFW's inland sport fishery reservoir salmon stocking program can be found in ICF Jones & Stokes. 2010. Hatchery and Stocking Program Environmental Impact Report/Environmental Impact Statement. Final. January 2010. SCH #2008082025. Sacramento, CA. Prepared for the California Department of Fish and Game and U.S. Fish and Wildlife Service, Sacramento, CA.

River, including areas proposed for fish collection and release. The activities proposed are not known to cause effects to spotted owls or their critical habitat.

Table 4-5. Species Potentially Occurring in the Study Area

Common Name	Scientific Name	Federal Status	State Status	U.S. Forest Service Sensitive Species
American peregrine falcon	*Falco peregrinus anatum*	Delisted	Delisted	
bald eagle	*Haliaeetus leucocephalus*	Delisted	Endangered	x
bank swallow	*Riparia riparia*	None	Threatened	
black swift	*Cypseloides niger*	None	None	
California wolverine	*Gulo gulo*	None	Threatened	x
fisher - West Coast DPS	*Pekania pennanti*	Candidate	Candidate Threatened	x
Osprey	*Pandion haliaetus*	None	None	
western mastiff bat	*Eumops perotis californicus*	None	None	

Sources: CNDDB 2016 (updated January 2016), USFS 2016

Shasta Lake

Shasta Lake and its margins provide habitat and food sources for a number of wildlife species. Notably, Shasta Lake supports an active bald eagle population. Twenty-five pairs of resident eagles were documented at Shasta Lake in 2012 (USFS 2012). At that time, the USFS Shasta and Trinity Units supported at least 38 pairs of resident eagles, which was estimated to make up nearly 20 percent of nesting bald eagles in California (USFS 2012). Bald eagle reproduction generally occurs between late December and early March in the study area (USFWS 2012).

Upper Sacramento River

According to the Sacramento River Watershed Program (2014), 75 mammal species occur along the Upper Sacramento River, including 17 species of bat. Common species include river otter (*Lutra canadensis*), bald eagle, osprey (*Pandion haliaetus*), and great blue heron (*Ardea herodias*).

Sensitive species identified near the Sacramento River portion of the study area include American peregrine falcon (*Falco peregrinum anatum*), bank swallow (*Riparia riparia*), black swift (*Cypseloides niger*) fisher, California wolverine (*Gulo gulo*), osprey, and western mastiff bat (*Eumops perotis californicus*) (CNDDB 2014).

McCloud River

The Sacramento River Watershed Program (2014) reports that approximately 217 wildlife species use habitat in the McCloud River watershed, including 132 birds, 55 mammals, 19 reptiles, and 11 amphibians. Forest species include black bear (*Ursus americanus*), mountain lion (*Puma concolor*), wolverine, ringtail cat (*Bassariscus astutus*), and gray fox (*Urocyon cinereoargenteus*). River otters can be found in pools adjacent to riparian areas (Sacramento River Watershed Program 2014).

Sensitive species in the vicinity of the McCloud River are expected to be similar to those found in the Sacramento River portion of the study area. Bald eagle and fisher occurrences are mapped near collection and release sites (CNDDB 2014).

Environmental Consequences

No Action Alternative

Under the No Action alternative, the Pilot Program would not be implemented; therefore, there would be no environmental effects on wildlife species.

Action Alternatives

Alternative 1 – Introduction to Sacramento River and McCloud River Separately Fish introduction into either the Sacramento or McCloud rivers could increase prey base to wildlife in the vicinity that feed on salmonids. The number of fish introduced would be negligible relative to the existing population of fish in these rivers, but, as opposed to existing migratory salmonids in the Study Area, introduced fish are expected to spawn and die instream, leaving carcasses that may be more available to scavengers such as black bear and bald eagle for brief periods of the year. Overall, however, the increase in prey is expected to be unsubstantial and would not increase wildlife frequency or pattern of use in the study area.

Bald eagles are sensitive to human disturbance during nesting season, and nest abandonment can occur due to noise or other disturbance. USFWS (2007) recommends a 330 foot buffer between active eagle nests and motorized boats. Motorized boat use could occur in Shasta Lake in conjunction with Pilot Program activities, but work would adhere with USFS guidance, including maintaining a buffer of 330 feet from active nests. Additionally, noise levels would be minimal in the context of noise from recreational boat use under existing conditions. Helicopters are recommended to keep a distance of 1,000 feet from bald eagle nests during the breeding season (USFWS 2007). In the study area, helicopters could be used for telemetry reconnaissance and redd surveys. There is potential for helicopter surveys to overlap the nesting period. Before any surveys, coordination would occur with USFS to identify location of active bald eagle nests and migratory bird nests. Vegetation removal would not be required under the proposed activities and work would comply with all Federal, State, and local regulations, including guidelines related to the Migratory Bird Treaty Act, Bald and Golden Eagle Protection Act, and USFWS National Bald Eagle Management Guidelines (USFWS 2007).

Additional vehicle travel related to Pilot Program activities could increase the potential for vehicular strikes of wildlife; however, most driving would occur on established, moderately to

heavily trafficked roads, and the increase wildlife mortality is expected to be minimal, particularly in the context of existing conditions.

Overall, Alternative 1 would have no adverse effects on wildlife.

Alternative 2 – Introduction to Sacramento River and McCloud River Concurrently
Effects under Alternative 2 are expected to be similar to those under Alternative 1. Introduction to both rivers simultaneously could marginally increase noise and traffic in the area, but these effects are expected to be minimal in the context of existing conditions.

Botanical Resources

Affected Environment

Ponderosa pine forest (*Pinus ponderosa*) is the dominant habitat type in both the Sacramento and McCloud arms of Shasta Lake. Other common habitats include montane hardwood-conifer, montane hardwood, and mixed chaparral (more common in the Sacramento Arm) (Reclamation 2013). Conifer species within these habitats may include Douglas-fir (*Pseudotsuga menziesii*), ponderosa pine, sugar pine (*Pinus lambertiana*), incense cedar (*Calocedrus decurrens*), and white fir (*Abies concolor*), and occasionally knobcone pine (*Pinus attenuate*); hardwoods include canyon live oak (*Quercus chrysolepis*), California black oak (*Quercus kelloggii*), mountain dogwood (*Cornus nuttallii*) and big-leaf maple (*Acer macrophyllum*) (Reclamation 2013, NSR 2010).

Botanical resources on the margins of Shasta Lake would not be affected, and are not discussed here. Botanical resources in riparian areas along the Upper Sacramento and McCloud rivers are similar. Riparian communities in the study area consist of riparian forests and riparian scrub (CTC 2007). Riparian areas along both rivers support a variety of species, including alder, big-leaf maple, vine maple (*Acer circinatum*), willow (*Salix spp.)*, dogwood, California hazelnut (*Corylus cornuta*), thimbleberry (*Rubus parviflorus*), blackcap raspberry (*Rubus leucodermis*), and Pacific yew (*Taxus brevifolia*). The dominant understory species is Indian rhubarb (*Darmera peltata*), which occurs along with rushes (*Juncus* spp.), sedges (*Carex* spp.), and ferns (USFS 2011, Sacramento River Watershed Program 2014).

Invasive plant species, including French broom (*Genista monspessulana*), Scotch broom (*Cytisus scoparius*), yellow starthistle (*Centaurea solstitialis*), Italian thistle (*Carduus pycnocephalus*), bull thistle (*Cirsium vulgare*), sweet pea (*Lathyrus latifolius*), Himalayan blackberry (*Rubus discolor*) and cut-leaved blackberry (*Rubus laciniatus*) occur throughout the study area (Upper Sacramento, McCloud, and Lower Pit Regional Water Management Group 2013). The non-native species black locust (*Robinia pseudoacacia*) was planted in the Ah-Di-Na area around 1900 and has spread downstream. In some areas along the McCloud River, black locust has replaced much of the original riparian vegetation (Upper Sacramento, McCloud, and Lower Pit Regional Water Management Group 2013, Rode and Dean 2004).

Table 4-6 lists sensitive plant species identified by CNDDB as occurring within 100 feet of the study area. USFWS has not identified any Federally-listed plant species with potential to occur in the quadrangles intersecting the study area.

Table 4-6. Sensitive Plant Species Located Within the Surrounding Quadrangles

Common Name	Scientific Name	Sacramento River	McCloud River
Shasta ageratina	*Ageratina shastensis*		x
marbled wild-ginger	*Asarum marmoratum*	x	
seaside bittercress	*Cardamine angulata*	x	
Shasta chaenactis*	*Chaenactis suffrutescens*	x	
northern clarkia*	*Clarkia borealis ssp. borealis*	x	
Oregon fireweed*	*Epilobium oreganum*	x	
Cantelow's lewisia*	*Lewisia cantelovii*	x	
Heckner's lewisia	*Lewisia cotyledon var. heckneri*	x	x
English Peak greenbrier	*Smilax jamesii*		X

Source: CNDDB 2016 Note: * USFS sensitive plant species, as identified in USFS 2016

Environmental Consequences

No Action Alternative

Under the No Action Alternative, the Pilot Program would not be implemented; there would be no effects to Botanical Resources

Action Alternatives

Alternative 1 – Introduction to Sacramento River and McCloud River Separately

Research indicates that riparian vegetation may benefit as salmon populations increase because the salmon carcasses deposit nutrients originating from the ocean (marine-derived nutrients) into upper watershed areas that may be nutrient limited (Naiman et al. 2009). Any potential benefit from marine-derived nutrients during the Pilot Program would be negligible because the number of adult Chinook Salmon transported upstream during the Pilot Program would be low, particularly relative to the linear extent of the study area, so little additional nutrients from decaying carcasses would be available for uptake by riparian vegetation. Additionally, adults would not likely be released until Year 3 of the Pilot Program.

Vehicle access and staging areas for activities under the Pilot Program will be on existing roads and disturbed areas. No vegetation would be removed under the Pilot Program. BMPs would be employed during the Pilot Studies, such as cleaning vehicles, removing seeds from field gear, and decontamination of all field gear. The likelihood of an increase in nonnative or invasive plant species in the study area is expected to be minimal.

Alternative 2 – Introduction to Sacramento River and McCloud River Concurrently
Under Alternative 2, impacts to botanical resources are expected to be minimal in both rivers, as described under Alternative 1.

Aesthetics

Affected Environment

The visual quality of the Upper Sacramento River and McCloud River watersheds, including Shasta Lake, are similar and generally moderate to high within the analysis area, particularly on public lands. Shasta Lake is the central visual attraction of the area (Reclamation 2013). The lake and surrounding areas provide high-quality recreational experiences and visual perceptions to the public. Mid-to-late seral forest is abundant as are limestone outcrops and other geologic features of note. Timber harvesting, mainly on private lands, has occurred and is still occurring in this watershed, which has had an adverse impact on visual quality. Private lands in the area are generally more intensively managed, with more clearcut areas (USFS 2011). The allocation of 28,199 acres to a STNF Late-Successional Reserve continues to minimize the amount of potential timber harvest on public lands and, consequently, maintain scenic values.

As these watersheds are mostly undeveloped, the central visual draw to these rivers for many recreationists is the river environment, which has "unique and outstandingly remarkable features" (USFS 2011). STNF Land and Resource Management Plan (LRMP) describes visual quality objectives (VQO) for each management prescription to enhance scenic quality on the Forest. Additionally, broader scale VQO (e.g., roads and high use areas) are managed to protect the scenery within the foreground (USFS 2011).

Environmental Consequences

No Action Alternative

Under the No Action alternative, the Pilot Program would not be implemented; therefore, there would be no environmental effects related to aesthetics.

Action Alternatives

Alternative 1 – Introduction to Sacramento River and McCloud River Separately
Aesthetic effects from fish introduction are expected to be the same in both the Sacramento and McCloud rivers. The installation of juvenile collection systems could affect the visual resources of the project area. Although these would alter the aesthetics of the immediate vicinity, all structures would be relatively small and would be removed seasonally and after the duration of

the Pilot Program, with no lasting effects. These temporary and minimal effects are expected to be minimal in size and unsubstantial.

Alternative 2 – Introduction to Sacramento River and McCloud River Concurrently
Under Alternative 2, effects on Aesthetic Resources in the study area are expected to be similar to those under Alternative 1 (temporary and minimal).

Air Quality

Affected Environment

The Clean Air Act, which was last amended in 1990, requires the EPA to set National Ambient Air Quality Standards (NAAQS) for criteria pollutants considered harmful to public health and the environment. Areas of the country where air pollution levels persistently exceed the NAAQS may be designated non-attainment.

The study area is located in the Shasta County Air Quality Management District (SCAQMD) within the Northern Sacramento Valley Air Basin (NSVAB), a subarea of the Sacramento Valley Air Basin (SVAB). The entire air basin is currently designated as nonattainment for the State standards for 24-hour and annual Particulate Matter up to 10 micrometers in size (PM10).

Environmental Consequences

No Action Alternative

Under the No Action alternative, the Pilot Program would not be implemented; there would be no environmental effects related to air quality.

Action Alternatives

Alternative 1 – Introduction to Sacramento River and McCloud River Separately
Implementation of the Pilot Program would result in a number of vehicle trips between the hatchery and the upstream release locations on the rivers, and between collection locations and downstream release locations in the lower Sacramento River. Specific logistics, including capture and release locations to be used, would be determined at a later time. Trip mileage for individual segments is summarized in Table 3-1, which provides a range of driving options for each river. Although the upstream releases would require few trips, monitoring would require daily visits that would result in increased vehicular emissions in the study area, and the downstream juvenile releases would require an unknown number of trips. The number of trips under any scenario, however, would be unsubstantial relative to the level of existing traffic in the area (roads are well traveled, particularly I-5). Therefore, relative to current conditions, there would be undetectable impacts to local air quality from increased vehicular use. Miles driven to individual release and capture locations would be greater for introductions in the McCloud River, as compared to the Sacramento River, but any increase in emissions over existing conditions would still be relatively small and would not result in adverse impacts. Emissions are not anticipated to contribute substantially to existing air quality violations or conflict with

implementation of SCAQMD air planning efforts. The federal attainment status and *de minimis* threshold for general conformity would not be exceeded.

Alternative 2 – Introduction to Sacramento River and McCloud River Concurrently
Under Alternative 2, effects on air quality would be similar to those under Alternative 1, but emissions would be greater because vehicles would be traveling to sites on both rivers in the same year. As under Alternative 1, the increase in emissions would be negligible compared to emissions from existing traffic, and emissions are not anticipated to contribute substantially to existing air quality violations or conflict with implementation of SCAQMD air planning efforts. Under Alternative 2, the federal attainment status and *de minimis* threshold for general conformity would not be exceeded.

Noise

Affected Environment

Shasta Lake, the Upper Sacramento River, and the McCloud River are located in a relatively undeveloped area. Existing sources of noise include recreation boating on Shasta Lake; vehicular traffic throughout the study area, particularly on I-5; occasional air traffic; operation of equipment related to forest management; and noise associated with rural residential activities.

A-weighted sound level of decibels (dbA) is one measurement of noise. The human ear can perceive sound over a range of frequencies, which varies for individuals. In using the A-weighted scale for measurement, only the frequencies heard by most listeners are considered. This gives a more accurate representation of the perception of noise. Using this scale, the background noise level (day/night average) of a rural residential area, similar to conditions at the site, can be estimated as approximately 40 dbA. Normal conversational speech at a distance of five to ten feet is approximately 70 dbA (Cavanaugh and Tocci 1998). The decibel scale is logarithmic, so, for example, sound at 90 dbA would be perceived to be twice as loud as sound at 80 dbA.

Passenger vehicles, motorcycles, trucks, and all-terrain vehicles (ATV) use the road in the vicinity of the site. Noise levels generated by vehicles vary based on a number of factors including vehicle type, speed, and level of maintenance. Intensity of noise is attenuated with distance. Some estimates of noise levels from vehicles are listed in Table 4-7.

Table 4-7. Estimated Typical Vehicular Noise Levels

Source	Distance (feet)	Noise Level (dbA)
Auto, 40 mph	50	72
Automobile horn	10	95
Light auto traffic	100	50
Truck, 40 mph	50	84
Heavy truck or motorcycle	25	90

Source	Distance (feet)	Noise Level (dbA)
Boat, 175hp	50	81
Helicopter, Model MD900, Overflight	400	73

Sources: PWIA 2011, Cavanaugh and Tocci 1998, Falzarano and Levy 2007, MM&A 2011

Key:
dbA = A-weighted sound level
hp = horsepower
mph = miles per hour

Excessive noise can cause stress to listeners, and at higher levels could result in hearing damage. Various agencies regulate noise levels, including the Occupational Safety and Health Administration (OSHA). OHSA requires hearing protection when workers are exposed to specific volume levels for different periods of time, as listed in Table 4-8. High noise levels can also impair wildlife species' ability to communicate and cause avoidance of potential habitat.

Table 4-8. Sound Levels Requiring Hearing Protection

Sound Duration	Noise Level (dbA)
> 8 hours	90
> 4 hours	95
> 1 hour	105

Source: CPWR 2001
Key:
dbA = A-weighted sound level

Environmental Consequences

No Action Alternative

Under the No Action alternative, the Pilot Program would not be implemented; therefore, there would be no environmental effects related to noise.

Action Alternatives

Alternative 1 – Introduction to Sacramento River and McCloud River Separately Sources of noise would increase compared to existing conditions due to operation of ground vehicles during the construction period and during fish transportation activities. These sources of noise would be temporary, undetectable, and localized and would not be of a duration or intensity that would result in hearing damage or excessive nuisance. If weekly or biweekly helicopter surveys would be needed it could temporarily create a more noticeable noise effect in more remote areas. There are no noise ordinances in Shasta County.

The study area is relatively sparsely populated and has few sources of excessive noise. The Upper Sacramento River has some baseline traffic noise due to its proximity to I-5, and noise from recreational boating occurs in Shasta Reservoir. Noise from helicopter use related to surveys could be noticeable in the area and could negatively affect recreational fishing

experiences. If helicopter use is necessary, it would be temporary. In addition, helicopter use would follow USFWS National Bald Eagle Management Guidelines.

Noise impacts to wildlife would be temporary and would not cause a long-term abandonment of habitat.

Alternative 2 – Introduction to Sacramento River and McCloud River Concurrently Noise effects under Alternative 2 are expected to be similar to those under Alternative 1.

Transportation

Affected Environment

The study area near Shasta Lake, the Upper Sacramento River, and the McCloud River contains a number of existing roads, including high-volume interstates and State highways, logging roads, and private roads (Table 3-1). Smaller roads include well-maintained and seasonally impassable roads. Many roads in the study area are well traveled by personal vehicles and logging vehicles.

Environmental Consequences

No Action Alternative

Under the No Action alternative, the Pilot Program would not be implemented; therefore, there would be no environmental effects related to transportation.

Action Alternatives

Alternative 1 – Introduction to Sacramento River and McCloud River Separately As listed in Table 3-1 and described in Section 2, work associated with releasing, capturing, and monitoring fish would result in an increase in vehicular traffic in the study area. Miles driven would be greater if fish are released in the McCloud River. However, the increased volume of traffic would be small relative to existing traffic in both rivers, and travel related to the Pilot Program would not impede current traffic flow or result in an effect to level of service of the roadways.

Alternative 2 – Introduction to Sacramento River and McCloud River Concurrently Under Alternative 2, effects on transportation would be similar to those under Alternative 1. Traffic volume could be greater under Alternative 2, since both rivers would be monitored simultaneously, but the increased volume would be small relative to existing traffic and would not impede current traffic flow or result in an effect to level of service of the roadways.

Recreation

Affected Environment

Shasta Lake

Shasta Lake is the centerpiece of the Shasta Unit of the Whiskeytown-Shasta-Trinity National Recreation Area (NRA). The Shasta Unit has a total area of approximately 125,500 acres, of which 29,500 acres are currently inundated by Shasta Lake at full pool, leaving approximately

96,000 acres of land area (USFS 1996). Environmental factors such as a hot summer season, steep terrain, and sparse forest cover in some areas favor water-oriented recreation as the main attraction. The focal point of recreation in the Shasta Unit is Shasta Lake itself, with its large surface area and 370 miles of shoreline (USFS 1996). Boating is the predominant recreation activity at Shasta Lake. The lake attracts all types and sizes of powerboats, including personal watercraft (jet skis); runabouts, ski boats, and fishing boats; and larger cabin cruisers, pontoon boats, deck boats, and houseboats (Graefe et al. 2005). Most fishing at Shasta Lake is done by boat rather than from the shoreline.

The summer stratification of the lake into an upper warm layer above a deep cold water pool provides opportunities for anglers to catch both warmwater and coldwater fish species year-round (USFS 1996). Because of the steep terrain around the lake, there are no suitable sites for developed beach facilities (USFS 1996), and most swimming is associated with boating. Shasta Lake is also a very popular camping destination. The primary recreation season at Shasta Lake is the period of approximately 100 days from Memorial Day weekend to Labor Day weekend, although recreation uses occur year-round, particularly sport fishing (Reclamation 2013).

Upper Sacramento River

The Upper Sacramento River area is described and promoted as an "outdoor recreation wonderland" (California Travel and Tourism Commission and California Business Transportation and Housing Agency, Division of Tourism 2006). In the Upper Sacramento River watershed, there are abundant opportunities for tourists and local residents to enjoy such activities as fishing, hunting, camping, boating, cycling, skiing, and mountaineering, including the informal recreational facilities and opportunities provided by the STNF. Opportunities for recreation within the region surrounding the project are plentiful.

Fishing is a popular recreational activity in the Upper Sacramento River watershed region that contributes considerably to the local economy. Anglers frequently travel from great distances from within and outside of the State of California to fish the Upper Sacramento River for its renowned trout (CDFG 2000; NSR 2010). Survey data collected by CDFW indicate a high level of participation angler use, which is greatest in the Dunsmuir reach, but not entirely dissimilar to other, longer river sections lower in the river (CDFG 2000). Good river access, the ability to use bait, the presence of hatchery trout, and the ability to harvest trout are all factors leading to higher angler use in the Dunsmuir reach. Further, sections of the Upper Sacramento River are open to trout fishing all year, which attracts trout anglers limited in most other waters by seasonal fishing restrictions.

The Upper Sacramento River is accessible along much of its reach due to its proximity to I-5. There are numerous public access points for anglers and others to access the river along much of its length for angling, but also swimming, boating, gold panning and other forms of recreation. The Upper Sacramento River provides whitewater rafting opportunities, primarily during the spring, along much of its length. There are several developed State and Federal campgrounds, both adjacent to, and in close proximity to the Upper Sacramento River available for public use.

McCloud River

Opportunities for recreation within the region surrounding the McCloud River are plentiful. The river provides a variety of recreational facilities and opportunities. Much of the National Forest

lands are open to the public for recreation. Regional recreational opportunities include fishing, camping, boating, hiking, scenic/wildlife viewing, hunting, and general day-uses such as picnicking and swimming (PG&E 2008).

The McCloud River extends 24 river miles from McCloud Dam to Shasta Lake and is considered one of the premiere trout streams in California, but only the upper nine miles of this 24-mile reach have land-based public access. The reach of the McCloud River downstream from the McCloud River Preserve is primarily privately owned and receives relatively light angler use resulting in low trout harvest (Rode and Dean 2004; PG&E 2011). The McCloud River WTA offers a wide diversity of angling opportunities. Anglers can gain relatively easy vehicular access to the river at Ash Camp or Ah-Di-Na, or hike and scramble between Ash Camp and Ah-Di-Na or at the Preserve. Fishing can be day use only or can entail a stay of several days. Anglers have the option of fishing under strictly controlled catch-and-release regulations (McCloud River Preserve and the Zero-limit area of the WTA) or harvest a couple of fish in the two-trout harvest area upstream from Ladybug Creek.

Survey data collected by PG&E indicate a high level of participation by anglers. The percentage of visitors whose primary activity included angling was highest in the McCloud River (84 percent) (PG&E 2011). Visitor survey results indicate that visitors to the McCloud River originate from throughout California, with a lower percentage of respondents living in adjacent counties than those visiting McCloud or Iron Canyon reservoirs, suggesting that the McCloud River has greater overall appeal and anglers would rather focus activities and destinations along the McCloud River than adjacent reservoirs. According to survey results, these users also frequent other regional rivers for angling (e.g., Upper Sacramento, Pit, and Trinity rivers) (PG&E 2011).

Because of its inaccessibility, recreational use along much of the McCloud River is limited. The McCloud River provides whitewater boating opportunities. The McCloud River is classified as Class III-IV whitewater (PG&E 2011). Visitor survey results indicate that although boating on the river does occur, the estimated number of boating trips (both whitewater and access based) account for about five to ten trips in most years depending on the water year type (PG&E 2011). Other common recreational uses in the area include camping and hiking.

Environmental Consequences

No Action Alternative

There would be no implementation of the Pilot Program under the No Action alternative; therefore, there would be no effects on recreation resources.

Action Alternatives

Alternative 1 – Introduction to Sacramento River and McCloud River Separately
Reintroduction of ESA-listed anadromous salmonids and the associated investigations would be authorized by NMFS under an ESA Section 10(j) rule to allow establishment of an experimental population of the listed species. Under the Section 10(j) rule, the Section 9 prohibitions on take of listed species by otherwise lawful activities would not apply and no impacts to regulations affecting recreation in the study area are expected.

The maximum number and densities of adult and juvenile salmon that would be released for the Pilot Program in the Upper Sacramento and McCloud rivers under either Alternative 1 or Alternative 2 would not be expected to result in significant ecological effects on resident fish populations, consequently affecting recreational sportfishing in the rivers, during the Pilot Program. Any emigrant juvenile Chinook Salmon that are not collected in the rivers and ultimately migrate to Shasta Lake as part of the Pilot Program would also be in such low numbers and densities, relative to other coldwater species already inhabiting the lake, so as not to affect fish populations and recreational sportfishing.

Releases of adult and juvenile Chinook Salmon to the rivers would occur at existing access points along the rivers or using temporary release pipes and chutes, which would have minimal effects on recreational river users. In stream and portable streamside incubators that could be used for egg incubation would generally be installed at inconspicuous locations and areas of low use along the river bank or within public or private facilities, such as the City of Dunsmuir Wastewater Treatment Plant on the Upper Sacramento River and the Nature Conservancy's McCloud River Preserve. And, although temporary security fencing along the bank could be required at some of these sites during the study period, accommodations for passage of boaters and well used angler paths would be made; therefore, no significant restrictions on customary river access practices would be expected.

Deployment of in-river and head-of-reservoir juvenile collection systems, as part of any Pilot Program investigations, would include release of information to the press, notifications at boat launches and put-in sites, and warning signage upstream and downstream from the collection systems directing boaters and swimmers of the presence and directions on how to safely navigate in the vicinity of the collection site. All cables and booms would be well marked and compliant with State and Federal boating and navigation marking conventions. Temporary fish collection structures would include flashing lights and flagging to alert boaters. Temporary fence weirs will include a removable panel marked with bright paint and signage to direct boaters and allow for boat passage.

If safe boating conditions exist upstream of the in-lake site then passage for boaters may be provided. If water depth precludes safe boating upstream then boat passage may not be allowed. Portage may be needed for kayakers and rafters passing the in-river site. Roaded or hiking access to these areas would not be affected.

Additionally, any mobile surveys to track telemetry tagged fish or count salmon redds to be conducted by land using existing public roads, by boat either rafting on the rivers or using powerboats on Shasta Lake, or by periodic aerial flights, would be generally consistent with existing patterns of other commercial and recreational activities in the study area. Mobile surveys would not be expected to detract from recreational uses.

Alternative 2 – Introduction to Sacramento River and McCloud River Concurrently
Effect on Recreation resources under Alternative 2 would be similar to those under Alternative 1.

Cultural Resources

"Cultural Resources" is a broad term that applies to archaeological resources, the built environment, and Traditional Cultural Properties (TCPs). Such resources include prehistoric and historic-era archaeological sites that provide evidence of past human lifeways; structures, such as

buildings, bridges, dams, and canals signifying more recent human activity; and specific locations associated with the history or cultural identity of living communities. Cultural resources that are included in, or eligible for inclusion in, the National Register of Historic Places (National Register) are known as historic properties [36 CFR § 800.16(l)(1)]. Title 54 U.S.C. § 306108, commonly known as Section 106 of the National Historic Preservation Act (NHPA), requires that Federal agencies take into account the effects of their undertakings on historic properties. Undertakings are defined as projects, activities, or programs funded in whole or in part under the direct or indirect jurisdiction of a Federal agency [36 CFR § 800.16(y)]. The SDFPE Pilot Program constitutes an undertaking by Reclamation requiring compliance with Section 106 of the NHPA.

The Section 106 process, as outlined at 36 CFR Part 800, describes how Federal agencies meet their statutory responsibilities for NHPA Section 106 compliance. The process involves efforts to identify historic properties in the undertaking's area of potential effects (APE), which is defined as the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist [36 CFR § 800.16(d)]. The Section 106 process requires consultation with Indian tribes concerning the identification of sites of religious or cultural significance that may be present in the APE. Other groups or individuals who are entitled, or have requested, to be consulting parties may also participate in the Section 106 process. Consultation with the State Historic Preservation Officer (SHPO) and/or the Advisory Council on Historic Preservation (ACHP) regarding the APE, identification efforts, finding of effect, and resolution of any adverse effects resulting from an undertaking is also as part of the Section 106 process (see Section 5 - Consultation and Coordination). Reclamation uses the findings made through Section 106 compliance to inform the cultural resources impact analysis under NEPA. Comments received through the NEPA process regarding cultural resources may be considered under the Section 106 process as well.

As part of the Section 106 process, Reclamation sent letters to federally recognized Indian tribes and non-federally recognized Native American organizations and individuals identified by the California Native American Heritage Commission as potentially having an interest in cultural resources within the Pilot Program study area. These letters provided information about the proposed undertaking and invited the recipients to participate in the Section 106 process. The non-federally recognized Winnemem Wintu Tribe responded with a formal written request to participate as a Section 106 consulting party as provided for at 36 CFR § 800.2(c)(5). Reclamation, in consultation with the SHPO pursuant to 36 CFR § 800.3(f)(3), confirmed the Winnemem Wintu Tribe's status as a Section 106 consulting party for this undertaking. To date, Reclamation has received no other responses regarding concerns with the undertaking or requests for consultation under Section 106 of the NHPA.

Affected Environment

The study area comprising Shasta Lake, the McCloud River, and the upper Sacramento River has a long history of human use and is rich in cultural resources. Numerous prehistoric and historic-era archaeological sites and components of the built environment have been previously documented in the area, only a small portion of which have been formally evaluated for National Register eligibility. Additional cultural resources, some of which may qualify for National Register inclusion, remain undocumented or undiscovered.

Based on information attained through previous ethnographic and ethnohistoric studies, Section 106 consultations, and background research, the study area is also known to include Native American TCPs that may qualify as historic properties eligible for listing on the National Register. For the current undertaking, the Winnemem Wintu Tribe has expressed concerns regarding the potential effects of the SDFPE Pilot Program on cultural resources, including a TCP. The Winnemem Wintu Tribe is not a federally recognized Indian tribe and has no reservation or tribal trust lands, on the McCloud River or otherwise; however, the historical and cultural ties of the Winnemem Wintu to the McCloud River watershed and its natural resources are well documented (e.g., DuBois 1935; Heizer 1973; Kroeber 1925; LaPena 1978; Merriam 1957; Theodoratus and LaPena 2003).

The Winnemem Wintu Tribe is one of several organized Northern California Native American groups with Wintu ancestry. At the time of Euro-American arrival in the area, Wintu territory comprised present-day Shasta and Trinity counties, and parts of Tehama and Siskiyou counties. The traditional homeland for the Winnemem Wintu centers on the lower McCloud River, but also includes the lower reaches of the Pit River and portions of the Upper Sacramento River (Theodoratus and LaPena 2003). The loss of this land base began, in earnest, in the mid-1800s, with the influx of Euro-Americans into the area and the compulsory ceding of lands to the U.S. Government (LaPena 1978; Winnemem Wintu Tribe 2016). While the issuance of land allotments to non-reservation Indians by the Federal government in the late 1800s allowed Winnemem Wintu families to remain on the McCloud River, a firm land base throughout traditional Wintu territory was never fully reestablished (Theodoratus and LaPena 2003; Winnemem Wintu Tribe 2016).

In the 20th century, the loss of Winnemem Wintu territory continued with the passage of the Central Valley Project Indian Lands Acquisition Act (55 Stat. 612) in the early 1940s. This act led in the removal of the Wintu families who remained living on the lower McCloud River; the construction of Shasta Dam and Reservoir subsequently resulted in the inundation of numerous Wintu home sites, villages, traditional use areas, and ceremonial sites in this locale. Despite this loss of territory, the Winnemem Wintu Tribe, and other Wintu groups, maintain cultural beliefs and practices tied to these areas. Foremost among these beliefs and practices are those centered on a long-standing and ongoing relationship with the salmon that historically spawned in the McCloud, Pit, and Upper Sacramento rivers prior to the construction of Shasta Dam (Winnemem Wintu Tribe 2016).

Based on written accounts from the late 1800s, Chinook salmon eggs collected at the U.S. Fish Commission's Baird Station on the McCloud River were shipped to various overseas fisheries, including New Zealand. The Winnemem Wintu Tribe maintains that the point of origin for current wild, winter-run Chinook salmon in New Zealand is the McCloud River, via the Baird Station hatchery, and has requested that the Chinook salmon from New Zealand be used as the stock for reintroduction to the McCloud River. Based on their deeply held cultural beliefs, which continue to hold the McCloud River and their salmon as sacred, the Winnemem Wintu Tribe considers Chinook salmon from New Zealand the appropriate fish for reintroduction above Shasta Dam (Winnemem Wintu Tribe 2016).

Environmental Consequences

No Action Alternative

Under the No Action Alternative, the Pilot Program would not be implemented. As such, no impacts to cultural resources from Pilot Program activities would occur.

Alternative 1 – Introduction to Sacramento River and McCloud River Separately

Reclamation's proposed action alternatives (i.e., Alternative 1 and Alternative 2) involve the release of hatchery-sourced Chinook salmon at existing access points, or through temporary pipes and chutes, along the McCloud River and upper Sacramento River. In-stream and portable streamside egg incubators would be installed along the McCloud River and upper Sacramento River within previously developed public or private facilities or in inconspicuous locations along the banks of these rivers, with little or no ground disturbance required. Proposed in-river and head-of-reservoir juvenile collection systems would require the installation of cables, booms, and collection facilities anchored to the banks and/or beds of the McCloud River, upper Sacramento River, and the interface of these rivers with Shasta Lake. The installation of signage and temporary fencing in association with some of the incubation and collection facilities would require minimal ground disturbance. These activities would also introduce new, albeit minor and temporary, visual elements to the landscape along and within both river systems.

Under Alternative 1, studies related to the release and collection of adult and juvenile Chinook salmon in the McCloud River and upper Sacramento River would occur at separate times. Regardless of timing, the activities associated with this proposed alternative have the potential to cause effects on historic properties (i.e., cultural resources eligible for inclusion in the National Register). Reclamation has initiated the Section 106 process for the SDFPE Pilot Program. Pursuant to 36 CFR § 800.4, and in consultation with the Winnemem Wintu Tribe and the SHPO, Reclamation is still in the process of identifying historic properties in the APE that may be affected by the undertaking. Such properties could include discrete cultural resources as well as TCPs that are eligible for National Register inclusion.

To date, Reclamation's historic properties identification efforts have included seeking input from Indian tribes and other Native American groups and individuals, background research, analysis of existing cultural resources records, review of previous cultural resources studies covering the Pilot Program study area, and field surveys of proposed juvenile collection facility locations. Thus far, these efforts have revealed the presence of prehistoric Native American and historic-era Euro-American archaeological sites near some proposed Pilot Program activity areas, on both the McCloud River and upper Sacramento River.

Based on the limited amount of equipment and minimal space required for implementing Pilot Program activities, direct physical effects to these types of cultural resources are likely to be minimal and preventable through the use of avoidance measures. Through formal written correspondence, the Winnemem Wintu Tribe has indicated the presence of historic properties present in the project area. Pursuant to 36 CFR § 800.4(a)(3), Reclamation is continuing to seek information from the Winnemem Wintu Tribe regarding such historic properties, including TCPs in the study area that qualify for National Register inclusion, the potential effects of the proposed undertaking on such properties, and ways to avoid, minimize, or mitigate adverse effects on such

properties if necessary. Reclamation is continuing to consult with the SHPO regarding these issues as well.

Further efforts are required to complete the Section 106 process for the current undertaking. These efforts will involve continuing consultation with the Winnemem Wintu Tribe, the SHPO, and other Section 106 consulting parties as appropriate. Until the effects of the undertaking can be fully determined through the Section 106 process, Reclamation is unable to assess the impacts of Alternative 1 on cultural resources. Reclamation must complete the Section 106 process, as outlined at 36 CFR Part 800, prior to implementation of the proposed Pilot Program.

Alternative 2 – Introduction to Sacramento River and McCloud River Concurrently

The potential impacts to cultural resources under Alternative 2 would be the same as or similar to those identified under Alternative 1.

Climate Change

Affected Environment

Atmospheric greenhouse gases (GHG) play a critical role in determining the earth's surface temperature. Solar radiation enters the earth's atmosphere from space. Prominent GHGs contributing to the greenhouse effect are carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, chlorofluorocarbons, and sulfur hexafluoride. Human-caused emissions of these GHGs that exceed natural ambient concentrations are responsible for intensifying the greenhouse effect and have led to a trend of unnatural warming of the earth's climate, known as global climate change or global warming (Ahrens 2003). Climate change is a global phenomenon. GHGs are global pollutants, unlike criteria air pollutants (see Air Quality section above), which are pollutants of regional and local concern.

Environmental Consequences

No Action Alternative

Under the No Action Alternative, the Pilot Program would not be implemented, and therefore, there would be no increase in emissions. As a result, there would be no impacts or change to or from climate change.

Action Alternatives

Alternative 1 – Introduction to Sacramento River and McCloud River Separately

Sources of GHG emissions associated with the Pilot Program are limited to vehicle trips for transporting fish and for installing collector equipment (see Air Quality and Transportation sections above). Impacts would be extremely small in the local or global context.

Alternative 2 – Introduction to Sacramento River and McCloud River Concurrently

Under Alternative 2, effects on Climate Change would be similar to those under Alternative 1, but emissions would be greater because vehicles would be traveling to sites on both rivers in the same year. As under Alternative 1, the increase in emissions would be negligible.

Environmental Commitments

Hazards and Hazardous Materials

- Use containment facilities, booms, and an environmental inspection program;
- Prevent any significant release of hazardous materials from harming the aquatic environment;
- Steam clean equipment used in contact with a water course prior to use and use soy-based hydraulic fluid when possible; and
- Report any release immediately to the Central Valley Water Board and CDFW.

Wildlife

- No mechanical equipment will operate within 100 feet of elderberry shrubs and no work will be done within 20 feet of the dripline of any elderberry shrubs.

Botanical Resources

- Vehicle access for activities under the Pilot Program will be on existing roads and disturbed areas. No significant vegetation removal would occur under the Pilot Program.

Recreation

- All cables and booms would be marked and compliant with State and Federal boating and navigation marking conventions.
- Reclamation would place signage to alert boaters of the structures upstream and downstream of the temporary fish collection devices.
- Signs would also be posted at nearby boat ramps.
- Temporary fish collection devices would include coast guard compliant markings.
- All Federal, State, and local boating operation and navigational regulations would be followed.

Cumulative Effects

Cumulative effects are those which result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions. These actions may be undertaken by Federal or non-Federal agencies or individuals. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time. Cumulative impacts from implementing the Pilot Program were evaluated related to other past, present, and reasonably foreseeable future actions.

Livingston Stone National Fish Hatchery Water Treatment System

Livingston Stone NFH is the proposed source of Sacramento River winter-run Chinook Salmon for the Pilot Program. Before any release of adults upstream from Shasta Dam, Livingston Stone NFH, a conservation hatchery for winter-run Chinook Salmon, would likely need to have its water treatment process upgraded. Adult Chinook Salmon carry pathogens, particularly infectious hematopoietic necrosis virus (IHNV) and *Renibacterium salmoninarum*, which causes bacterial kidney disease (BKD). When salmonids die, they release these pathogens into the aquatic system. Livingston Stone NFH draws its water from the water passing through Shasta Dam, located immediately upstream from the hatchery. Pathogens and diseases introduced upstream through transport of fish from the Pilot Program could pass downstream and potentially reach Livingston Stone NFH, thus potentially infecting the egg and juvenile life stages and reducing survival (Foott 2014). To prevent contamination Livingston Stone NFH would institute a treatment process to kill these pathogens and prevent contamination to the rearing facilities. Based on information provided at the Fish Health and Genetics subcommittee meeting in June 2014, this upgrade should be completed before any release of adults upstream from Shasta Dam occurs.

McCloud Dam and Reservoir FERC Relicensing

McCloud Dam, completed in 1965, is owned and operated by PG&E as part of the McCloud-Pit Hydropower Project. The dam is 235 feet high, 630 feet long at its crest, and impounds a maximum capacity of 35,200 acre-feet (FERC 2011). Pacific Gas & Electric's (PG&E) McCloud-Pit Hydroelectric Project (Federal Energy Regulatory Commission [FERC] Project No. 2106) diverts water at McCloud Reservoir, through a tunnel complex into the Pit River drainage at Iron Canyon Reservoir. The Project collectively includes five dams, four reservoirs, an afterbay, two tunnels, and three powerhouses which generate up to 364 megawatts (MW).

FERC is currently in the relicensing process for P-2106. FERC issued its Final EIS in February 2011 (FERC 2011). The EIS evaluated increased minimum instream flows in the McCloud River, from a release of 50 cfs between May and November and 40 cfs between December and April to a release of 160 to 210 cfs.

After negotiations with NMFS, FERC concurred that it was reasonably foreseeable that anadromous fish may be reintroduced into the McCloud River basin, based on the BO's RPA for fish passage. Currently, the State Water Resources Control Board is working on CWA Section 401 Water Quality Certification for the relicensing process (NOAA 2014).

NMFS and Reclamation have updated McCloud River stakeholders on the project status during the bi-annual Coordinated Resources Management Plan (CRMP) meetings (see Section 4, Consultation and Coordination) and other meetings. The agencies indicated during the CRMP meetings, that they anticipated no request for a modification in the flows negotiated under the FERC process.

Shasta Lake Water Resources Investigation

Reclamation recently conducted a feasibility study including preparation of a decision document and EIS for the Shasta Lake Water Resources Investigation (SLWRI). Studies to date have focused on identifying water resources problems and needs, developing a set of planning

objectives, and formulating alternatives. The alternative plans include enlarging Shasta Dam from 6.5 feet, 12.5 feet, and 18.5 primarily for increasing anadromous fish survival and water supply reliability downstream. On July 29, 2015, Reclamation transmitted to Congress the Final Feasibility Report and EIS.

If Shasta Dam is raised then the upper limit of the reservoir inundation zone would change on both the Sacramento and McCloud rivers. The design of juvenile collectors under the Pilot program allows them to be deployed at different locations depending on water level and other site characteristics. The schedule of the SLWRI project would be outside the proposed Pilot Studies timeline. The SLWRI would occur in the long-term phase if the Pilot Program is deemed feasible. The design of any future fish collection facility would need to take into account the change in lake elevations. Less than one mile of the lower reach of each river would be inundated at full pool with an 18.5-foot dam raise. This area is not suitable Chinook spawning habitat and therefore, spawning habitat availability would not be affected. The rearing habitat reach would be slightly shorter. The SLWRI and the SDFPE are independent actions and each could occur with or without the other.

The Pilot Program would not result in cumulative impacts related to other past, present, and reasonable foreseeable future actions.

Section 5
Consultation and Coordination

Public Involvement and Parties Consulted

Implementation of the Pilot Program would require collaboration with landowners in both the Upper Sacramento and McCloud river watersheds in order to provide access to specific areas for release and monitoring of fish. Outreach to stakeholders in both watersheds has been ongoing since 2010.

The following sections provide public involvement and other parties consulted in the development of the Pilot Program.

Stakeholder Communication and Engagement Plan

Reclamation developed a Stakeholder Communication and Engagement Plan (SCEP), released March 2014. The SCEP included a Landowner and Stakeholder Analysis summarizing results from interviews related to the Pilot Program. The results of the interviews and analysis, as well as the entire SCEP can be found at:

http://www.usbr.gov/mp/BayDeltaOffice/shasta-dam-fish-pass.html

McCloud River Coordinated Resource Management Plan

On October 26, 2010, NMFS and Reclamation presented information regarding SDFPE to the McCloud River CRMP group in Mount Shasta, California. Information included the formation of an interagency steering committee and the targeted schedule. CRMP Members expressed the desire to be involved in the process.

Reclamation and NMFS have attended CRMP semi-annual meetings to provide updates at various locations since 2011.

Siskiyou County Board of Supervisors Meeting

On September 20, 2011 NMFS and Reclamation appeared before the Siskiyou County Board of Supervisor and provided an overview regarding SDFPE. NMFS presented information including statistics related to endangered winter-run Chinook Salmon, spawner abundance, historical upstream habitat and temperature/climate information. NMFS advised of the anticipated process of providing landowner assurances through experimental population process. Reclamation provided an overview of the Pilot Program, including the need for NEPA compliance.

Additional meetings were held with the Board of Supervisors in Yreka on May 7, 2013 and January 6, 2015. Reclamation and NMFS presented overviews and current status of the project and provided an explanation of the ESA section 10(j) process, with follow-up question and answer sessions.

California Forest Practice Rules for Anadromous Salmonid Protection

On March 14, 2014 Reclamation met with a representative from the Board of Forestry to discuss the issues and processes surrounding the California Forest Practice Rules for Anadromous Salmonid Protection (ASP). ASP rules do not apply to the Pilot Program.

Winnemem Wintu

Reclamation and NMFS began meeting with the Winnemem Wintu in September 2011 near Redding. The Winnemem Wintu presented at an August 2013 landowner and stakeholder workshop in Lakehead which included their concerns regarding the proposed fish stock to be used in the McCloud River and the possibility of the McCloud River being a traditional cultural property The Winnemem Wintu were interviewed as part of the SCEP described above.

On July 19, 2014, Reclamation and NMFS met with the Winnemem Wintu in Sacramento. During 2015, approximately five meetings were held with Winnemem Wintu representatives, including a meeting with Reclamation's Regional Director David Murillo and NMFS Regional Administrator Will Stelle.

On February 1, 2016, the Winnemem Wintu submitted a draft Winnemem Wintu Salmon Restoration Plan as part of comments on the Pilot Plan. The Pilot Plan and this preliminary draft EA have been revised in response to the Winnemem Wintu's comments.

Reclamation invited the Winnemem Wintu to be a consulting party in the Section 106 process on October 19, 2015. The Section 106 process is further described above in the Cultural Resources section. The consultation under Section 106 with Winnemem Wintu is ongoing.

During 2016 through 2017 Reclamation and the Winnemem Wintu held meetings to address ideas and continued participation in the project.

Other Meetings

Other public meetings held related to the project included:

- Public Meetings
    - August 27, 2013 Lakehead
    - December 4, 2014 Webinar
    - September 2015 Webinar
- Landowner and Stakeholder Meetings
    - November 20, 2013 Sacramento River
    - July 20, 2014 Castella

Shasta Dam Fish Passage Draft Pilot Implementation Plan

Reclamation released a draft of the Pilot Plan for public review on January 14, 2016. A press release provided a link to the document and instructions on how to provide written comments before the close of business February 24, 2016.

Reclamation received over 55 comment letters on the Pilot Plan from individuals, tribes, and organizations. The revised Pilot Plan and a summary of the comments are included on the website listed above.

Regulatory Compliance Consultations

Endangered Species Act 1973

This section describes the Federal ESA rules and permitting requirements for activities associated with the Pilot Program, specifically with the reintroduction of salmonid populations (Sections 10(j)), 4(d), and 10(a)(1)(A)) under NMFS jurisdiction. Species under the USFWS jurisdiction do not have the potential to be impacted by the Pilot Program.

The ESA recognizes that fish, wildlife and plant species have aesthetic, ecological, educational, historical, recreational and scientific value and provides a means to conserve the ecosystems upon which endangered or threatened species depend. Section 10 of the Act, entitled "Exceptions," offers an avenue to authorize activities that would otherwise be prohibited. Under section 10(j), the Secretary of the Department of the Interior can designate reintroduced populations established outside the species' current range, but within its historical range, as "experimental."

The Pilot Program includes activities to enhance the propagation or survival of an ESA listed species that would likely result in the species being harassed, captured, harmed, possessed, or killed. Additionally, a section 10(a)(1)(A) permit is required for research efforts that include abundance surveys, genetic research, hatchery operations, relocations, capture and marking, and telemetric monitoring. Therefore, authority to take under section 10(a)(1)(A) is required.

In 1982, Congress made significant changes to the ESA with addition of Section 10(j), which provides for the designation of specific reintroduced populations of listed species as experimental populations established outside the species' current range. Section 10(j) provides greater flexibility in reintroducing listed species into unoccupied habitat, by allowing for the creation of listed experimental populations for which management restrictions can be relaxed. Conversely, a listed species that is relocated outside of its listed range without experimental population status receives full protection under the ESA. However, NMFS may choose to designate a population as experimental if it furthers the conservation of the species, and the experimental population is geographically separate from the rest of the listed species.

It is important to consider land ownership patterns in the experimental area where fish would be released. Section 10(j) experimental population designations, in particular non-essential experimental population designations, reduce ESA Section 7 requirements for Federal agencies or federally funded activities. In mixed ownership situations, a non-essential experimental population designation would provide regulatory relief for Federal land managers, and the

designation also would provide the option of promulgating a 4(d) rule to reduce the regulatory burden on private landowners.

Through section 4(d) of the ESA, a threatened designation allows the Services greater discretion in devising management programs and special regulations for the listed population. Section 4(d) allows the Services to adopt whatever regulations are necessary to provide for the conservation of a threatened species.

NMFS is currently working on an experimental population designation pursuant to ESA Section 10(j) which will be completed before the initiation of the Pilot Program. NMFS is currently seeking a non-essential experimental population designation for winter-run Chinook Salmon included in the Pilot Program. In the Pilot Program, NMFS would (1) authorize the release of specifically marked Sacramento River winter-run Chinook Salmon into habitat above Shasta Dam under section 10(j) of the ESA, (2) designate the marked Sacramento River winter-run Chinook Salmon released into habitat above Shasta Dam as a nonessential experimental population, and (3) adopt limited protective regulations under ESA Section 4(d) that would prohibit intentional take of outmigrating smolts and returning adults from the experimental population.

National Historic Preservation Act (54 USC § 300101 et seq.)

The National Historic Preservation Act (NHPA) of 1966, as amended, requires Federal agencies to take into account the effects of their undertakings on historic properties, i.e., significant cultural resources that are listed, or eligible for listing, on the National Register of Historic Places. The process for implementing what is commonly referred to as Section 106 of the NHPA (54 USC § 306108) is outlined at 36 CFR Part 800. Reclamation is required to complete the Section 106 process when an undertaking has the potential to cause effects on historic properties, assuming such properties are present.

Completion of the Section 106 process involves consultation with the SHPO, Indian tribes, and other interested parties. Reclamation is currently consulting with the SHPO and with the Winnemem Wintu Tribe under Section 106. Reclamation also invited the following Indian tribes and Native American organizations and individuals to participate in the Section 106 process, pursuant to 36 CFR §800.4(a)(4) and §800.4(a)(3), respectively: Redding Rancheria, Pit River Tribe, and Quartz Valley Indian Community (federally recognized) and Shasta Indian Nation, Wintu Tribe of Northern California, and Mr. Howard Wynant (non-federally recognized). Additional Native American organizations and individuals, and other interested parties may also request Section 106 consulting party status.

Reclamation must complete the Section 106 process prior to the implementation of the SDFPE Pilot Program.

Clean Water Act

The CWA is the Federal legislation governing the water quality aspects of the project. The objective of the act is "to restore and maintain the chemical, physical, and biological integrity of the nation's waters." The CWA establishes the basic structure for regulating discharge of pollutants into the waters of the U.S. and gives EPA the authority to implement pollution control

programs such as setting wastewater standards for industries. In certain states such as California, EPA has delegated authority to State agencies. Section 404 regulates the placement of dredged or fill materials into wetlands and other waters of the United States. Section 401 of the CWA requires Federal agencies to obtain certification before discharging or issuing permits that would result in increased pollutant loads to a water body. The certification is issued only if such increased loads would not cause or contribute to exceedances of water quality standards. Section 401 certification is required for projects that require a permit under Section 404 and other Federal statutes.

The US Army Corps of Engineers (Corps) indicated a permit is not needed for the pilot project since the materials used in-river are not considered fill. On April 6, 2016, the Corps reviewed the plans and again concurred that a Section 404 permit is not necessary. Therefore, a Section 401 permit is also not needed.

California Forest Practice Rules for Anadromous Salmonid Protection (ASP)

The ASP regulations apply to watersheds where listed anadromous salmonids are "currently present or can be restored." Watersheds covered by the rules are defined in maps adopted on January 1, 2010. These maps exclude watersheds above permanent dams, such as Shasta Dam, which "attenuate the transport of fine sediments…" Absent changes to the maps by the Board of Forestry, ASP rules do not apply to the Shasta Dam Fish Passage Evaluation.

In February 2015, concerns were expressed at a CRMP meeting that third parties could interpret the ASP regulations and maps in a manner that could require the ASP regulations to be implemented in the presence of the experimental populations of Chinook Salmon. NMFS continued coordinating with the Board of Forestry, and submitted new language for the ASP regulations to treat experimental fish above a barrier dam as exempt from the ASP regulation. The Board of Forestry voted unanimously to accept the new language, and the new regulation will be in effect in January 2017.

Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act establishes a management system for national marine and estuarine fishery resources. This legislation requires that all Federal agencies consult with NMFS regarding proposed actions that may adversely affect Essential Fish Habitat (EFH). EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." EFH is not designated in the Pilot Program action areas; therefore, the Pilot Program would not adversely affect EFH.

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Section 6
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