UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802-4213

February 18, 2011

In response refer to:
2010/02146

Honorable Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
Office of Energy Projects
888 First Street, N.E.
Washington, D.C. 20426

Dear Secretary Bose:

This document transmits NOAA's National Marine Fisheries Service's (NMFS) biological opinion (BO) (Enclosure 1) based on our review of the proposed Federal Energy Regulatory Commission (FERC) license surrender for the Kilarc-Cow Creek project (FERC No. 606), and thereby decommissioning of the project, on Old Cow Creek, South Cow Creek, and tributaries in Shasta County, California, and its effects on the Federally-listed as threatened Central Valley spring-run Chinook salmon (*Oncorhynchus tshawytscha*), threatened Central Valley steelhead (*O. mykiss*), and their designated critical habitat, in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq.*). Your request for formal consultation was received on May 19, 2010. Formal consultation was initiated by NMFS' Central Valley Office on May 19, 2010.

This BO is based on information provided in the Biological Evaluation of Operational Effects (provided on May 19, 2010), the FERC license surrender application, several meetings with Pacific Gas and Electric Company and their consultants, field investigations, and other sources of information. A complete administrative record of this consultation is on file at the NMFS' Central Valley Office.

Based on the best available scientific and commercial information, the BO concludes that this project is not likely to jeopardize the continued existence of the above listed species, or adversely modify critical habitat. NMFS has also included an incidental take statement with reasonable and prudent measures and non-discretionary terms and conditions that are necessary and appropriate to minimize incidental take associated with the project.

Also enclosed are Essential Fish Habitat (EFH) conservation recommendations for Pacific salmon as required by the Magnuson-Stevens Fishery Conservation and Management Act as amended (16 U.S.C. 1801 *et seq.*; Enclosure 2). This document concludes that the decommissioning of the Kilarc-Cow project will not adversely affect the EFH of Pacific salmon in the action area and adopts the ESA conservation recommendations of the BO as the EFH conservation recommendation.

Please contact Ms. Naseem Alston at (916)930-3655, or via e-mail at Naseem.Alston@noaa.gov if you have any questions concerning this matter, or require additional information.

Sincerely,

Rodney R McInnis

Rodney R. McInnis
Regional Administrator

Enclosures (2)

cc: Copy to file – ARN # 151422SWR2010SA00197
NMFS-PRD, Long Beach, CA

Enclosure 1

BIOLOGICAL OPINION

Agency: Federal Energy Regulatory Commission
Washington, D.C.

Activity: Kilarc-Cow Creek Hydroelectric Project (Project No. 606)

Consultation Conducted By: Southwest Region, National Marine Fisheries Service

File Number: 151422SWR2010SA00197

Date Issued: **February 18, 2011**

I. CONSULTATION HISTORY

Pacific Gas and Electric Company (PG&E) initially sought a new license for the Kilarc-Cow Creek Hydroelectric Project (Project), filing a Notice of Intent in 2002. At that time, PG&E began relicensing meetings with interested stakeholders and resource agencies including the United States Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), and the California Department of Fish and Game (CDFG). Between 2002 and 2003, NMFS provided PG&E with comment letters that identified NMFS' trust species and also relicensing studies that NMFS would need in order to evaluate Project impacts on the trust species. These studies related to instream flow gauging, hydrology, sediment characterization, aquatic habitat, passage barriers, fish populations, fish entrainment issues, and Project operations. These comment letters were submitted to the FERC record for this proceeding.

Pacific Gas and Electric Company (PG&E) conducted early coordination with the United States Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), and the California Department of Fish and Game (CDFG) when seeking a new license for the Kilarc-Cow Hydroelectric Project (Kilarc-Cow) in 2004. These agencies were among the signatories to an Agreement (PG&E 2005) that PG&E not seek a new FERC license but it will be either 1) acquired by another license applicant; or 2) decommissioned by FERC order.

The Agreement states that PG&E would support decommissioning. The Agreement also identifies what the signatory parties believed are the subjects that would need to be addressed and the desired condition of each of these subjects after decommissioning. The Agreement also states that notwithstanding the Agreement, all governmental agencies that are party to the Agreement retain all of their authorities and mandates related to the Project, the Project-affected resources, PG&E's ongoing relicense or surrender of Project relicensing, and to any new licensing proceeding that may be initiated for the Project. The Agreement specifies that such authorities and mandates are not diminished in any way by government agencies entering into the Agreement. The Agreement also states that entering into the Agreement is not in any manner a pre-decisional act or commitment by any of the governmental agencies as to the disposition of the Project assets or water rights.

Since entering into the Agreement, NMFS, USFWS and CDFG have continued to express support for decommissioning. NMFS has participated in scoping site visits to tour the project facilities and to discuss the decommissioning plan and any potential resource issues. NMFS has met in person with community members to discuss potential non-decommissioning proposals, and NMFS has reviewed non-decommissioning proposals filed in the FERC record by community members. NMFS has provided written response in the FERC record regarding these site visits, meetings and proposals. NMFS has also submitted comment letters to the FERC record in response to PG&E's draft license surrender application, FERC's Ready for Environmental Analysis Notice, and FERC's Draft Environmental Impact Statement. In each of these filings, NMFS has expressed support for decommissioning as providing the greatest conservation benefit for NMFS' trust resources.

As the designated non-federal representative for informal consultation under the federal Endangered Species Act (ESA), PG&E began early coordination with NMFS in 2008 to discuss components of the project description as well as conservation measures and avoidance and minimization measures as needed. PG&E also met with NMFS staff in 2009 to discuss comments on the draft license surrender application. PG&E submitted a draft biological assessment to NMFS on April 30, 2009, with follow-up phone meetings.

II. DESCRIPTION OF THE PROPOSED ACTION

A. Project Activities

1. Project Description

Kilarc-Cow consists of two developments: the Kilarc Development located on Old Cow Creek and the Cow Creek Development located on South Cow Creek (Figure 1). The proposed action would involve decommissioning all project features at both developments. Together, the project facilities include two forebays and five associated dams; 20 canal sections, with associated flumes, tunnels, and spillways; one siphon; two penstocks; two powerhouses with associated tailraces, switchyards and equipment; and transmission facilities.

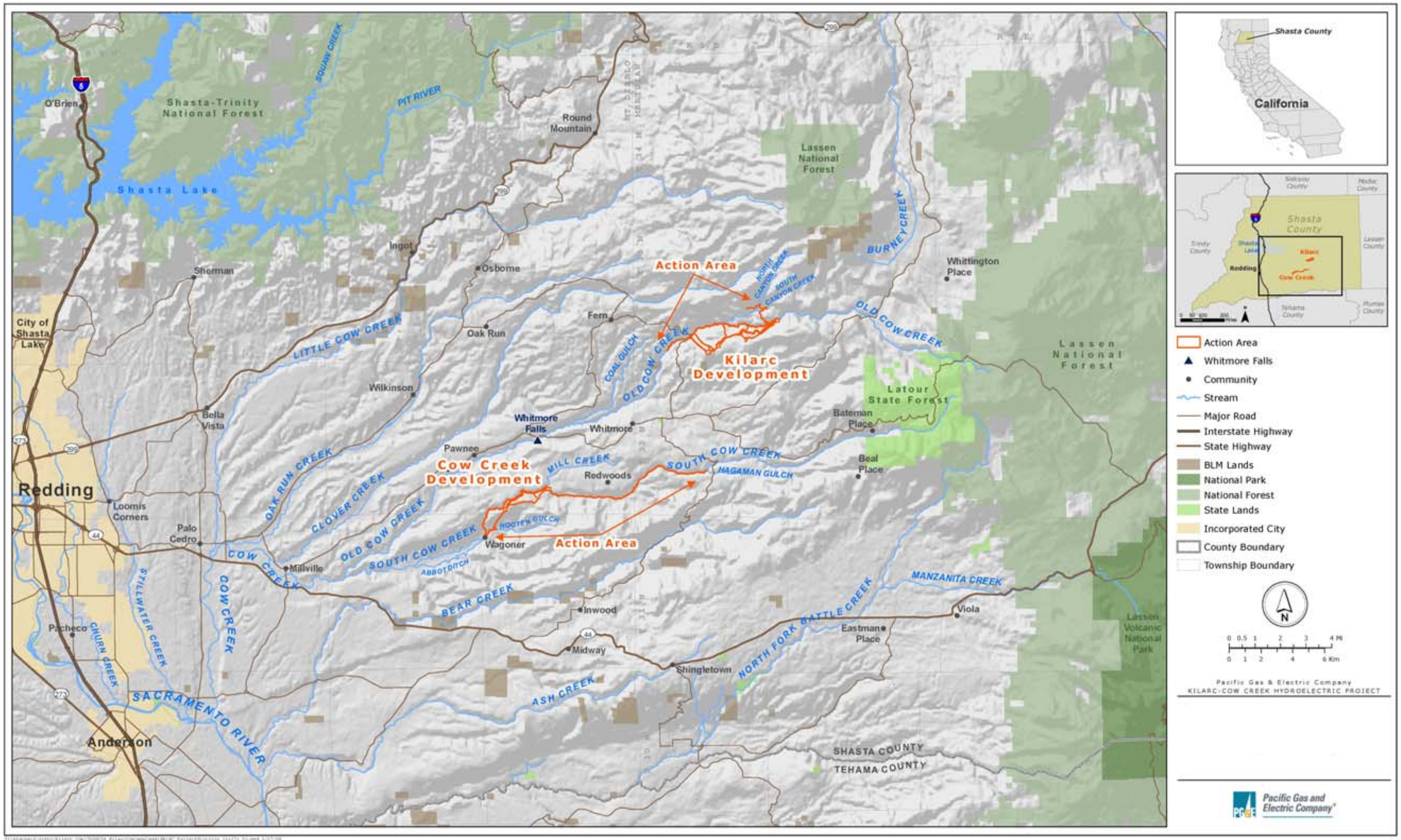

Figure 1. Project vicinity of Kilarc Development and Cow Creek Development.

a. *Cow Creek Development*

The Cow Creek Development is located in the South Cow Creek sub-watershed. The development features include: South Cow Creek Diversion Dam and Appurtenant Structures, Mill Creek Diversion Dam, South Cow Creek Main Canal, Mill Creek-South Cow Creek Canal, Cow Creek Forebay Dam and Forebay, Cow Creek Penstock, Cow Creek Powerhouse and Cow Creek Access Roads and Staging Areas. The Mill Creek-South Cow Creek Canal conveys diverted water from Mill Creek into South Cow Creek above the South Cow Creek Diversion Dam. From South Cow Creek, the water is diverted into the South Cow Creek Main Canal and into the Cow Creek Forebay. From Cow Creek Forebay, the water flows through a penstock to Cow Creek Powerhouse. The water is then discharged from the powerhouse to Hooten Gulch, approximately 0.5 mile upstream of its confluence with South Cow Creek (Figure 2).

<u>South Cow Creek Diversion Dam and Appurtenant Structures</u>

Water is diverted from South Cow Creek into the South Cow Creek Main Canal at the South Cow Creek Diversion Dam. The dam is a concrete capped steel bin wall and rock fill dam, 86.5 feet long, 12.3 feet wide, and 8.5 feet high built on top of independent upstream and downstream concrete cut-off walls (foundation footers) that are embedded in the stream bed. Water diverted by the dam passes through a concrete intake structure, with a trash rack and control gate, into a transition section. In the transition section, water is split between the South Cow Creek Main Canal and the South Cow Creek fish ladder. Water going to the fish ladder passes through a control gate and down the ladder. Water going to the canal passes through a fish screen and then a control gate before entering the canal.

Decommissioning the dam would be accomplished through mechanical means, which may include backhoes and loaders. Decommissioning would include removing the concrete cap, removing fill, and removing the bin walls and interior baffles. Some abutments and foundation structures that connect to the steep side slopes and below the channel bed would be left in place to minimize potential future erosion and disturbance to the slopes. These structures include the two parallel cut-off walls beneath the bin wall dam structure and the retaining walls on both slopes. Retention of the cut-off walls would provide bed grade control after the dam is removed. A portion of the north bank retaining wall would be left in place, with fill behind the wall graded to match the existing slope. Retention of the wall would provide erosion protection and address landowner concerns over bank stability. A portion of the south bank retaining wall adjacent to the intake would also be left in place to avoid destabilizing the steep bank behind and above it. The sediment resting against the upstream side of the diversion dam would be pulled back at its natural angle of repose to remove the weight from the upstream bin wall. The broken concrete from the dam and ancillary structure removal, as well as the fill material between the bin walls, would be placed in the first reaches of the main canal and covered with native material.

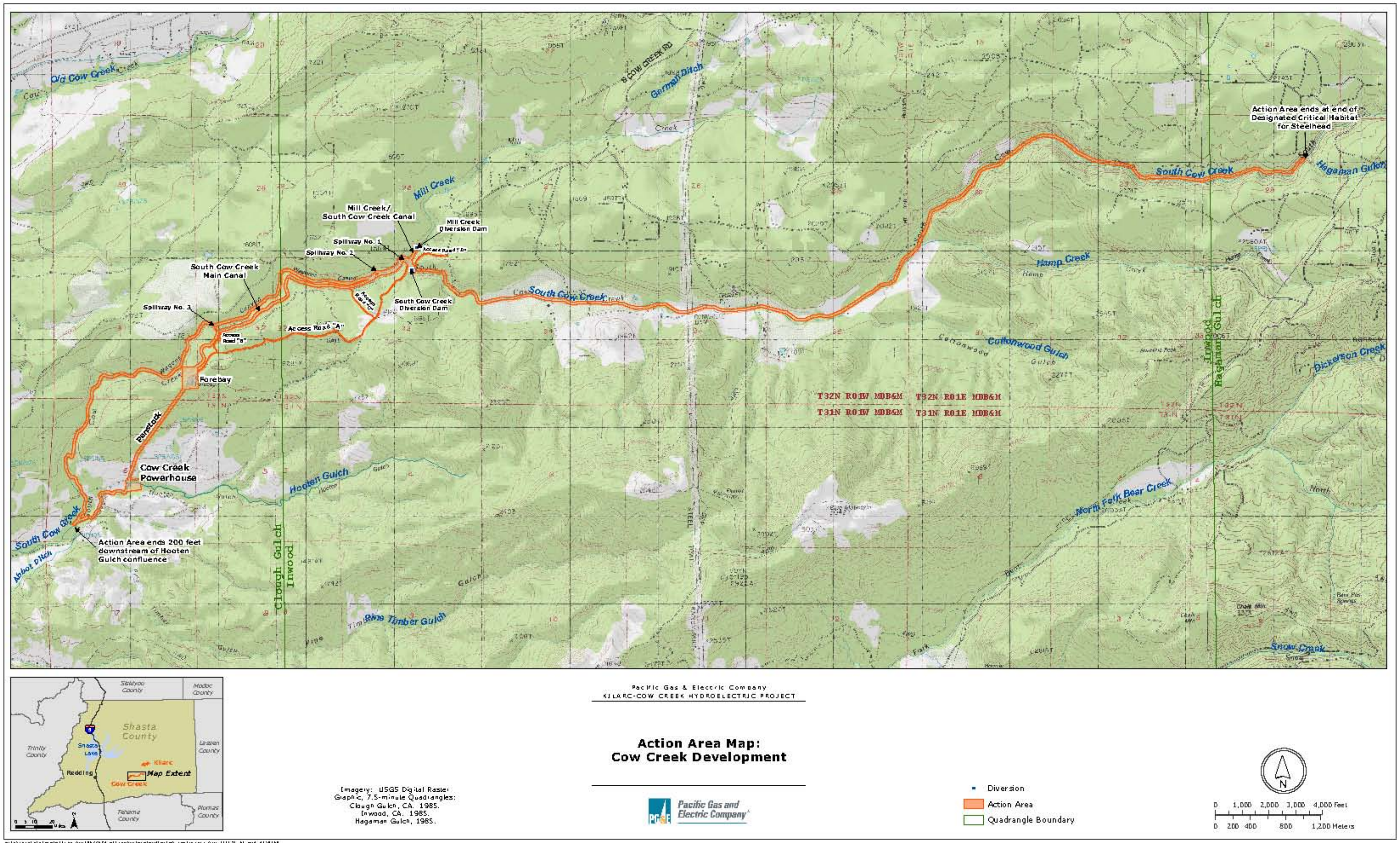

Figure 2. Cow Creek Development.

Decommissioning would also include removing all equipment at the diversion dam site, including electrical, mechanical devices, gates, screens, rakes, exposed rebar, metal cables, crib dam sheet metal panels, tie bars and drainage pipes. Equipment removal would minimize environmental damage to the surrounding vicinity.

Mill Creek Diversion Dam and Canal Intake

The Mill Creek Diversion Dam is located about 0.1 miles upstream of Mill Creek's natural confluence with South Cow Creek and diverts water from Mill Creek into the Mill Creek-South Cow Creek Canal. The dam is a concrete structure, 40.3 feet long and 2.5 feet high set on top of a bedrock slab. Decommissioning would activities include demolition and removal of the diversion, gate and supporting structure from the site. Concrete from the dam and guide walls would be buried in the canal.

South Cow Creek Main Canal Tunnel

The South Cow Creek Main Canal, including the tunnel, is a little over 2 miles long and approximately 13 feet wide and 4.8 feet deep. It has a capacity of 50 cubic feet per second (cfs) and an average grade of 0.0015 percent. Approximately 0.12 mile of the canal is lined with shotcrete and approximately 1.9 miles are unlined. The tunnel is about 200 feet long and is 6 feet wide by 6.8 feet tall. Two additional subfeatures are located along the canal: a cross-over flume and a cat bridge. There is limited elevation and watershed drainage above the canal, with a significant percentage of seasonal runoff crossing the canal on a single cross-over flume. Abandoning the canals in place, with strategic breaching, would be the preferred alternative for private landowners on whose property the canal is located. For the earthen section of the canal, strategic breaching would address storm runoff and avoid potential erosion/sediment issues. The short, shotcrete-lined canal segment from the diversion structure to the bridge would have the shotcrete removed and placed in the bottom of the canal. The canal segment would then be filled with material from the berm, burying the shotcrete.

The cross-over flume is a metal structure that could be easily removed. Given the minimal amount of runoff from uphill sources and the difficulty of maintaining the structure after abandonment, the recommendation is to remove the flume. Removal could be done primarily through unbolting or cutting metal connections. Foundations would be left in place to avoid disturbance to the steep slopes. The cat bridge is a substantial structure tied into the walls of the canal. The bridge would be abandoned in place to allow access across the dry canal. The tunnel section would be plugged with concrete at its upstream and downstream ends (for public safety) and abandoned in place. The spillways (two or three) would be modified such that the spill height elevation would be the same as the canal bottom.

Mill Creek-South Cow Creek Canal

The Mill Creek-South Cow Creek Canal is unlined, with a 5-foot-long by 3.3-foot-deep cross section, and has a total length of 0.17 mile, a capacity of 10 cfs and an average grade of 0.0021 percent. Decommissioning activities would consist of abandoning the canal and filling it with excavated dam material covered with natural material, where reasonably feasible, to minimize environmental disturbance of the berm. This would be the preferred alternative for private landowners on whose property the canal is located. Strategic breaching would be implemented to prevent retention of runoff water, where necessary.

Cow Creek Forebay Dam and Forebay

Cow Creek Forebay has a gross and useable storage capacity of 5.4 af at an elevation of 1,537.2 feet above mean sea level (MSL), and a surface area of 1 acre. The Cow Creek Forebay is comprised of a forebay dam, an intake structure and a spillway. The dam is an earth-filled berm and has a maximum height of 16 feet, a maximum base of 54 feet and a crest length of 653 feet. The spillway is 49.7 feet wide, 1.7 feet deep, and has a rated capacity of 50 cfs with 1.2 feet of freeboard. The spillway is a side discharge overflow section of shotcrete reinforcement leading to a natural waterway with the upper portion also armored with shotcrete.

The intake structure has a 42-inch slide gate, hydraulically operated and protected by a trash rack. The intake consists of a concrete structure supporting a control gate and automated trash rake. The outlet structure consists of a submerged 42-inch pipe which transitions into the penstock. A metal catwalk provides access to the intake and Corrugated Metal Pipe (CMP) telemetry shafts.

During decommissioning, the forebay would be dewatered to the extent practicable, although some small pools of water may remain, and all additional removal work would occur in the dry. By necessity, this would occur after the canal has been dewatered. Work would involve removing the forebay by backfilling with the adjacent berm material, grading, and reseeding. Removal of the outlet structure would consist of removing structural steel elements, cutting off corrugated metal pipe flush with the bottom, breaking up concrete, and backfilling. Broken concrete would be placed in the forebay and covered with earth. The work would include removing the mechanical trash rake and the demolition and removal of the concrete walls. Below-grade structures would be left in place and graded over. The spillway would be abandoned in place to minimize disturbance to the slope that would be caused by its removal.

Cow Creek Penstock

The Cow Creek Penstock is a 4,487-foot-long buried steel pipe. Beginning at the upstream end, the first 15 feet of penstock consist of 0.19-inch-thick steel pipe, with a diameter that tapers from 42 to 36 inches. The next 766 feet consist of 36-inch-diameter, 0.5-inch welded steel pipe. The final 3,706 feet are made of riveted steel with a 30-inch diameter and plate thickness that varies from 0.19 to 0.44 inches and includes a short tapered section.

The penstock would be decommissioned and abandoned in place to minimize site disturbance. The upstream and downstream ends of the penstock would be plugged with an engineered concrete block to prevent access. Since it does not enter the water and will be left in place, decommissioning the penstock is not expected to have any effect on federally listed fish species and their habitat.

Cow Creek Powerhouse, Switchyard and Tailrace

The Cow Creek Powerhouse is a 53.5-foot by 35-foot steel truss structure (plan dimensions) composed of cut stone walls and a corrugated metal roof. The powerhouse contains two generators and other electric and mechanical equipment. The switchyard is located immediately adjacent to the powerhouse. The switchyard includes a three-phase, oil-immersed, self-cooled outdoor unit. PG&E's interconnected transmission system passes through the powerhouse switchyard via a 70-foot-long, 60-kilovolt transmission tap line which would remain in place. After water passes through the turbines in the Cow Creek Powerhouse it leaves the powerhouse and flows into the tailrace that in turn discharges to Hooten Gulch.

Hooten Gulch is a low-gradient, steep-banked stream. The substrate within the gulch consists mainly of cobble, with lesser components of gravel and boulder. The lower portion of Hooten Gulch (about 0.5 mile) carries tailrace water from the Cow Creek Powerhouse to South Cow Creek, resulting in this portion of Hooten Gulch having year-round flows, except during outages. Releases from the powerhouse typically range from a high of about 50 cfs in the winter to a low of about 3 cfs during the summer. Decommissioning would end artificial flows within Hooten Gulch, which would return to its natural ephemeral condition. Relicensing studies conducted in 2003 noted that Hooten Gulch upstream of the powerhouse was dry in the summer and fall months, indicating an ephemeral channel. This channel was also carrying very little flow (less than 0.1 cfs) during a site visit in April 2008. However, based on the channel morphology, occasional episodic high flow events, probably during the winter and spring seasons, are capable of eroding banks, scouring pools, and transporting sediments (PG&E 2009). The banks along Hooten Gulch are heavily eroded. A short section of the channel banks and bottom (approximately 170 feet) near the powerhouse are lined with gunite to protect the bank, parking lot and powerhouse from erosion. The Abbott Ditch Diversion Dam (not Project-related), currently blocks access to Hooten Gulch for anadromous fish.

Decommissioning of the powerhouse and switchyard would involve removing the turbines, generators, and all associated electrical and mechanical equipment and abandoning the structure in place. The turbine pits (located inside the powerhouse structure) would be filled with mass concrete or other suitable fill material, and capped with concrete to be flush with the surrounding floor. The powerhouse structure would be secured and left in place, leaving the option for future reuse of the structure available.

The switchyard would be dismantled and all equipment and structures would be removed. Decommissioning the powerhouse and switchyard is not expected to have any effect on listed species. Decommissioning the Cow Creek Powerhouse Tailrace would involve abandoning it in place, backfilling with adjacent berm material, grading, and reseeding.

The shotcrete armor in Hooten Gulch adjacent to the powerhouse would be removed. New bank stabilization measures, designed to be more fish and habitat friendly, would be installed to protect the bank, parking lot and powerhouse from erosion. These measures will be developed in consultation with CDFG and NMFS. The shotcrete would be buried in the tailrace and covered with natural material.

Cow Creek Access Roads and Staging Areas

The Cow Creek Development is accessed from the southwest on State Route (SR) 44 via South Cow Creek Road. South Cow Creek Road, a paved county road, connects with SR 44 approximately 35 miles east of Redding. South Cow Creek Road has been defined by Shasta County to end at the pavement terminus where it is gated. The unpaved road continues over private property to the Cow Creek Powerhouse a short distance beyond. From there, over private lands, a single-lane, unpaved, rough road, portions of which have steep grades, continues on and connects unpaved spur roads (access roads) that provide access to the Cow Creek Forebay and South Cow Creek Diversion Dam (Road Segment C-1 to C-3). The South Cow Creek Diversion Dam and Cow Creek Forebay can also be reached from the northeast through gates at the county-defined end of South Cow Creek Road on the Whitmore side. From here, the Project can be reached via an unpaved, single-lane road that runs across private land (C-9 to C-3 and C-2). This road segment crosses South Cow Creek over a wet crossing. The county-maintained portion of South Cow Creek Road intersects Whitmore Road approximately 2 miles east of Whitmore. Since the county-maintained portion of South Cow Creek Road is gated on the southwest and northeast of the Project, the Cow Creek Development is inaccessible to the public.

Access for the Cow Creek Development features is discussed below. In general, the Cow Creek Powerhouse can be accessed from roads to the southwest, and the South Cow Creek Diversion Dam and Forebay can be accessed from roads to the northeast. An existing network of roads, both in and outside of the FERC Project boundary, interconnects all of the development's features.

Project decommissioning may require improvements to existing roads for the equipment required for decommissioning the Project facilities. Existing access roads fall both within and outside of the Project boundary and cross a mix of PG&E and private lands. Improvements to existing roads would be limited to the existing road bed and would consist primarily of surface smoothing and pothole filling with a motor grader. Because the equipment proposed for the decommissioning is relatively small due to the small size of the Project features, it would have a low impact on existing roads. Typical equipment may include multi-terrain loaders and rubber-tired backhoe loaders similar to Caterpillar models 297C and 450E, respectively. Construction equipment would be off-loaded from haulers at a central staging area (described below). From here, this equipment would travel under their own power to the work sites to minimize the need for extensive road improvements.

The staging area would be located in a wide and relatively flat grassland area at the main intersection of several access roads on the ridge above the South Cow Creek Diversion Dam and South Cow Creek Main Canal (C3, Figure 2-3). This area is the central point proposed for offloading and staging of construction equipment to avoid heavy truck traffic on the small, less improved connecting road segments. It is anticipated that the contractor would stage equipment used to decommission Hooten Gulch and the Cow Creek Powerhouse Tailrace in the powerhouse parking area.

The bullets below describe the improvement(s) needed to each road segment in the network of roads that interconnects all six of the development features. This section is followed by the avoidance and minimization measures that would be applied to all improvement activities.

- **Cow Creek Powerhouse**. Access to the Cow Creek Powerhouse is via SR 44 and South Cow Creek Road. The Cow Creek Powerhouse is approximately 0.5 mile past a locked gate on an unpaved road. The unpaved road into the Cow Creek Powerhouse is in very good condition and would not require any improvements for access.
- **Cow Creek Penstock.** Access to the lower end of the Cow Creek Penstock is from the Cow Creek Powerhouse on access roads described above. The upper end of the penstock is accessible from the Cow Creek Forebay on access roads described in the Cow Creek Forebay section below. Because removal of the buried Cow Creek Penstock is not recommended, no access road is proposed for this feature.
- **Cow Creek Forebay**. The Cow Creek Forebay is accessed along the main access road segment connecting the South Cow Creek Diversion Dam to the Cow Creek Forebay, designated as C-3 to C-17. This road segment is approximately 2 miles long and needs only minor improvement to be suitable for construction access. There are two options for reaching the main access road segment C-3 to C-17: one from the Cow Creek Powerhouse on road segment C-1 to C-18, and the second from the north side on road segment C-9 to C-3. Road segment C-1 to C-18 is approximately 2.25 miles long and climbs over 800 feet in elevation. Although the average grade is 6.5 percent, there are segments that are much steeper. In addition, there are areas on this road segment that appear to be subject to localized slumping and over-road flows, and are generally in bad condition. Given the length of the road and required improvements, the road segment C-1 to C-18 is not recommended for use or improvement. Road segment C-9 to C-3 is approximately 1 mile long. This road segment crosses South Cow Creek at a paved wet crossing and climbs less than 100 total feet to the main access road segment road, C-3 to C-17, although it may have a steeper grade into and out of South Cow Creek. The road segment C-9 to C-3 and C-3 to C-17 is recommended for access to Cow Creek Forebay because it is in much better condition than C-1 to C-18 and is in need of only minor improvement.
- **South Cow Creek Main Canal.** The South Cow Creek Main Canal can be accessed at four main points along its length: from the South Cow Creek Diversion Dam, the cross-over flume, the cat bridge, and the Cow Creek Forebay. The access is described as spurs from C-3, since C-3 is the main intersection of several access roads on the ridge above the South Cow Creek Diversion Dam and South Cow Creek Main Canal. As described in the Cow Creek Forebay section above, road access is recommended from the north side of the Project (from C-9 to C-3). Access to the South Cow Creek Diversion Dam is from C-3 to C-4. Access to the Cow Creek Forebay is from road segment C-3 to C-17. Access to the cat bridge is from C-3 through C-13 to C-14. C-13 to C-14 is a road about 0.25 miles long in need of minor to moderate improvement. The cross-over flume can be accessed from C-3 through C-10 to C-11. However, C-10 to C-11 is a 0.25-mile-long rough road that only accesses the cross-over flume from the uphill side and would require moderate to major improvement. Therefore, this road is not recommended for use. The flume can instead be accessed from the canal side via C-3 to C-14 (recommended for the cat bridge access).

- **South Cow Creek Diversion Dam and Associated Structures.** The South Cow Creek Diversion Dam can be accessed from the north side via road segments C-9 to C-7, a 0.25-mile-long segment in the Project boundary needing moderate improvement, and C-7 to C-6, a 0.125-mile-long segment in the boundary needing moderate to major improvement. This northern approach from C-7 to C-6 via C-9 has a very steep final grade that is not suitable for equipment use. Use of this segment would likely cause heavy impacts to the road surface and immediate surroundings, requiring extensive rehabilitation. Therefore, this approach is not recommended for access to the South Cow Creek Diversion Dam. The south side of the South Cow Creek Diversion Dam and all the appurtenant structures can be accessed from C-9, through the wet crossing, to C-3 and on to C-4, which is the recommended access route. However, the northern end of the road segment from C-3 to C-4 is overly steep for over-the-road transport vehicle access, and there is limited room to maneuver at the bottom. Therefore, construction equipment would be off-loaded near C-3 and driven to the construction site, as described in the South Cow Creek Main Canal section above.
- **Mill Creek Diversion Dam and Mill Creek-South Cow Creek Canal.** Mill Creek Diversion can be accessed from road segment C-9 to C-7 and from a short, rough segment of logging access between points C-7 and C-8. This segment is approximately 373 feet long and would require moderate to major improvement; however it is not recommended for access. The Mill Creek-South Cow Creek Canal would be worked from the canal and would not require an access road. Light equipment and hand tools have been recommended for decommissioning the Mill Creek Diversion and the Mill Creek-South Cow Creek Canal. As the canal is decommissioned, it could serve as an access to reach the portion of the north bank retaining wall of the South Cow Creek Diversion Dam that is to remain in place for the associated minor backfilling and grading. This route is not recommended for heavier equipment access to the South Cow Creek Diversion Dam.

Project roads would either be left in place or decommissioned, depending on landowner preferences. If roads are to be decommissioned, the surface of these roads would be scarified and seeded. Barriers/obstacles would be installed as requested to limit future access.

b. *Kilarc Development*

The Kilarc Development is located in the Old Cow Creek sub-watershed. The sub-watershed encompasses approximately 80 square miles, and the drainage area at the Kilarc Main Canal Diversion Dam is 23.8 square miles. The average yearly runoff at the dam is 48,900 af. Approximately 55 percent of the annual runoff is diverted from the stream to the Kilarc Powerhouse. The estimated dependable generating capacity of the Kilarc Development is approximately 1.2 megawatts and the estimated average annual energy generated is 19.1 million kwh.

The Kilarc Development features include:

- Kilarc Main Canal Diversion Dam (a.k.a. Kilarc Diversion Dam)
- Kilarc Main Canal
- Kilarc Forebay and Forebay Dam

- Kilarc Penstock
- Kilarc Powerhouse, Switchyard, and Tailrace
- North Canyon Creek Diversion Dam and Canal
- South Canyon Creek Diversion Dam and Canal
- South Canyon Creek Siphon
- Kilarc Access Roads and Staging Areas

Kilarc Powerhouse is supplied with water diverted from North Canyon, South Canyon, and Old Cow Creeks. The North Canyon Creek Canal diverts water from North Canyon Creek to South Canyon Creek. Water from South Canyon Creek is diverted to South Canyon Creek Canal, which enters the South Canyon Creek Siphon and then the Kilarc Main Canal.
Neither North Canyon nor South Canyon Creek diversions have been operated in several years. Water from Old Cow Creek is also diverted by the Kilarc Diversion Dam into the Kilarc Main Canal which flows to the Kilarc Forebay. From the Kilarc Forebay, water flows through a 4,801-foot-long buried penstock to the Kilarc Powerhouse. Near the powerhouse, the water is returned to Old Cow Creek (Figure 3).

Kilarc Main Canal Diversion Dam (a.k.a. Kilarc Diversion Dam)

The Kilarc Diversion Dam diverts water from Old Cow Creek into the Kilarc Main Canal. The dam is a concrete structure 83 feet long and 8 feet high that sits on a natural bedrock sill. During decommissioning the concrete portion that was added to the existing natural bedrock sill would be removed. Work would include removing the dam structures, guide walls, the diversion gate and frame, the gate operator, and debris from the site. No Project structures would be left in the stream channel where they would affect fish passage.

Kilarc Main Canal

The Kilarc Main Canal has a total length of 3.65 miles with a capacity of 52 cfs and an average grade of 0.0021 percent. The conveyance system consists of 2.03 miles of canal, 1.44 miles of metal and wood flume, and 0.18 mile of 6-foot-wide by 7-foot-high wood-lined tunnel.
The earthen sections of the canal would either be abandoned in place or filled, depending on accessibility to that section by construction equipment. Filling would involve excavating one-half of the height of the canal berm and using the excavated materials as fill (the canal is constructed of native material and has no lining). If filled, the surface would be graded to drain rainwater and snowmelt and appropriate erosion control measures would be implemented. If abandoned in place, the canal would be strategically breached to address storm runoff and avoid potential erosion/sediment issues.

The method used to decommission the concrete and shotcrete-lined canal sections of canal will vary depending on access to that section by construction equipment. If the canal is accessible by construction equipment, the concrete walls and bottom would be broken up and pushed into the canal bottom. If there is little to no accessibility for heavy equipment to the canal section, the canal would be abandoned in place. Abandoned-in-place sections would be strategically breached to address storm runoff and avoid potential erosion/sediment issues. Concrete sections with the downhill wall exposed may be hand cut, broken along the bottom edge, and pushed into the canal bottom. If excess native material is readily available, the canal would be filled with excavated berm material and graded. Erosion control measures will be implemented for all sections. Final disposition of sections not accessible by construction equipment will be determined on a case-by case-basis and the practicality of hand removal options will be considered.

The flume portions of the canal would be removed to their foundations, anchor bolts would be saw cut or ground flush, and foundation piers would be left in place. Gates, frames, gate operators, support structures, the catwalk, guidewalls, a shed, and any foundations to grade would be removed. The overflow spillway would be demolished and filled and graded, and appropriate erosion control measures would be implemented. The thermal electric generator and building would be removed along with its slab or foundation concrete. Decommissioning work would include grading and installing rip-rap, as required.

Kilarc Forebay and Forebay Dam

The Kilarc Forebay is comprised of a forebay dam, an intake structure, and a spillway. Kilarc Forebay has a surface area of 4.5 acres and a gross and usable storage capacity of 30.4 af at an elevation of 3,782.4 feet above MSL. The dam at Kilarc Forebay is earth filled and has a maximum height of 13 feet, a maximum base width of 43 feet wide, and a crest length of 1,419 feet. The outlet structure (entrance to the penstock) has a 48-inch slide gate with a manual lift, protected by a trash rack over the opening to the Kilarc Penstock. The spillway is 10 feet wide, 3 feet deep, and has a rated capacity of 50 cfs with 1.6 feet of freeboard.

During decommissioning, the forebay would be dewatered, although a few small pools of water may remain. The forebay would be filled with excavated berm and dam material, graded for drainage, and seeded with appropriate seed mix to minimize the potential for erosion. The picnic tables and site furnishing would be removed. The restroom buildings and slabs would be demolished and removed and the toilet vaults would be pumped, backfilled, and abandoned in place.

Decommissioning the forebay dam would include removing the trash rack, telemetry, and electrical equipment located at the downstream end of Kilarc Main Canal, where it flows into the forebay; demolishing and removing fencing and structures, along with any concrete foundations to grade; and backfilling the culvert located under the bridge when the canal is backfilled. The overflow spillway would be demolished, filled, and graded as part of reservoir fill work while implementing appropriate erosion control measures (described below). The bridge and platform would be demolished and removed and the outlet shaft at the bottom of the reservoir would be cut off. Concrete supports, if any, would be left in the reservoir bottom and covered by fill during reservoir backfilling operations.

Kilarc Penstock

The Kilarc Penstock is a 4,801 foot-long buried steel pipe made of riveted steel with a diameter that varies from 36 to 48 inches and a plate thickness that varies from 0.19 to 0.25 inches. The maximum flow capacity is 43 cfs.

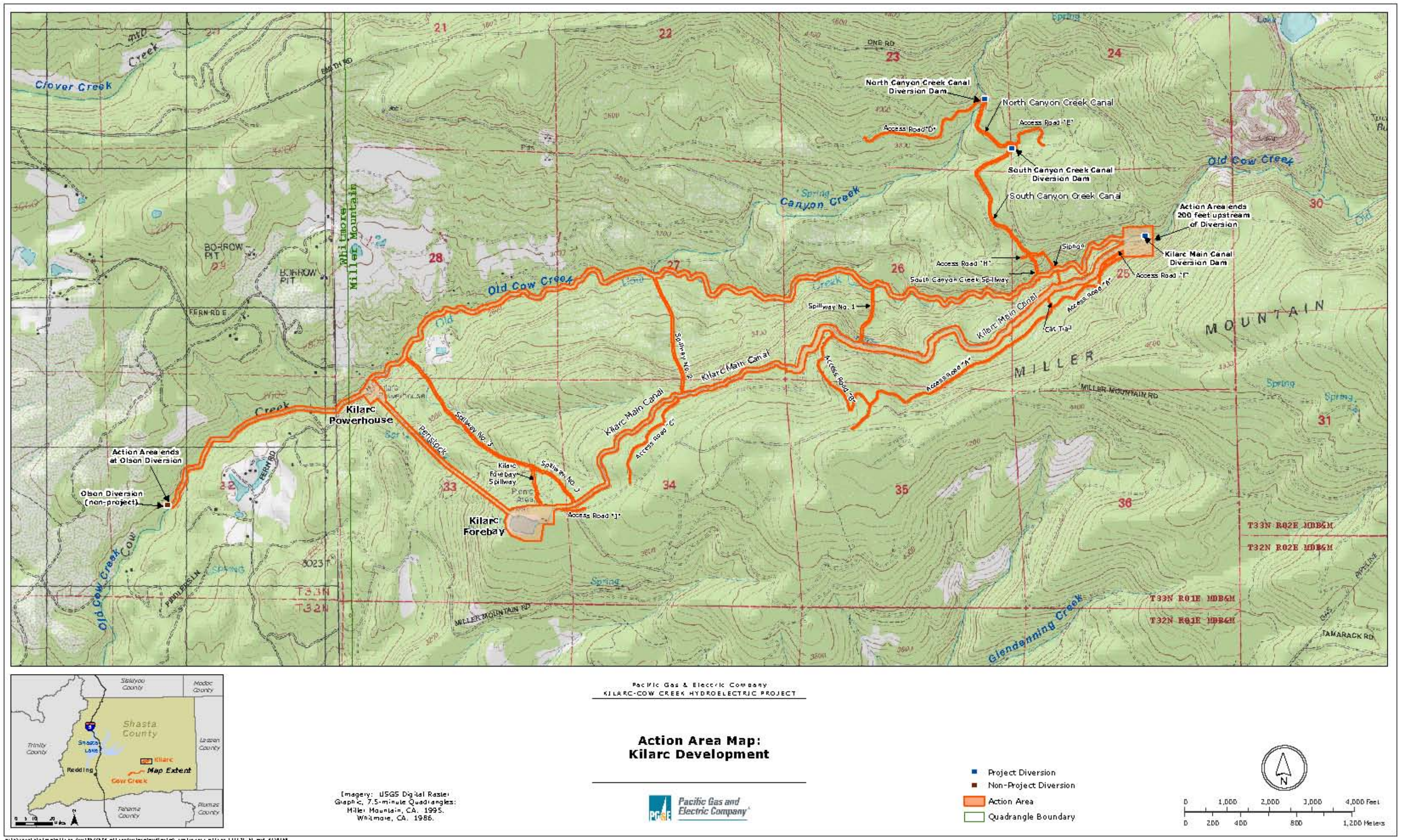

Figure 3. Kilarc Development.

Decommissioning work on the penstock would include plugging the upper and lower ends of the pipe with concrete; cutting off the surge tower, removing it, and placing a welded steel plate over the opening; and grading to cover the exposed section at the surge tower. Because removal of the buried pipe would cause significant site disturbance at a significant cost, the buried pipe would be left in place. Since it does not enter the water and will be left in place, decommissioning the penstock is not expected to have any effect on listed species.

Kilarc Powerhouse, Switchyard, and Tailrace

The Kilarc Powerhouse is a 65-foot by 40-foot steel frame structure composed of rubble masonry walls and a corrugated iron roof. The powerhouse contains two turbines and generators and other electrical mechanical equipment. The Kilarc Switchyard includes an oil-immersed, outdoor type transformer. PG&E's interconnected transmission system passes through the powerhouse switchyard via a 7-foot-long, 60-kilovolt-amperes transmission line tap, which would remain in place. After water passes through the turbines in the Kilarc Creek Powerhouse it enters a tailrace that in turn discharges to Old Cow Creek.

As with the Cow Creek Powerhouse and Switchyard, decommissioning of the Kilarc Powerhouse and Switchyard would involve removing the turbines and generators, dismantling and removing all associated electrical and mechanical equipment, and abandoning the structure in place. The turbine pits (located inside the powerhouse structure) would be filled with mass concrete or other suitable fill material and capped with concrete to be flush with the surrounding floor. All exterior openings would be sealed in a manner dependent on their use. Draft tube openings would be sealed with formed concrete plugs; penetrations for electrical connections would be sealed with foam type filler or plywood, depending on size; windows would be left in place but covered with plywood cut to match the opening; and doors and windows would be closed and locked but not permanently sealed. The powerhouse structure would be secured and left in place during decommissioning. An option for future reuse of the structure would be preserved.

The switchyard would be left in place because it is an integral part of the PG&E interconnected transmission system. Decommissioning the powerhouse and switchyard is not expected to have any effect on listed species.

Decommissioning the tailrace would involve abandoning the tailrace in place, backfilling to the confluence using local earth material, grading, and reseeding.

North and South Canyon Creek Diversion Dams and Canals

A system of dams, canals and a siphon collect water from North Creek and Canyon Creek and carry it to the Kilarc Main Canal. The North Canyon Creek Canal diverts water from North Canyon Creek to South Canyon Creek. Water from South Canyon Creek is diverted to South Canyon Creek Canal, which enters Canyon Creek Siphon and then the Kilarc Main Canal. Water is diverted from North Canyon Creek into the North Canyon Creek Canal at the North Canyon Creek Diversion Dam. The dam is a timber structure, 9.9 feet long by 1 foot high with a crest elevation of 3,939.5 feet above MSL. The North Canyon Creek Canal is a small unlined canal about 3 feet wide by 1.5 feet deep and 0.35 mile long. The canal has a capacity of 2.5 cfs and an average grade of 0.0021 percent. The canal delivers water to a point just upstream of the South Canyon Creek Diversion Dam.

The South Canyon Creek Diversion Dam is a concrete structure, 37.8 feet long and 3 feet high, with a crest elevation of 3,893.6 feet above MSL. It diverts water from South Canyon Creek into the South Canyon Creek Canal. The South Canyon Creek Canal has a total length of 0.74 mile, and consists of 0.71 mile of unlined canal, 4 feet wide by 2 feet deep, and 0.03 mile of flume, 2 feet wide by 1.8 feet deep. The canal has a capacity of 7.5 cfs and an average grade of 0.0021 percent. The South Canyon Creek Siphon conveys water from South Canyon Creek Canal to the Kilarc Main Canal. The siphon consists of a 0.17 mile, 12-inch diameter pipe.

Decommissioning the North Canyon Creek Diversion Dam would involve removing the wooden stream bank supports and bottom boards. A small wooden structure that is part of the dam would remain in place to minimize site disturbance caused by difficult access. Decommissioning the South Canyon Creek Diversion Dam would involve removing the diversion walls to natural ground or streambed level, gate, operating mechanism, and all other concrete components.

Options for decommissioning the earthen sections of the North Canyon Creek and South Canyon Creek Canals include either abandoning the canals in place or filling, depending on accessibility to the canal section. Filling would occur if the canals are fully accessible, and would involve excavating one-half of the height of the canal berm and using the excavated materials as fill (the canal is constructed of native material and has no lining). The surface would be graded to drain rainwater and snowmelt and appropriate erosion control measures would be implemented consistent with BMPs. If access is limited the canals would be abandoned in place, through filling and strategic breaching, to address storm runoff and avoid potential erosion/sediment issues.

Decommissioning South Canyon Creek flume would include removing wooden and corrugated metal pipe structures. Concrete foundations would be left in place. Decommissioning the South Canyon Creek siphon would include removing trash bars and concrete wing walls, collapsing a rubble wall and burying it with excavated berm material. All above-grade pipes would be removed and a cast-in-place concrete block would be installed at the vertical intake. Buried portions of the siphon would be capped and abandoned in place.

Kilarc Access Roads and Staging Areas

The Kilarc Development is accessed from Fern Road East via Whitmore Road. A junction connecting to Whitmore Road lies approximately 30 miles east of Redding along SR 44. The paved Whitmore Road transitions into the improved partially graveled Miller Mountain Road as far as the Kilarc Forebay intake structure. Miller Mountain Road continues on, transitioning into a Project road for the length of the Kilarc Main Canal system (Figure 2-5). Access to the North and South Canyon portion of the Kilarc Development from Fern Road is via Oak Run Fern Road to Smith Road.

The Proposed Action may require improving existing roads and/or new road segments to allow access for equipment required for decommissioning the Project facilities. Elevated flume structures prevent access to some canal segments, and therefore new temporary road segments are being considered that allow construction equipment to reach these canal segments. Eight of these canal segments are cut off by the elevated flume structures. In order to access these segments, 13 short potential access roads are being considered, encompassing about 0.5 mile in total distance, or two-thirds of an acre.

Two staging areas may be located at the upper end and lower end of the Kilarc Development. The exact locations have not yet been determined, but would be located to avoid any environmentally sensitive areas. These staging areas would be served by existing roads. Proposals for access road improvement, or development of temporary new road segments to Kilarc Development facilities, are presented below, followed by the avoidance and minimization measures that will be applied to these activities.

- **Kilarc Powerhouse.** The powerhouse is accessible from a paved road in Whitmore via Whitmore and Fern roads. No improvements are proposed for these roads.
- **Kilarc Forebay.** The Kilarc Forebay is accessed from Miller Mountain Road up to the Kilarc Forebay intake structure, K-5 (Figure 2-5). From K-5 to the Kilarc Forebay, access is along the existing recreation area roads and parking lot. No work is proposed for access all the way to the start of the Kilarc Forebay. Access from the Kilarc Forebay to overflow and spillway features would require improvements to Road Sections K-1 to K-2, K-2 to K-3, K-3 to K-4 and K-4 to K-5, forming a loop from the Kilarc Forebay to the overflow spillway and back to the intake structure. Less than 0.25 road miles would require minor improvements.
- **Kilarc Penstock.** The Kilarc Penstock is accessible at the lower end from the powerhouse and the upper end from the Kilarc Forebay. Removal of the buried Kilarc Penstock is not recommended, and therefore no access road is proposed for this feature.
- **Kilarc Main Canal**. The Project road that continues from Miller Mountain Road, from K-5 to the Kilarc Main Canal Diversion Dam at K-7, is approximately 3.2 miles long and in generally good condition, and would require only minor improvement with a motor grader. This road segment provides access to the two ends of the canal. Intermediate access is provided by Road Segments K-36 to K-38, K-25 to K-40, K-13 to K-14 and K-8 to K-9. With the exception of K-25 to K-40, these segments would require minor to moderate improvement to provide construction access. K-25 to K-40 is a very steep segment with a tight bend in the middle that would be difficult to improve for good access. An existing road on private property, K-6 to K-26, provides access to the same canal point on a much flatter route of about 1 mile in length and would require only moderate improvement. The canal is broken up along its length by a number of flumes that are designated for removal. Because of the terrain gaps bridged by the flumes, the canal is not crossable along its length by accessing one end or the other. Even with the intermediate roads described above, there are canal segments that cannot be accessed without new road segments. Typically, these proposed new road segments would be very short and would begin at an existing road near the canal. Without these new road segments, there are a number of canal segments that would have to be either abandoned in place or hand cut (as described under *Kilarc Main Canal*).

- **Kilarc Main Canal Diversion.** Access is via the main Project road K-5 to K-7, which has segments both inside and outside the Project boundary. This is a major logging road in reasonably good condition and would require minimum dressing with a motor grader.
- **North and South Canyon Creeks.** New, temporary road segments are proposed to allow access to canal segments that would be otherwise rendered inaccessible by elevated flume structures. Some of these proposed access roads would cross private property, and PG&E will discuss proposed access with the private property owners. Proposed new access roads serving eight canal locations would total approximately 0.5 mile (accounting for less than 9 percent of the access road total). Development of new access roads or access road improvements are not expected to have any effect on listed species. New and existing Project roads would either be left in place or decommissioned, depending on landowner preferences. Disposition of roads to be decommissioned would include scarifying and seeding the surfaces of any roads to be rehabilitated, and erecting barriers/obstacles as requested to limit future access.

B. Proposed Conservation Measures

1. <u>Proposed Conservation Measures</u>

a. *Cow Creek Development*

<u>South Cow Creek Diversion Dam and Appurtenant Structures</u>

1) Avoid Sensitive Periods for Steelhead and Chinook Salmon
The decommissioning work will be conducted from July through September when neither adult steelhead nor Chinook salmon of any life stage are present in South Cow Creek.

2) Isolate Construction Area and Conduct Fish Rescue in Instream Work Area
The construction area would be isolated from the active stream using temporary cofferdams/diversions or other such barriers. It is estimated that up to 400 feet of stream channel may need to be dewatered to remove the dam and excavate the pilot thalweg channel (see below). Water would be routed around the construction area in pipes or by removing the dam in two or more phases, while the isolated portion of the dam is removed. After the work area is isolated, a fish rescue would be conducted in about 400 feet of stream to remove any fish trapped in the work area. The fish rescue would be conducted using seines to the extent practicable, as this generally results in less potential for harm to the fish than electrofishing. Electrofishing may be conducted after seining is completed, to capture fish in areas where seining cannot be successfully implemented. These fish would be relocated to an adjacent section of stream with suitable habitat within South Cow Creek, identified in consultation with NMFS and CDFG. The work area would then be drained and all work would occur in the dried section of channel to minimize potential discharge of sediment or chemicals from construction equipment.

3) Meet NMFS Passage Guidelines for Anadromous Salmonids
A portion of the South Cow Creek Diversion Dam (i.e., the cut-off walls) may be left in place as a grade control structure. The top of the cut-off walls are at about the same elevation as the natural stream bed in this area and also approximate the elevation of the head of the downstream riffle. Because of this, it is not anticipated that the cut-off walls would form a passage barrier.

However, if such a barrier is formed, PG&E will modify these cut-off walls or implement other appropriate measures to meet NMFS passage guidelines (e.g., drop, velocity, depth and other site-specific factors) for anadromous salmonids (NMFS 2001). PG&E will consult with NMFS on designs to provide adequate fish passage.

4) Sediment Release Measures

Following removal of the South Cow Creek Diversion Dam, the downstream face of the sediment wedge left in place at the diversion structure would be reshaped to an appropriate angle of repose. A pilot thalweg would be formed to ensure temporary fish passage until the stored sediments have been transported by flow from the former impoundment site and to help advance the processes of natural channel formation at the knickpoint created by the dam removal. The following specifications will be incorporated into the pilot thalweg channel based on the current understanding of the site:

Excavation of a pilot thalweg through the sediment wedge that connects with the existing thalweg at a nearby upstream point to the thalweg immediately downstream of the dam.

- Shaping the pilot thalweg on site during the dam removal process.
- Dimensioning the pilot thalweg so that it has, at minimum, a 6-foot bottom width, which is approximately 20 percent of the 30-foot bankfull channel width downstream from the dam.
- Laying back the side slopes of the pilot thalweg to a natural, stable angle of repose.
- Construction of the thalweg channel so that the starting depth at the downstream end of the channel is approximately equivalent to the water surface elevation of the plunge pool immediately downstream from the dam.
- Incorporation of coarse bed-elements or other techniques into the pilot thalweg channel, to ensure appropriate depth and velocities for fish passage, as needed.

The final design will be based on the best available information at the time prior to implementation, in consultation with NMFS and CDFG. PG&E will make adjustments to the thalweg dimensions and elevation if site-specific conditions make it infeasible to construct the pilot channel to the recommended specifications at the dam site. A NMFS-approved biologist will inspect the thalweg channel, including where it passes over the cut-off walls, within one month after water has been returned to the stream to verify that the thalweg channel is passable. PG&E will provide notification to resource agencies prior to this monitoring so that agency staff may participate in this survey. If it appears the fish may not be able to readily pass through the channel, PG&E will work with NMFS and CDFG to make modifications to the channel to allow passage.

Sediments excavated from the South Cow Creek Diversion impoundment and within the bin walls (if not composed of non-native material) would be distributed along the channel margins. These native sediments would be placed so they do not interfere with riparian vegetation. These sediments and the stored sediments that were not disturbed during construction would be available for future recruitment during high flow events to downstream areas. It is estimated that up to approximately 150 cubic yards (0.09 af) of sediment behind South Cow Creek Diversion Dam would need to be removed in order to remove the dam itself, to help shape the sediment wedge against the upstream dam face, and to create a pilot thalweg channel. This would leave approximately 1,150 cubic yards (0.70 af) stored behind the dam, all of which would be mobilized over time by natural sediment transport processes. Non-native angular rock material (which may potentially be found between the bin walls of South Cow Creek Diversion Dam) would be disposed of locally at a suitable site (e.g., as canal fill) but would not be placed in the stream.

5) Monitor Passage Conditions Following Removal of South Cow Creek Diversion Dam
To assess the efficacy of the sediment release measure described above and monitor for any potential development of long-term barriers, PG&E will monitor fish passage conditions from upstream of the current sediment accumulations above the dam to a point approximately ten channel widths downstream of the dam after the diversions are removed.

Monitoring would be conducted for two years after completing the decommissioning of the diversion dam. In each year of monitoring, monitoring would be conducted once after the first major runoff event (as access conditions and staff safety allows) and once again later in the year during the low-flow season, when the condition of the streambed can be more easily assessed. A NMFS-approved biologist with experience in assessing fish passage will conduct the monitoring. The biologist will walk the stream segment described above and visually assess for any passage challenges arising from sediment movement (i.e., shallow riffles or bars) and obtain depth and velocity measurements at critical high elevation points. PG&E will provide notification to resource agencies including NMFS prior to monitoring so that agency staff may participate in this survey. PG&E will provide a summary of monitoring results at the conclusion of each year of monitoring to the NMFS, CDFG, USFWS, SWRCB, and FERC. In the event that decommissioning is followed by two dry water years, PG&E will consult with the agencies to determine if the second year of monitoring should be postponed. If this occurs, the second year of monitoring would be conducted under the Corps Section 404 permit.

If, during the monitoring, a long-term passage impediment is identified as a result of the diversions being removed, PG&E will consult with the CDFG, NMFS, and Corps under the Section 404 permit to determine appropriate measures to remedy the situation.

6) Bank Erosion at South Cow Creek Diversion Dam
To minimize potential impacts associated with bank erosion, a monitoring assessment would be performed after removal of the dam. A visual assessment with photographic documentation of the impounded sediment wedge and streambanks adjoining the perimeter of the former impoundment area would be conducted after spring runoff, as soon as weather permits access to the sites and flows are low enough that the streambanks can be easily observed. The visual assessment would be used to identify any areas of active erosion or undercutting, or areas that appear to be susceptible to erosion. Monitoring would be conducted for two years.

If during the monitoring assessment substantial erosion or bank undercutting is observed, erosion control measures would be implemented and installed, as feasible, in the channel. PG&E will adhere to standard procedures, including applicable measures developed by the United States Forest Service (USDA-FS) and published in *Water Quality Management for Forest System Lands* in California Best Management Practices (USDA-FS 2000). Bank erosion control measures will be designed in consultation with CDFG and the Regional Water Quality Control

Board—Central Valley Region (RWQCB-CVR) during the permitting process. These erosion control measures may include planting vegetation on the exposed banks to help in stabilization, use of geotextile fabric, dormant pole plantings, or other techniques that may be suitable, potentially in combination with rip-rap for stabilization. Any revegetation would be consistent with a Mitigation and Monitoring Plan (MMP).

7) Prepare and Implement a Mitigation and Monitoring Plan
PG&E will prepare and implement an MMP for impacts to riparian vegetation near the South Cow Creek Diversion Dam. The MMP will be developed in consultation with the Corps, CDFG, and RWQCB-CVR as part of the permitting process. The MMP will include mitigation areas, goals, the species to be used, as well as methods and performance criteria. Riparian vegetation requiring restoration or mitigation would be monitored for five years† following decommissioning.

8) Implement Soil Erosion and Sedimentation Control and Stormwater Pollution Prevention Best Management Practices
PG&E will design and implement site-specific Best Management Practices (BMPs) to avoid potential slope erosion and increased sedimentation in streams during and after construction activities at the South Cow Creek Diversion site. These BMPs will include restoration of natural drainage paths, and recontouring of slopes to match pre-existing slope morphology, where applicable. Revegetation would be implemented to increase bank stability, as described in Measure 7, above. Additionally, PG&E will implement stormwater pollution prevention BMPs, and include a monitoring and maintenance schedule to ensure BMP effectiveness for sediment control, spill containment, and post-construction measures. Soil erosion and sedimentation control and stormwater pollution prevention BMPs are general and will apply to all Project features. These measures are described in more detail below under *General Avoidance and Minimization Measures*.

<u>Mill Creek Diversion Dam and Canal Intake</u>

1) Isolate Construction Area and Conduct Fish Rescue in Instream Work Area
The construction area would be isolated from the active stream using temporary cofferdams/diversions or other such barriers. After a work area is isolated, a fish rescue would be conducted in about 100 feet of stream to remove any fish trapped in the work area. The fish rescue would be conducted using seines to the extent practicable, as this generally results in less potential for harm to the fish than electrofishing. Electrofishing may be conducted after seining is completed, to capture fish in areas where seining cannot be successfully implemented. These fish would be relocated to an adjacent section of stream with suitable habitat.

2) Implement Soil Erosion and Sedimentation Control and Stormwater Pollution Prevention Best Management Practices
Soil erosion and sedimentation control and stormwater pollution prevention BMPs will be identified and implemented for all Project features, as described below under *General Avoidance and Minimization Measures*.

South Cow Creek Main Canal and Tunnel

1) Retain Fish Screen in South Cow Creek Main Canal

The fish screen at the diversion dam would be kept in place until after any fish rescue is complete and the head of the canal is closed off to isolate it from the active channel, so fish can no longer enter the canal. Once the fish rescue is accomplished, the head of the canal would be closed before the screen is removed.

2) Conduct Fish Rescue in Canals

Prior to decommissioning, a fish rescue would be conducted to remove any fish in the canal. The rescue would target salmonids and lamprey (*Lampetra* spp.) for rescue. Non-native fish such as golden shiner (*Nolemigonus crysoleucas*) would not be rescued. The rescue would be implemented by partly draining the canal and then seining and electrofishing to remove fish. The fish rescue would be conducted using seines and fyke nets to the extent practicable, as this generally results in less potential for harm to the fish than electrofishing. Electrofishing may be conducted afterwards in areas where seining cannot be successfully implemented. Rescued fish would be relocated to an area to be identified in consultation with CDFG and NMFS, unless consultation with these agencies determines that these fish should not be rescued and relocated. Non-native fish would not be relocated into anadromous waters. Once the fish rescue is complete, the canal would be allowed to dewater completely and decommissioning would commence.

3) Implement Soil Erosion and Sedimentation Control and Stormwater Pollution Prevention Best Management Practices

All natural drainage paths along the canal and tunnel will be identified during pre-construction surveys. Slopes prone to instability will be identified, and site-specific BMPs will be adopted to avoid potential slope erosion and increased sedimentation in streams during construction activities and after decommissioning is complete, including restoration of natural drainage paths and recontouring of slopes to match pre-existing slope morphology, as feasible. Revegetation would be implemented to increase bank stability, and stormwater pollution prevention BMPs would be implemented, as described below under *General Avoidance and Minimization Measures*.

Mill Creek-South Cow Creek Canal

Avoidance and Minimization Measures 1, 2 and 3 from the South Cow Creek Main Canal (Section 2.3.1.3) would also be implemented at the Mill Creek-South Cow Creek Canal.

Cow Creek Forebay Dam and Forebay

1) Isolate Construction Area and Conduct Fish Rescue in Cow Creek Forebay

A fish rescue would be conducted to remove fish species trapped in the Cow Creek Forebay. The rescue would target salmonids and lamprey for rescue. Non-native fish, such as golden shiner, would not be rescued. To facilitate the fish rescue, the forebay may be drained to a few isolated pools to concentrate the fish. The fish rescue would be conducted using seines or electrofishing depending on site-specific conditions. Rescued fish would be relocated to an area to be identified in consultation with CDFG and NMFS. Non-native fish would not be relocated into anadromous waters.

2) Implement Soil Erosion and Sedimentation Control and Stormwater Pollution Prevention Best Management Practices

Soil erosion and sedimentation control and stormwater pollution prevention BMPs will be identified and implemented, as described below under *General Avoidance and Minimization Measures.*

<u>Cow Creek Powerhouse, Switchyard and Tailrace</u>

1) Discontinue Cow Creek Powerhouse Operations in Spring

During decommissioning, operations at Cow Creek Powerhouse would be discontinued in the spring when natural flow is present in Hooten Gulch. This would allow fish to move downstream naturally as flows decline.

2) Remove Hooten Gulch Gunite and Implement Bank Stability Measures during the Dry Season

PG&E will remove the gunite in Hooten Gulch and install any replacement bank stabilization measures (detailed in “General Measures” section) during the summer when the gulch is dry. This will minimize the potential for turbidity and contaminant impacts, as no fish or aquatic organisms would be present.

3) Prepare and Implement a Mitigation and Monitoring Plan

PG&E will prepare and implement an MMP for impacts to riparian vegetation at Hooten Gulch, as described in Measure 7 of Section 2.3.1.1.

4) Implement Soil Erosion and Sedimentation Control and Stormwater Pollution Prevention Best Management Practices

Soil erosion and sedimentation control and stormwater pollution prevention BMPs will be identified and implemented during decommissioning work in Hooten Gulch and the tailrace, as described below under *General Avoidance and Minimization Measures*.

<u>Cow Creek Access Roads and Staging Areas</u>

1) Implement Soil Erosion and Sedimentation Control and Stormwater Pollution Prevention Best Management Practices

Potential erosion from increased use and/or expansion of access roads and construction and/or use of staging areas throughout the Cow Creek Development will be addressed by soil erosion and sedimentation control BMPs. Artificial swales, culverts, and/or other structures will be designed to direct runoff away from disturbed areas based on the natural drainage features of the area. Additional information on soil erosion and sedimentation control and stormwater pollution prevention BMPs is provided below under *General Avoidance and Minimization Measures*.

2) Prepare and Implement a Mitigation and Monitoring Plan
PG&E will prepare and implement an MMP for impacts to riparian and wetland vegetation. PG&E will include restoration of abandoned or temporary roadbeds as part of the MMP, including compaction issues, seeding, mulching, and planting, and will develop the MMP in consultation with private landowners, where appropriate. PG&E will re-seed other disturbed areas, including temporary work areas, filled and graded areas, and roads requiring rehabilitation, and will consult with private landowners where appropriate. If straw is used for temporary erosion control, it will be certified weed-free. Native plants will be used for re-seeding and other revegetation on PG&E's property, and on private property unless the private landowner specifies the use of other materials. If the use of native seed is intended but sufficient supplies are not available, cereal seed will be used for temporary erosion control. Cereal seed used for erosion control will be seed for sterile cereal, if available. If seed for sterile cereal is not available, other cereal seed may be used.

b. *Kilarc Development*

<u>Kilarc Main Canal Diversion Dam (a.k.a. Kilarc Diversion Dam)</u>

Steps similar to those described for the removal of the South Cow Creek Diversion Dam would be followed during removal of the Kilarc Diversion Dam. Anadromous fish may be present near the Kilarc Tailrace, but are not likely to be present at other decommissioning work areas in the Kilarc Development. Anadromous fish are not able to access the area near the Project headworks on Old Cow Creek, because downstream of the diversion dam is a 12-foot-high falls located 2.7 miles upstream of Kilarc Powerhouse that forms a complete barrier to upstream fish passage. Anadromous salmonids would also be precluded from access to the areas near North Canyon and South Canyon Creek Diversion Dams, by barriers on Canyon Creek. Furthermore, instream work at these two small diversions would occur during the low-flow season, when flow is low or the stream channel is dry. Fish rescues in these areas other than the Kilarc Tailrace focus on native resident (nonanadromous) fishes.

Descriptions are included here for informational purposes only, but no take of anadromous fish would occur.

1) Isolate Construction Area and Conduct Fish Rescue in Instream Work Area
The work area on Old Cow Creek would be isolated using temporary cofferdams/diversions or other such barriers. Water would be routed around the construction area in pipes. After a work area is isolated, a fish rescue would be conducted in about 200 feet of stream to remove any fish trapped in the work area. The fish rescue would be conducted by electrofishing, because the large substrates present in the vicinity of the dam make seining impractical. These fish would be relocated to an area of suitable habitat within Old Cow Creek downstream of the work area. No anadromous fish species of concern are expected to be present in the work area, due to a complete passage barrier located about 2.7 miles upstream of the Kilarc Powerhouse.

2) Sediment Release Measures
Following removal of the Kilarc Diversion Dam, PG&E will implement the same sediment release measures as described above for the South Cow Creek Diversion Dam.

It is estimated that up to approximately 50 cubic yards (0.03 af) of sediment would need to be removed from behind Kilarc Main Canal Diversion Dam to accomplish dam removal, shape the sediment wedge, and create a pilot thalweg connecting the upstream and downstream channels. This would leave approximately 530 cubic yards (0.31 af) behind the diversion dam. Of the 530 cubic yards, about 250 cubic yards of predominately gravel and cobble material would be entrained over time and transported through the diversion and dispersed to the downstream reach by natural fluvial processes. About 230 cubic yards (approximately 40 percent of the 530 cubic yards) is boulder-sized material, most of which would likely remain in place.

3) Monitor Passage Conditions Following Removal of Kilarc Diversion Dam

Passage conditions following removal of Kilarc Diversion Dam would be monitored for two years after the diversion is removed, using the same protocols described above for the South Cow Diversion Dam.

4) Implement Soil Erosion and Sedimentation Control and Stormwater Pollution Prevention Best Management Practices

Soil erosion and sedimentation control and stormwater pollution prevention BMPs would be identified and implemented during decommissioning work at the Kilarc Diversion, as described below under *General Avoidance and Minimization Measures*.

<u>Kilarc Main Canal</u>

1) Conduct Fish Rescue in Canals

Prior to decommissioning, a fish rescue would be conducted to remove any fish in the canal. This would be done by partly draining the canal and then seining or electrofishing to remove fish. The fish rescue would be conducted using seines and fyke nets to the extent practicable, as this generally results in less potential for harm to the fish than electrofishing. Electrofishing may be conducted afterwards in areas where seining cannot be successfully implemented. Rescued fish would be relocated to an area to be identified in consultation with CDFG and NMFS, unless consultation with these agencies determines that these fish should not be rescued and relocated. Non-native fish and hatchery rainbow trout would not be relocated into anadromous waters. Once the fish rescue has been accomplished, the canal would be allowed to dewater completely and decommissioning would commence.

2) Implement Soil Erosion and Sedimentation Control and Stormwater Pollution Prevention Best Management Practices

All natural drainage paths along the canal would be identified during pre-construction surveys. Slopes prone to instability would be identified, and site-specific BMPs adopted to avoid potential slope erosion and increased sedimentation in streams during construction activities and after decommissioning is complete. Soil erosion and sedimentation control and stormwater pollution prevention BMPs are described in more detail below under *General Avoidance and Minimization Measures*

Kilarc Forebay and Forebay Dam

1) Consult with CDFG
As with the Kilarc Main Canal, PG&E will consult with CDFG on fish management options to reduce the number of fish in the forebay (including reduced stocking, increased catch limits and other measures) prior to decommissioning with the intent of minimizing the number of fish needing to be rescued.

2) Isolate Construction Area and Conduct Fish Rescue in Kilarc Forebay
A fish rescue would be conducted to remove desirable fish species trapped in the Kilarc Forebay. These species will be determined in consultation with CDFG. To facilitate the fish rescue, the forebay would be drained to a few isolated pools to concentrate the fish. The fish rescue would be conducted using seines to the extent practicable, as this generally results in less potential for harm to the fish than electrofishing. Electrofishing may be conducted after seining is completed, to capture fish in areas where seining cannot be successfully implemented. Rescued fish would be relocated to an area to be identified in consultation with CDFG and NMFS, unless consultation with these agencies determines that these fish should not be rescued and relocated. Non-native fish and hatchery rainbow trout (*Oncorhynchus mykiss*) would not be relocated into anadromous waters.

3) Implement Soil Erosion and Sedimentation Control and Stormwater Pollution Prevention Best Management Practices
Soil erosion and sedimentation control and stormwater pollution prevention BMPs will be identified and implemented, as described below under *General Avoidance and Minimization Measures.*

Kilarc Powerhouse, Switchyard and Tailrace

1) Avoid Sensitive Periods for Steelhead and Chinook Salmon
The decommissioning work would be conducted from July through September when neither adult steelhead (*O. mykiss*) nor Chinook salmon (*O. tshawytscha*) of any life stage are present in Old Cow Creek.

2) Isolate Construction Area and Conduct Fish Rescue in Instream Work Area
To decommission the Kilarc Tailrace, the work area would be isolated using temporary cofferdams/diversions or other such barriers. After a work area is isolated, a fish rescue would be conducted to remove any fish trapped in the work area. The fish rescue would be conducted using seines to the extent practicable, as this generally results in less potential for harm to the fish than electrofishing. Electrofishing may be conducted after seining is completed, to capture fish in areas where seining cannot be successfully implemented. These fish would be relocated to an area of suitable habitat within Old Cow Creek downstream of the work area.

3) Implement Soil Erosion and Sedimentation Control and Stormwater Pollution Prevention Best Management Practices

Soil erosion and sedimentation control and stormwater pollution prevention BMPs would be identified and implemented during decommissioning work at the Kilarc Tailrace, as described below under *General Avoidance and Minimization Measures*.

North and South Canyon Creek Diversion Dams and Canals

1) Isolate Construction Area and Conduct Fish Rescue in Instream Work Area and Canals

Construction at the North Canyon Diversion Dam would either be done after North Canyon Creek goes dry, or the construction area would be isolated and a fish rescue would be implemented, as follows. The construction area at the North and South Canyon Diversion Dams would be isolated from the active stream using temporary cofferdams/diversions or other such barriers. After a work area is isolated, a fish rescue would be conducted in about 50 feet of stream to remove any fish trapped in the work area. These fish would be relocated to an adjacent section of stream with suitable habitat.

To decommission the canals, a fish rescue would be conducted to remove any fish trapped in the canals. Rescued fish would be relocated to an adjacent stream segment with suitable habitat. Once the fish rescue has been completed, the canal would be dewatered.

2) Implement Soil Erosion and Sedimentation Control and Stormwater Pollution Prevention Best Management Practices

All natural drainage paths along the canal would be identified during pre-construction surveys. Slopes prone to instability would be identified, and site-specific BMPs would be adopted to avoid potential slope erosion and increased sedimentation in streams during construction activities and after decommissioning is complete.

Kilarc Access Roads and Staging Areas

1) Implement Soil Erosion and Sedimentation Control and Stormwater Pollution Prevention Best Management Practices; Prepare and Implement a Mitigation and Monitoring Plan

Potential erosion from access roads and staging areas throughout the Kilarc Development would be addressed by Soil Erosion and Sedimentation Control BMPs. Specific measures to restore abandoned or temporary access roads would be described in the MMP. These are described above in *Cow Development Access Roads* and below under *General Avoidance and Minimization Measures*.

General Avoidance and Minimization Measures

This section provides additional details on the avoidance and minimization measures that apply to decommissioning work at all Project features.

1) Implement Soil Erosion and Sedimentation Control and Stormwater Pollution Prevention Best Management Practices

Soil Erosion and Sedimentation Control BMPs would be identified and implemented. The BMPs would address soil erosion impacts that may occur both during and after decommissioning construction work. PG&E will adhere to standard erosion control procedures, including applicable measures developed by the USDA-FS and published in *Water Quality Management for Forest System Lands* in California Best Management Practices (USDA-FS 2000).

All natural drainage paths along the canals and tunnel would be identified during preconstruction surveys. Slopes prone to instability would be identified, and site-specific BMPs would be implemented to avoid potential slope erosion and increased sedimentation in streams during and after construction activities.

During the construction period, PG&E will install BMPs in all areas where soil is disturbed and could result in an increase in sedimentation and/or erosion. PG&E will perform inspections after storm events and perform any necessary repairs, replacements and/or addition of BMPs.
At the end of construction, potential future erosion sites would be identified and long-term BMPs would be installed.

Specific areas that would be addressed are listed below:

- After removal of the canals, diversions, and impoundment structures, PG&E will implement BMPs such as restoration of natural drainage paths, and recontouring of slopes to match pre-existing slope morphology, as feasible. Revegetation would be implemented to increase bank stability.
- PG&E will implement BMPs to address potential erosion of access roads and staging areas throughout the Kilarc and Cow Creek developments. Artificial swales, culverts, and/or other structures would be designed to direct runoff away from disturbed areas based on the natural drainage features of the area. For any temporary access roads that are removed, PG&E will implement measures in accordance with BMP 2-26 *Obliteration or Decommissioning of Roads*, as defined in the USDA-FS *Water Quality Management for Forest System Lands* in California Best Management Practices (USDA-FS 2000). To ensure the effectiveness of the long-term BMPs, post-construction monitoring would be conducted for two years within the stream channel (see *Stormwater Pollution Prevention BMPs* below) and for one year in all other construction areas. The post-construction inspections would be to ensure that BMPs installed at the end of construction are effective and/or to identify areas where installation of additional BMPs is necessary.

2) Stormwater Pollution Prevention BMPs

PG&E will identify all potential pollutant sources, including sources of sediment (e.g., areas of soil exposed by grading activities, soil/sediment stockpiles) and hazardous pollutants (e.g., from petroleum products leaked by heavy equipment or stored in maintenance areas). Any nonstormwater discharges, such as springs, will also be identified. BMPs will be implemented to protect streams from potential pollutants and minimize erosion of topsoil. These measures may include requiring all contractors to have materials on hand to control and contain a spill of oil or hazardous materials. A monitoring and maintenance schedule will be developed to ensure BMP effectiveness for sediment control, spill containment, and post-construction measures.

C. Description of Action Area

The action area is defined as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action. The action area for this project includes all of the Kilarc and Cow Creek developments and the associated waterways. On Old Cow Creek, the Action Area extends downstream to the Olson Project, located 1.2 miles downstream of the Kilarc Powerhouse. The influence of the Proposed Action on the Kilarc Development is considered to end at this next large diversion, because at this point the FERC licensed Olson Project begins (diverting all but 30 cfs into the Olson Powerhouse). The Action Area extends 200 feet upstream of Kilarc, North Canyon and South Canyon diversions. On South Cow Creek, the Action Area extends 200 feet downstream of South Cow Creek's confluence with Hooten Gulch (approximately 0.6 mile downstream of the Cow Creek Powerhouse). The Action Area extends upstream to South Cow Creek's confluence with Hagaman Gulch, located approximately 7 miles upstream of Cow Diversion. .

III. STATUS OF THE SPECIES AND CRITICAL HABITAT

The following Federally listed species (Evolutionarily Significant Units (ESU) or Distinct Population Segments (DPS) and designated critical habitat occur in the action area and may be affected by the decommissioning of the PG&E Kilarc-Cow project in the Cow Creek watershed:

Central Valley steelhead DPS
threatened (signed December 22, 2005)
Central Valley steelhead designated critical habitat
(September 2, 2005, 70 FR 52488)

The Central Valley (CV) spring-run Chinook salmon ESU threatened (June 28, 2005, 70 FR 37160) includes the action area of the project, however, only a few observations have been made of adult Chinook salmon during spring-run timing within the action area. Designated critical habitat (September 2, 2005, 70 FR 52488), occurs at the confluence of Old Cow and South Cow creeks, approximately six miles downstream of the Action Area, and its intermittent usage consists mostly of rearing juveniles (Figure 4). In addition, the Cow Creek Watershed does not contain the necessary primary constituent elements such as adequate holding pools or spawning habitat to support a spring-run Chinook salmon population. Temperatures are too high, and flows are generally low. Habitat substrate has a large amount of hardpan, and gravel is limited. Cow Creek has some potential for supporting salmonids year-round above some current barriers, with cooler water and more habitat (Brenda Olson, pers. comm. 2009). Spring-run Chinook salmon are not likely to be adversely affected by the decommissioning of the Kilarc-Cow project; the potential for adverse effects is therefore discountable and not expected to reach the level where take will occur. For this reason, effects of the Kilarc-Cow project on spring-run Chinook salmon will not be analyzed further in this Biological Opinion.

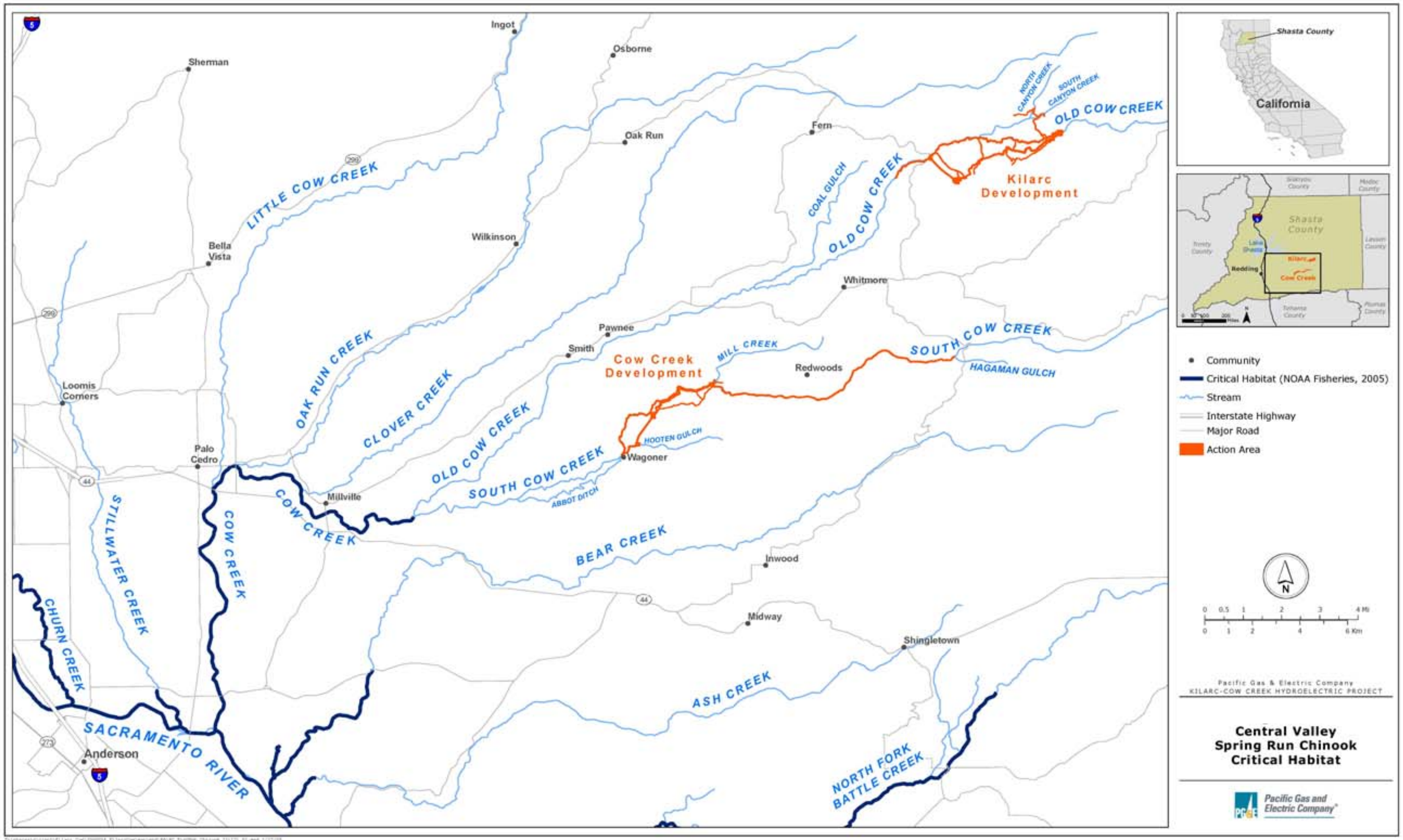

Figure 4. Designated Critical Habitat for Central Valley Spring-Run Chinook Salmon.

A. Species Life History, Population Dynamics, and Likelihood of Survival

1. Central Valley Steelhead

Central Valley steelhead were originally listed as threatened on March 19, 1998 (63 FR 13347). This DPS consists of steelhead populations in the Sacramento and San Joaquin River basins in California's Central Valley. In June 2004, after a complete status review of the 26 west coast salmon, NMFS proposed that Central Valley spring-run Chinook salmon remain listed as threatened (69 FR 33102), while the other Chinook salmon and steelhead were further reviewed. On June 28, 2005, after reviewing the best available scientific and commercial information, NMFS issued its final decision to retain the status of Central Valley steelhead as threatened (70 FR 37160). This decision also included the Coleman National Fish Hatchery and Feather River Hatchery (FRH) steelhead populations. These populations were previously included in the DPS but were not deemed essential for conservation and thus not part of the listed steelhead population. Critical habitat was designated for Central Valley steelhead on September 2, 2005 (70 FR 52488).

Steelhead can be divided into two life history types, summer-run steelhead and winter-run steelhead, based on their state of sexual maturity at the time of river entry and the duration of their spawning migration, stream-maturing and ocean-maturing. Only winter steelhead are currently found in Central Valley rivers and streams (McEwan and Jackson 1996), although there are indications that summer steelhead were present in the Sacramento river system prior to the commencement of large-scale dam construction in the 1940s [Interagency Ecological Program (IEP) Steelhead Project Work Team 1999]. At present, summer steelhead are found only in northern California coast drainages, mostly in tributaries of the Eel, Klamath, and Trinity River systems (McEwan and Jackson 1996).

Central Valley steelhead generally leave the ocean from August through April (Busby *et al.* 1996), and spawn from December through April, with peaks from January through March, in small streams and tributaries where cool, well oxygenated water is available year-round (table 6, Hallock *et al.* 1961, McEwan and Jackson 1996). Timing of upstream migration is correlated with higher flow events, such as freshets or sand bar breaches, and associated lower water temperatures. Unlike Pacific salmon, steelhead are iteroparous, or capable of spawning more than once before death (Busby *et al.* 1996). However, it is rare for steelhead to spawn more than twice before dying; most that do so are females (Busby *et al.* 1996). Iteroparity is more common among southern steelhead populations than northern populations (Busby *et al.* 1996). Although one-time spawners are the great majority, Shapolov and Taft (1954) reported that repeat spawners are relatively numerous (17.2 percent) in California streams.

Spawning occurs during winter and spring months. The length of time it takes for eggs to hatch depends mostly on water temperature. Hatching of steelhead eggs in hatcheries takes about 30 days at 51°F. Fry emerge from the gravel usually about 4 to 6 weeks after hatching, but factors such as redd depth, gravel size, siltation, and temperature can speed or retard this time (Shapovalov and Taft 1954). Newly-emerged fry move to the shallow, protected areas associated with the stream margin (McEwan and Jackson 1996) and they soon move to other areas of the stream and establish feeding locations, which they defend (Shapovalov and Taft 1954).

Steelhead rearing during the summer takes place primarily in higher velocity areas in pools, although young-of-the-year also are abundant in glides and riffles. Productive steelhead habitat is characterized by complexity, primarily in the form of large and small woody debris. Cover is an important habitat component for juvenile steelhead both as velocity refugia and as a means of avoiding predation (Meehan and Bjornn 1991).

Juvenile steelhead emigrate episodically from natal streams during fall, winter, and spring high flows. Emigrating Central Valley steelhead use the lower reaches of the Sacramento River and the Delta for rearing and as a migration corridor to the ocean. Juvenile Central Valley steelhead feed mostly on drifting aquatic organisms and terrestrial insects and will also take active bottom invertebrates (Moyle 2002).

Some juvenile steelhead may utilize tidal marsh areas, non-tidal freshwater marshes, and other shallow water areas in the Delta as rearing areas for short periods prior to their final emigration to the sea. Hallock *et al.* (1961) found that juvenile steelhead in the Sacramento River basin migrate downstream during most months of the year, but the peak period of emigration occurred in the spring, with a much smaller peak in the fall. Nobriga and Cadrett (2003) have also verified these temporal findings based on analysis of captures at Chipps Island, Suisun Bay.

Historic Central Valley steelhead run sizes are difficult to estimate given the paucity of data, but may have approached 1 to 2 million adults annually (McEwan 2001). By the early 1960s, the steelhead run size had declined to about 40,000 adults (McEwan 2001). Over the past 30 years, the naturally-spawned steelhead populations in the upper Sacramento River have declined substantially. Hallock *et al.* (1961) estimated an average of 20,540 adult steelhead through the 1960s in the Sacramento River, upstream of the Feather River. Steelhead counts at RBDD declined from an average of 11,187 for the period of 1967 to 1977, to an average of approximately 2,000 through the early 1990s, with an estimated total annual run size for the entire Sacramento-San Joaquin system, based on RBDD counts, to be no more than 10,000 adults (McEwan and Jackson 1996, McEwan 2001). Steelhead escapement surveys at RBDD ended in 1993 due to changes in dam operations.

Recent estimates from trawling data in the Delta indicate that approximately 100,000 to 300,000 (mean 200,000) smolts emigrate to the ocean per year, representing approximately 3,600 female Central Valley steelhead spawners in the Central Valley basin (Good *et al.* 2005). This can be compared with McEwan's (2001) estimate of 1 to 2 million spawners before 1850, and 40,000 spawners in the 1960s.

Existing wild steelhead stocks in the Central Valley are mostly confined to the upper Sacramento River and its tributaries, including Antelope, Deer, and Mill Creeks and the Yuba River. Populations may exist in Big Chico and Butte Creeks, and a few wild steelhead are produced in the American and Feather rivers (McEwan and Jackson 1996). Recent snorkel surveys (1999 to 2008) indicate that steelhead are present in Clear Creek (Giovannetti *et al.* 2008, Good *et al.*

2005) and in Battle Creek (CDFG 2010). Because of the large resident *O. mykiss* population in Clear Creek, steelhead spawner abundance has not been estimated.

Until recently, Central Valley steelhead were thought to be extirpated from the San Joaquin River system. However, recent monitoring has detected small, self-sustaining populations of steelhead in the Stanislaus, Mokelumne, and Calaveras rivers, and other streams previously thought to be devoid of steelhead (McEwan 2001). On the Stanislaus River, steelhead smolts have been captured in rotary screw traps at Caswell State Park and Oakdale each year since 1995 (S.P. Cramer and Associates Inc. 2000).

It is possible that naturally-spawning populations exist in many other streams but are undetected due to lack of monitoring programs (IEP Steelhead Project Work Team 1999). Incidental catches and observations of steelhead juveniles have also occurred on the Tuolumne and Merced rivers during fall-run Chinook salmon monitoring activities, indicating that steelhead are widespread throughout accessible streams and rivers in the Central Valley (Good *et al.* 2005). CDFG staff have prepared juvenile migrant Central Valley steelhead catch summaries on the San Joaquin River near Mossdale, representing migrants from the Stanislaus, Tuolumne, and Merced rivers. Based on trawl recoveries at Mossdale between 1988 and 2002, as well as rotary screw trap efforts in all three tributaries, CDFG (2003) stated that it is “clear from this data that rainbow trout do occur in all the tributaries as migrants and that the vast majority of them occur on the Stanislaus River.” The documented returns on the order of single fish in these tributaries suggest that existing populations of Central Valley steelhead on the Tuolumne, Merced, and lower San Joaquin rivers are severely depressed.

Good *et al.* (2005) indicated that population census estimates completed in the 1990s found that compared to most Chinook salmon populations in the Central Valley, Central Valley steelhead spawning population above RBDD had a fairly strong negative population growth rate and small population size; in addition, that this decline was continuing, as evidenced by new information (Chipps Island trawl data). Central Valley steelhead populations generally show a continuing decline, an overall low abundance, and fluctuating return rates. The future of Central Valley steelhead is uncertain due to limited data concerning their status. However, Lindley *et al.* (2007), concluded that there is sufficient evidence to suggest that the ESU is at moderate to high risk of extinction.

Table 6. The temporal occurrence of adult (a) and juvenile (b) Central Valley steelhead in the Central Valley. Darker shades indicate months of greatest relative abundance.

(a) Adult

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
[1,3]Sac. River												
[2,3]Sac R at Red Bluff												
[4]Mill, Deer Creeks												
[6]Sac R. at Fremont Weir												
[6]Sac R. at Fremont Weir												
[7]San Joaquin River												

(b) Juvenile

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
[1,2]Sacramento River												
[2,8]Sac. R at Knights Land												
[9]Sac. River @ KL												
[10]Chipps Island (wild)												
[8]Mossdale												
[11]Woodbridge Dam												
[12]Stan R. at Caswell												
[13]Sac R. at Hood												

Source: [1]Hallock 1961; [2]McEwan 2001; [3]USFWS unpublished data; [4]CDFG 1995; [5]Hallock et al. 1957; [6]Bailey 1954;
[7]CDFG Steelhead Report Card Data; [8]CDFG unpublished data; [9]Snider and Titus 2000;
[10]Nobriga and Cadrett 2003; [11]Jones & Stokes Associates, Inc., 2002; [12]S.P. Cramer and Associates, Inc. 2000; [13]Schaffter 1980.

Relative Abundance: = High = Medium = Low

B. Critical Habitat and Primary Constituent Elements for Listed Salmonids

Critical habitat was designated for Central Valley steelhead on September 2, 2005 (70 FR 52488). Critical habitat for Central Valley steelhead includes stream reaches such as those of the Sacramento, Feather, and Yuba rivers, and Deer, Mill, Battle, and Antelope creeks in the Sacramento River basin; the San Joaquin River, including its tributaries, and the waterways of the Delta. Critical habitat includes the stream channels in the designated stream reaches and the lateral extent as defined by the ordinary high-water line. In areas where the ordinary high-water line has not been defined, the lateral extent will be defined by the bankfull elevation (defined as the level at which water begins to leave the channel and move into the floodplain; it is reached at a discharge that generally has a recurrence interval of 1 to 2 years on the annual flood series) (Bain and Stevenson 1999, 70 FR 52488). Critical habitat for Central Valley steelhead is defined as specific areas that contain the primary constituent elements (PCE) and physical habitat elements essential to the conservation of the species. Following are the inland habitat types used as PCEs for Central Valley steelhead.

1. Spawning Habitat

Freshwater spawning sites are those with water quantity and quality conditions and substrate supporting spawning, incubation, and larval development. Most spawning habitat for Central Valley steelhead is located in areas directly downstream of dams containing suitable environmental conditions for spawning and incubation and primarily occur on perennial watersheds throughout the Central Valley. These reaches can be subjected to variations in flow and temperature, particularly over the summer months, which can have adverse effects upon salmonids spawning below them. Most remaining natural spawning habitats (those not downstream from large dams) are currently in good condition, with adequate water temperatures, stream flows, and gravel conditions to support successful reproduction. Some areas below dams, especially for steelhead, are degraded by fluctuating flow conditions related to water storage and flood management that scour or strand redds. Regardless of its current condition, spawning habitat in general has a high intrinsic value, as its function directly affects the spawning success and reproductive potential of listed salmonids.

2. Freshwater Rearing Habitat

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

3. Freshwater Migration Corridors

Ideal freshwater migration corridors are free of obstruction with water quantity and quality conditions and contain natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility, survival and food supply. Migratory corridors are downstream of the spawning area and include the lower Sacramento River and the Delta. These corridors allow the upstream passage of adults, and the downstream emigration of outmigrant juveniles. Migratory habitat condition is strongly affected by the presence of barriers, which can include dams (*i.e.*, hydropower, flood control, and irrigation dams), unscreened or poorly-screened diversions, and degraded water quality. For successful survival and recruitment of salmonids, freshwater migration corridors must function sufficiently to provide adequate passage. For adults, upstream passage through the Delta and much of the Sacramento River is not a problem, but problems exist on many tributary streams, and at the RBDD. For juveniles, unscreened or inadequately screened water diversions throughout their migration corridors and a scarcity of complex in-river cover have degraded this PCE. However, since the primary migration corridors are used by numerous populations, and are essential for connecting early rearing habitat with the ocean, even the degraded reaches are considered to have a high intrinsic value to the species.

4. <u>Estuarine Areas</u>

Estuarine areas free of obstruction with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh and salt water are included as a PCE. Natural cover, such as submerged and overhanging large wood, aquatic vegetation, and side channels, are suitable for juvenile and adult foraging. The remaining estuarine habitat for these species is severely degraded by altered hydrologic regimes, poor water quality, reductions in habitat complexity, and competition for food and space with exotic species. Regardless of the condition, the remaining estuarine areas are of high intrinsic value because they function as rearing habitat and as an area of transition to the ocean environment.

C. Factors Affecting Listed Species and Critical Habitat

California's robust agricultural economy and rapidly increasing urban growth place high demand for water in the Sacramento and San Joaquin River basins. The demand for water in the Central Valley has significantly altered the natural morphology and hydrology of the Sacramento and San Joaquin rivers and their major tributaries. Agricultural lands and urban areas have flourished on historic floodplains. An extensive flood management system of dams, levees, and bypass channels restricts the river's natural sinuosity, volume, and reduces the lag time of water flowing through the system. An impressive network of water delivery systems have transformed the Central Valley drainage system into a series of lined conveyance channels and reservoirs that are operated by several pumping facilities. Flood management and water delivery systems, in addition to agricultural, grazing, and urban land uses, are the main anthropogenic factors affecting watersheds in the action area.

A number of documents have addressed the history of human activities, present environmental conditions, and factors contributing to the decline of salmon and steelhead species in the Central Valley (*e.g.*, Busby *et al.* 1996, Myers *et al.* 1998, Good *et al.* 2005, CALFED 2000). NMFS has also assessed the factors contributing to Chinook salmon and steelhead decline in supplemental documents (NMFS 1996, 1998) and Federal Register notices (*e.g.*, June 16, 1993, 58 FR 33212; January 4, 1994, 59 FR 440; May 6, 1997, 62 FR 24588; August 18, 1997, 62 FR 43937; March 19, 1998, 63 FR 13347; May 5, 1999, 64 FR 24049; September 16, 1999, 64 FR 50394; February 16, 2000, 65 FR 7764). The foremost reason for the decline in these anadromous salmonid populations is the degradation and/or destruction of habitat (*e.g.*, substrate, water quality, water quantity, water temperature, water velocity, shelter, food, riparian vegetation, and migration conditions). Additional factors contributing to the decline of these populations include: over-utilization, disease or predation, the inadequacy of existing regulatory mechanisms, and other natural and manmade factors including global climate change. All of these factors have contributed to the ESA-listing of these fish and deterioration of their critical habitats. However, it is widely recognized in numerous species accounts in the peer-reviewed literature that the modification and curtailment of habitat and range have had the most substantial impacts on the abundance, distribution, population growth, and diversity of salmonid ESUs and DPSs. Although habitat and ecosystem restoration has contributed to recent improvements in habitat conditions throughout the ESUs/DPSs, global climate change remains a looming threat.

1. <u>Modification and Curtailment of Habitat and Range</u>

Modification and curtailment of habitat and range from hydropower, flood control, and consumptive water use have permanently blocked or hindered salmonid access to historical spawning and rearing grounds, resulting in the complete loss of substantial portions of spawning, rearing, and migration PCEs. Clark (1929) estimated that there were originally 6,000 linear miles of salmon habitat in the Central Valley system, and that 80 percent of this habitat had been lost by 1928. Yoshiyama *et al.* (1996) calculated that roughly 2,000 linear miles of salmon habitat was actually available before dam construction and mining, and concluded that 82 percent is not accessible today. Yoshiyama *et al.* (1996) surmised that steelhead habitat loss was even greater than salmon loss, as steelhead migrated farther into drainages. In general, large dams on every major tributary to the Sacramento River, San Joaquin River, and the Delta block salmon and steelhead access to the upper portions of their respective watersheds. The loss of upstream habitat had required Chinook salmon and steelhead to use less hospitable reaches below dams. The loss of substantial habitat above dams also has resulted in decreased juvenile and adult steelhead survival during migration, and in many cases, had resulted in the dewatering and loss of important spawning and rearing habitats.

The diversion and storage of natural flows by dams and diversion structures on Central Valley waterways have depleted stream flows and altered the natural cycles by which juvenile and adult salmonids have evolved. Changes in stream flows and diversions of water affect spawning habitat, freshwater rearing habitat, freshwater migration corridors, and estuarine habitat PCEs. As much as 60 percent of the natural historical inflow to Central Valley watersheds and the Delta have been diverted for human uses. Depleted flows have contributed to higher temperatures, lower dissolved oxygen (DO) levels, and decreased recruitment of gravel and instream woody material. More uniform flows year-round have resulted in diminished natural channel formation, altered food web processes, and slower regeneration of riparian vegetation. These stable flow patterns have reduced bedload movement, caused spawning gravels to become embedded, and decreased channel widths due to channel incision, all of which has decreased the available spawning and rearing habitat below dams.

Water withdrawals for agricultural and municipal purposes have reduced river flows and increased temperatures during the critical summer months, and in some cases, have been of a sufficient magnitude to result in reverse flows in the lower San Joaquin River (Reynolds *et al.* 1993). Direct relationships exist between water temperature, water flow, and juvenile salmonid survival (Brandes and McLain 2001). High water temperatures in the Sacramento River have limited the survival of young salmon.

The development of the water conveyance system in the Delta has resulted in the construction of more than 1,100 miles of channels and diversions to increase channel elevations and flow capacity of the channels (Mount 1995). Levee development in the Central Valley affects spawning habitat, freshwater rearing habitat, freshwater migration corridors, and estuarine habitat PCEs. The construction of levees disrupts the natural processes of the river, resulting in a multitude of habitat-related effects that have diminished conditions for adult and juvenile migration and survival.

Many of these levees use angular rock (riprap) to armor the bank from erosive forces. The effects of channelization and riprapping include the alteration of river hydraulics and cover along the bank as a result of changes in bank configuration and structural features (Stillwater Sciences 2006). These changes affect the quantity and quality of nearshore habitat for juvenile salmonids and have been thoroughly studied (USFWS 2000, Schmetterling *et al.* 2001, Garland *et al.* 2002). Simple slopes protected with rock revetment generally create nearshore hydraulic conditions characterized by greater depths and faster, more homogeneous water velocities than occur along natural banks. Higher water velocities typically inhibit deposition and retention of sediment and woody debris. These changes generally reduce the range of habitat conditions typically found along natural shorelines, especially by eliminating the shallow, slow-velocity river margins used by juvenile fish as refuge and escape from fast currents, deep water, and predators (Stillwater Sciences 2006).

Large quantities of downed trees are a functionally important component of many streams (NMFS 1996). Large woody debris influences channel morphology by affecting longitudinal profile, pool formation, channel pattern and position, and channel geometry. Downstream transport rates of sediment and organic matter are controlled in part by storage of this material behind large wood. Large wood affects the formation and distribution of habitat units, provides cover and complexity, and acts as a substrate for biological activity (NMFS 1996). Wood enters streams inhabited by salmonids either directly from adjacent riparian zones or from riparian zones in adjacent non-fish bearing tributaries. Removal of riparian vegetation and instream woody material from the streambank results in the loss of a primary source of overhead and instream cover for juvenile salmonids. The removal of riparian vegetation and instream woody material and the replacement of natural bank substrates with rock revetment can adversely affect important ecosystem functions. Living space and food for terrestrial and aquatic invertebrates is lost, eliminating an important food source for juvenile salmonids. Loss of riparian vegetation and soft substrates reduces inputs of organic material to the stream ecosystem in the form of leaves, detritus, and woody debris, which can affect biological production at all trophic levels.

In addition, the armoring and revetment of stream banks tends to narrow rivers, reducing the amount of habitat per unit channel length (Sweeney *et al.* 2004). As a result of river narrowing, benthic habitat decreases and the number of macroinvertebrates, such as stoneflies and mayflies, per unit channel length decreases affecting salmonid food supply.

2. Ecosystem Restoration

The Central Valley Project Improvement Act (CVPIA), implemented in 1992, requires that fish and wildlife get equal consideration with other demands for water allocations derived from the Central Valley Project. From this act arose several programs that have benefited listed salmonids: the Anadromous Fish Restoration Program (AFRP), the Anadromous Fish Screen Program (AFSP), and the Water Acquisition Program (WAP). The AFRP is engaged in monitoring, education, and restoration projects geared toward doubling the natural populations of select anadromous fish species residing in the Central Valley. Restoration projects funded through the AFRP include fish passage, fish screening, riparian easement and land acquisition, development of watershed planning groups, instream and riparian habitat improvement, and gravel replenishment. The AFSP combines Federal funding with State and private funds to prioritize and construct fish screens on major water diversions mainly in the upper Sacramento River. The goal of the WAP is to acquire water supplies to meet the habitat restoration and enhancement goals of the CVPIA and to improve the Department of the Interior's ability to meet regulatory water quality requirements. Water has been used successfully to improve fish habitat for Central Valley steelhead by maintaining or increasing instream flows in Butte and Mill Creeks and the San Joaquin River at critical times.

Two programs included under CALFED; the Ecosystem Restoration Program (ERP) and the Environmental Water Account, were created to improve conditions for fish, including listed salmonids, in the Central Valley. Restoration actions implemented by the ERP include the installation of fish screens, modification of barriers to improve fish passage, habitat acquisition, and instream habitat restoration. The majority of these actions address key factors affecting listed salmonids, and emphasis has been placed in tributary drainages with high potential for Central Valley steelhead production. Additional ongoing actions include new efforts to enhance fisheries monitoring and directly support salmonid production through hatchery releases. Recent habitat restoration initiatives sponsored and funded primarily by the CALFED-ERP have resulted in plans to restore ecological function to 9,543 acres of shallow-water tidal and marsh habitats within the Delta. Restoration of these areas primarily involves flooding lands previously used for agriculture, thereby creating additional rearing habitat for juvenile salmonids.

The California Department of Water Resources' (DWR) Four Pumps Agreement Program has approved approximately $49 million for projects that benefit salmon and steelhead production in the Sacramento-San Joaquin basins and Delta since the agreement's inception in 1986. Four Pumps projects that benefit Central Valley steelhead include water exchange programs on Mill and Deer Creeks; enhanced law enforcement efforts from San Francisco Estuary upstream to the Sacramento and San Joaquin rivers and their tributaries; design and construction of fish screens and ladders on Butte Creek; and screening of diversions in Suisun Marsh and San Joaquin tributaries. Additionally, predator habitat isolation and removal and spawning habitat enhancement projects on the San Joaquin tributaries benefit steelhead.

3. Land Use Activities

Land use activities continue to have large impacts on salmonid habitat in the Central Valley watershed. Until about 150 years ago, the Sacramento River was bordered by up to 500,000 acres of riparian forest, with bands of vegetation extending outward for 4 or 5 miles (California Resources Agency 1989). Starting with the gold rush, these vast riparian forests were cleared for building materials, fuel, and to clear land for farms on the raised natural levee banks. The degradation and fragmentation of riparian habitat continued with extensive flood control and bank protection projects, together with the conversion of the fertile riparian lands to agriculture outside of the natural levee belt. By 1979, riparian habitat along the Sacramento River diminished to 11,000 to 12,000 acres, or about 2 percent of historic levels (McGill 1987). The clearing of the riparian forests removed a vital source of snags and driftwood in the Sacramento and San Joaquin river basins. This has reduced the volume of large woody debris (LWD) input needed to form and maintain stream habitat that salmon depend on in their various life stages. In addition to this loss of LWD sources, removal of snags and obstructions from the active river channel for navigational safety has further reduced the presence of LWD in the Sacramento and San Joaquin rivers, as well as the Delta.

Increased sedimentation resulting from agricultural and urban practices within the Central Valley is one of the primary causes of salmonid habitat degradation (NMFS 1996a). Sedimentation can adversely affect salmonids during all freshwater life stages by: clogging or abrading gill surfaces, adhering to eggs, hampering fry emergence (Phillips and Campbell 1961), burying eggs or alevins, scouring and filling in pools and riffles, reducing primary productivity and photosynthesis activity (Cordone and Kelley 1961), and affecting intergravel permeability and DO levels. Excessive sedimentation over time can cause substrates to become embedded, which reduces successful salmonid spawning and egg and fry survival (Waters 1995).

Land use activities associated with road construction, urban development, logging, mining, agriculture, and recreation have significantly altered fish habitat quantity and quality through the alteration of stream bank and channel morphology; alteration of ambient water temperatures; degradation of water quality; elimination of spawning and rearing habitat; fragmentation of available habitats; elimination of downstream recruitment of LWD; and removal of riparian vegetation, resulting in increased stream bank erosion (Meehan and Bjornn 1991). Urban stormwater and agricultural runoff may be contaminated with herbicides and pesticides, petroleum products, sediment, *etc.* Agricultural practices in the Central Valley have eliminated large trees and logs and other woody debris that would otherwise be recruited into the stream channel (NMFS 1998).

Since the 1850s, wetlands reclamation for urban and agricultural development has caused the cumulative loss of 79 and 94 percent of the tidal marsh habitat in the Delta downstream and upstream of Chipps Island, respectively (Conomos *et al.* 1985, Nichols *et al.* 1986, Wright and Phillips 1988, Monroe *et al.* 1992, Goals Project 1999). Prior to 1850, approximately 1400 km^2 of freshwater marsh surrounded the confluence of the Sacramento and San Joaquin rivers, and another 800 km^2 of saltwater marsh fringed San Francisco Bay's margins. Of the original 2,200 km^2 of tidally influenced marsh, only about 125 km^2 of undiked marsh remains today. In Suisun Marsh, saltwater intrusion and land subsidence gradually has led to the decline of agricultural production. Presently, Suisun Marsh consists largely of tidal sloughs and managed wetlands for duck clubs, which first were established in the 1870s in western Suisun Marsh (Goals Project 1999). Even more extensive losses of wetland marshes occurred in the Sacramento and San Joaquin River Basins. Little of the extensive tracts of wetland marshes that existed prior to 1850 along the valley's river systems and within the natural flood basins exist today. Most has been "reclaimed" for agricultural purposes, leaving only small remnant patches.

Dredging of river channels to enhance inland maritime trade and to provide raw material for levee construction has significantly and detrimentally altered the natural hydrology and function of the river systems in the Central Valley. Starting in the mid-1800s, the U.S. Army Corps of Engineers (Corps) and other private consortiums began straightening river channels and artificially deepening them to enhance shipping commerce. This has led to declines in the natural meandering of river channels and the formation of pool and riffle segments. The deepening of channels beyond their natural depth also has led to a significant alteration in the transport of bed load in the riverine system as well as the local flow velocity in the channel (Mount 1995). The Sacramento Flood Control Project at the turn of the nineteenth century ushered in the start of large scale Corps actions in the Delta and along the rivers of California for reclamation and flood control. The creation of levees and the deep shipping channels reduced the natural tendency of the San Joaquin and Sacramento rivers to create floodplains along their banks with seasonal inundations during the wet winter season and the spring snow melt periods. These annual inundations provided necessary habitat for rearing and foraging of juvenile native fish that evolved with this flooding process. The armored riprapped levee banks and active maintenance actions of Reclamation Districts precluded the establishment of ecologically important riparian vegetation, introduction of valuable LWD from these riparian corridors, and the productive intertidal mudflats characteristic of the undisturbed Delta habitat.

Urban stormwater and agricultural runoff may be contaminated with pesticides, oil, grease, heavy metals, polycyclic aromatic hydrocarbons (PAHs), and other organics and nutrients (Denton 2006) that can potentially destroy aquatic life necessary for salmonid survival (NMFS 1996a, b). Point source (PS) and non-point source (NPS) pollution occurs at almost every point that urbanization activity influences the watershed. Impervious surfaces (*i.e*., concrete, asphalt, and buildings) reduce water infiltration and increase runoff, thus creating greater flood hazard (NMFS 1996a, b). Flood control and land drainage schemes may increase the flood risk downstream by concentrating runoff. A flashy discharge pattern results in increased bank erosion with subsequent loss of riparian vegetation, undercut banks and stream channel widening. In addition to the PS and NPS inputs from urban runoff, juvenile salmonids are exposed to increased water temperatures as a result of thermal inputs from municipal, industrial, and agricultural discharges.

Past mining activities routinely resulted in the removal of spawning gravels from streams, the straightening, and channelization of the stream corridor from dredging activities, and the leaching of toxic effluents into streams from mining operations. Many of the effects of past mining operations continue to impact salmonid habitat today. Current mining practices include suction dredging (sand and gravel mining), placer mining, lode mining and gravel mining. Present day mining practices are typically less intrusive than historic operations (hydraulic mining); however, adverse impacts to salmonid habitat still occur as a result of present-day mining activities. Sand and gravel are used for a large variety of construction activities including base material and asphalt, road bedding, drain rock for leach fields, and aggregate mix for concrete to construct buildings and highways.

Most aggregate is derived principally from pits in active floodplains, pits in inactive river terrace deposits, or directly from the active channel. Other sources include hard rock quarries and mining from deposits within reservoirs. Extraction sites located along or in active floodplains present particular problems for anadromous salmonids. Physical alteration of the stream channel may result in the destruction of existing riparian vegetation and the reduction of available area for seedling establishment (Stillwater Sciences 2002). Loss of vegetation impacts riparian and aquatic habitat by causing a loss of the temperature moderating effects of shade and cover, and habitat diversity. Extensive degradation may induce a decline in the alluvial water table, as the banks are effectively drained to a lowered level, affecting riparian vegetation and water supply (NMFS 1996b). Altering the natural channel configuration will reduce salmonid habitat diversity by creating a wide, shallow channel lacking in the pools and cover necessary for all life stages of anadromous salmonids. In addition, waste products resulting from past and present mining activities, include cyanide (an agent used to extract gold from ore), copper, zinc, cadmium, mercury, asbestos, nickel, chromium, and lead.

Juvenile salmonids are exposed to increased water temperatures in the Delta during the late spring and summer due to the loss of riparian shading, and by thermal inputs from municipal, industrial, and agricultural discharges. Studies by DWR on water quality in the Delta over the last 30 years show a steady decline in the food sources available for juvenile salmonids and sturgeon and an increase in the clarity of the water due to a reduction in phytoplankton and zooplankton. These conditions have contributed to increased mortality of juvenile steelhead and sturgeon as they move through the Delta.

4. Hatchery Operations and Practices

Four hatcheries currently produce steelhead in the Central Valley. Releasing large numbers of hatchery fish can pose a threat to wild Chinook salmon and steelhead stocks through genetic impacts, competition for food and other resources between hatchery and wild fish, predation of hatchery fish on wild fish, and increased fishing pressure on wild stocks as a result of hatchery production (Waples 1991). The genetic impacts of artificial propagation programs in the Central Valley primarily are caused by straying of hatchery fish and the subsequent interbreeding of hatchery fish with wild fish. In the Central Valley, practices such as transferring eggs between hatcheries and trucking smolts to distant sites for release contribute to elevated straying levels (Department of Interior 1999). For example, the primary steelhead broodstock at Nimbus Hatchery on the American River originated from the Eel River basin. One of the recommendations in the Joint Hatchery Review Report (NMFS and CDFG 2001) was to identify and designate new sources of steelhead brood stock to replace the current Eel River origin brood stock.

The management of hatcheries, such as Nimbus Hatchery and FRH, can directly impact steelhead populations by oversaturating the natural carrying capacity of the limited habitat available below dams. At Nimbus Hatchery, operating Folsom Dam to meet temperature requirements for returning hatchery fall-run Chinook salmon often limits the amount of water available for steelhead spawning and rearing the rest of the year.

The increase in Central Valley hatchery production has reversed the composition of the steelhead population, from 88 percent naturally produced fish in the 1950s (McEwan 2001) to an estimated 23 to 37 percent naturally produced fish currently (Nobriga and Cadrett 2003). The increase in hatchery steelhead production proportionate to the wild population has reduced the viability of the wild steelhead populations, increased the use of out-of-basin stocks for hatchery production, and increased straying (NMFS and CDFG 2001). Thus, the ability of natural populations to successfully reproduce and continue their genetic integrity likely has been diminished.

The relatively low number of spawners needed to sustain a hatchery population can result in high harvest-to-escapements ratios in waters where fishing regulations are set according to hatchery population. This can lead to over-exploitation and reduction in the size of wild populations existing in the same system as hatchery populations due to incidental bycatch (McEwan 2001).

Hatcheries also can have some positive effects on salmonid populations. Artificial propagation has been shown to be effective in bolstering the numbers of naturally spawning fish in the short term under specific scenarios. Artificial propagation programs can also aid in conserving genetic resources and guarding against catastrophic loss of naturally spawned populations at critically low abundance levels. However, relative abundance is only one component of a viable salmonid population.

5. Disease and Predation

Infectious disease is one of many factors that influence adult and juvenile salmonid survival. Salmonids are exposed to numerous bacterial, protozoan, viral, and parasitic organisms in spawning and rearing areas, hatcheries, migratory routes, and the marine environment (NMFS 1996a, 1996b,). Specific diseases such as bacterial kidney disease, *Ceratomyxosis shasta*, columnaris, furunculosis, infectious hematopoietic necrosis, redmouth and black spot disease, whirling disease, and erythrocytic inclusion body syndrome are known, among others, to affect steelhead and Chinook salmon (NMFS 1996a, 1996b). Very little current or historical information exists to quantify changes in infection levels and mortality rates attributable to these diseases; however, studies have shown that wild fish tend to be less susceptible to pathogens than are hatchery-reared fish. Nevertheless, wild salmonids may contract diseases that are spread through the water column (*i.e.*, waterborne pathogens) as well as through interbreeding with infected hatchery fish. The stress of being released into the wild from a controlled hatchery environment frequently causes latent infections to convert into a more pathological state, and increases the potential of transmission from hatchery reared fish to wild stocks within the same waters.

Accelerated predation also may be a factor in the decline of Central Valley steelhead. Human-induced habitat changes such as alteration of natural flow regimes and installation of bank revetment and structures such as dams, bridges, water diversions, piers, and wharves often provide conditions that both disorient juvenile salmonids and attract predators (Stevens 1961, Decato 1978, Vogel *et al.* 1988, Garcia 1989).

Predation on juvenile salmonids has increased as a result of water development activities which have created ideal habitats for predators and non-native invasive species. Turbulent conditions near dam bypasses, turbine outfalls, water conveyances, and spillways disorient juvenile salmonid migrants and increase their predator avoidance response time, thus improving predator success. Increased exposure to predators has also resulted from reduced water flow through reservoirs; a condition which has increased juvenile travel time. Other locations in the Central Valley where predation is of concern include flood bypasses, post-release sites for salmonids salvaged at the CVP and SWP Fish Facilities, and the SMSCG. Predation on salmon by striped bass (*Morone saxatilis*) and Sacramento pikeminnow (*Ptychocheilus grandis*) at salvage release sites in the Delta and lower Sacramento River has been documented (Orsi 1967, Pickard *et al.* 1982); however, accurate predation rates at these sites are difficult to determine. CDFG conducted predation studies from 1987 to 1993 at the SMSCG to determine if the structure attracts and concentrates predators. The dominant predator species at the SMSCG was striped bass, and the remains of juvenile Chinook salmon were identified in their stomach contents (Edwards *et al.* 1996, Tillman *et al.* 1996, NMFS 1997).

Avian predation on fish contributes to the loss of migrating juvenile salmonids by constraining natural and artificial production. Fish-eating birds that occur in the California Central Valley include great blue herons (*Ardea herodias*), gulls (*Larus* spp.), osprey (*Pandion haliaetus*), common mergansers (*Mergus merganser*), American white pelicans (*Pelecanus erythrorhynchos*), double-crested cormorants (*Phalacrocorax* spp.), Caspian terns (*Sterna caspia*), belted kingfishers (*Ceryle alcyon*), black-crowned night herons (*Nycticorax nycticorax*), Forster's terns (*Sterna forsteri*), hooded mergansers (*Lophodytes cucullatus*), and bald eagles (*Haliaeetus leucocephalus*) (Stephenson and Fast 2005). These birds have high metabolic rates and require large quantities of food relative to their body size.

Mammals can also be an important source of predation on salmonids within the California Central Valley. Predators such as river otters (*Lutra canadensis*), raccoons (*Procyon lotor*), striped skunk (*Mephitis mephitis*), and western spotted skunk (*Spilogale gracilis*) are common. Other mammals that take salmonid include: badger (*Taxidea taxus*), bobcat (*Lynx rufus*), coyote (*Canis latrans*), gray fox (*Urocyon cinereoargenteus*), long-tailed weasel (*Mustela frenata*), mink (*M. vison*), mountain lion (*Felis concolor*), red fox (*Vulpes vulpes*), and ringtail (*Bassariscus astutus*). These animals, especially river otters, are capable of removing large numbers of salmon and trout from the aquatic habitat (Dolloff 1993). Mammals have the potential to consume large numbers of salmonids, but generally scavenge post-spawned salmon. In the marine environment, pinnipeds, including harbor seals (*Phoca vitulina*), California sea lions (*Zalophus californianus*), and Steller's sea lions (*Eumetopia jubatus*) are the primary marine mammals preying on salmonids (Spence *et al*. 1996). Pacific striped dolphin (*Lagenorhynchus obliquidens*) and killer whale (*Orcinus orca*) can also prey on adult salmonids in the nearshore marine environment, and at times become locally important. Although harbor seal and sea lion predation primarily is confined to the marine and estuarine environments, they are known to travel well into freshwater after migrating fish and have frequently been encountered in the Delta and the lower portions of the Sacramento and San Joaquin rivers. All of these predators are opportunists, searching out locations where juveniles and adults are most vulnerable, such as the large water diversions in the South Delta.

6. Natural Fluctuations in Ocean Conditions and Global Climate Change

Natural changes in the freshwater and marine environments play a major role in salmonid abundance. Recent evidence suggests that marine survival among salmonids fluctuates in response to 20- to 30-year cycles of climatic conditions and ocean productivity (Hare *et al.* 1999, Mantua and Hare 2002). This phenomenon has been referred to as the Pacific Decadal Oscillation. In addition, large-scale ocean temperature shifts, such as El Niño, appear to change ocean productivity, and can have significant effects on rainfall in the Central Valley

Another key factor affecting many West Coast fish stocks has been a general 30-year decline in ocean productivity. The mechanism whereby stocks are affected is not well understood, partially because the pattern of response to these changing ocean conditions has differed among stocks, presumably due to differences in their ocean timing and distribution. NMFS presumes that survival is driven largely by events occurring between ocean entry and recruitment to a subadult life stage. One indicator of early ocean survival can be computed as a ratio of CWT recoveries from subadults relative to the number of CWTs released from that brood year.

Salmon and steelhead are exposed to high rates of natural predation, particularly during freshwater rearing and migration stages. Ocean predation may also contribute to significant natural mortality, although to what degree is not known. In general, salmonids are prey for pelagic fishes, birds, and marine mammals, including harbor seals, sea lions, and killer whales. There have been recent concerns that the rebound of seal and sea lion populations—following their protection under the Marine Mammal Protection Act of 1972—has substantially increased salmonid mortality.

Finally, the unusual drought conditions in 2001 warrant additional consideration. Flows in 2001 were among the lowest flow conditions on record. The available water in the Sacramento and San Joaquin River watersheds was 70 percent and 66 percent of normal, according to the Sacramento River Index and the San Joaquin River Index, respectively. The juveniles that passed downriver during the 2001 spring and summer out migration were likely affected, and this, in turn, likely affected adult returns primarily in 2003 and 2004, depending on the stock and species.

a. *Global Climate Change*

The world is about 1.3 °F warmer today than a century ago and the latest computer models predict that, without drastic cutbacks in emissions of carbon dioxide and other gases released by the burning of fossil fuels, the average global surface temperature may rise by two or more degrees Fahrenheit in the 21st century (Intergovernmental Panel on Climate Change 2001). Much of that increase will likely occur in the oceans, and evidence suggests that the most dramatic changes in ocean temperature are now occurring in the Pacific (Noakes 1998). Using objectively analyzed data, Huang and Liu (2000) estimated a warming of about 0.9 °F per century in the Northern Pacific Ocean.

An alarming prediction is the fact that Sierra snow packs are expected to decrease with global warming and that the majority of runoff in California will be from rainfall in the winter rather than from melting snow pack in the mountains (DWR 2006). This will alter river runoff patterns and transform the tributaries that feed the Central Valley from a spring/summer snowmelt-dominated system to a winter rain dominated system. This would likely truncate the period of time that suitable cold-water conditions exist below existing reservoirs and dams due to the warmer inflow temperatures to the reservoir from rain runoff. Without the necessary cold-water pool developed from melting snow pack filling reservoirs in the spring and early summer, late summer and fall temperatures below reservoirs, such as Lake Shasta, could rise above thermal tolerances for juvenile and adult salmonids (*e.g.,* Sacramento River winter-run Chinook salmon and Central Valley steelhead) that must hold below Keswick Dam over the summer and fall periods.

7. Critical Habitat for Salmonids

According to NMFS' (2005b) Critical Habitat Analytical Review Team (CHART) report, the major categories of habitat-related activities affecting Central Valley salmonids include: (1) irrigation impoundments and withdrawals, (2) channel modifications and levee maintenance, (3) the presence and operation of hydroelectric dams, (4) flood control and streambank stabilization, and (5) exotic and invasive species introductions and management. All of these activities affect PCEs via their alteration of one or more of the following: stream hydrology, flow and water-level modification, fish passage, geomorphology and sediment transport, temperature, DO levels, nearshore and aquatic vegetation, soils and nutrients, physical habitat structure and complexity, forage, and predation (Spence *et al.* 1996). According to the CHART report (NMFS 2005b), the condition of critical habitat varies throughout the range of the species. Generally, the conservation value of existing spawning habitat ranges from moderate to high quality, with the primary threats including changes to water quality, and spawning gravel composition from rural, suburban, and urban development, forestry, and road construction and maintenance. Downstream, river and estuarine migration and rearing corridors range in condition from poor to high quality depending on location. Tributary migratory and rearing corridors tended to rate as moderate quality due to threats to adult and juvenile life stages from irrigation diversion, small dams, and water quality. Delta (*i.e.*, estuarine) and mainstem Sacramento and San Joaquin River reaches tended to range from poor to high quality, depending on location. In the alluvial reach of the Sacramento River between Red Bluff and Colusa, the PCEs of rearing and migration habitat are in good condition because, despite the influence of upstream dams, this reach retains natural, and functional channel processes that maintain and develop anadromous fish habitat. The river reach downstream from Colusa and including the Delta is poor in quality due to impaired hydrologic conditions from dam operations, water quality from agriculture, degraded nearshore and riparian habitat from levee construction and maintenance, and habitat loss and fragmentation.

IV. ENVIRONMENTAL BASELINE

The environmental baseline is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the species within the action area. The environmental baseline "includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of

State or private actions which are contemporaneous with the consultation in process" (50 CFR § 402.02).

The Cow Creek watershed encompasses approximately 425 square miles and has an average annual discharge of more than 500 thousand acre-feet (USFWS 1995). Cow Creek flows southwest from the base and foothills of Mt. Lassen and enters the Sacramento River at RM 280 (USFWS 1995, USFWS 2000). Most of the Cow Creek tributaries originate at 5,000 to 7,000 feet in elevation, and have steep gradients in their upper reaches. The landscape in the higher elevations consists predominately of mixed conifer forest of ponderosa pine (*Pinus ponderosa*), Douglas-fir (*Pseudotsuga menziesii*), incense cedar (*Calocedrus decurrens*), and California black oak (*Quercus kelloggii*) (USFWS 1995). The oak-digger pine association is predominant in the lower foothills, while the valley floor is dominated by oak grassland and pasture (USFWS 1995).

As reported by USFWS (2000), Cow Creek and its tributaries carve into diverse layers of geologic features. The eastern high of the Cow Creek watershed elevation reaches are the result of relatively recent volcanic activity, with the last eruption series occurring from 1915-1917 (Alt and Hyndman 1975 *as cited in* USFWS 2000). Encrusted lava rocks along with loose volcanic debris were deposited over more ancient (Cretaceous) marine sandstone and shale formations (USFWS 2000). Over time the Cow Creek tributaries have sliced through the blanket of volcanic deposits and eroded into the underlying sandstone and shale producing extensive alluvial deposits (Alt and Hyndman *as cited in* USFWS 2000). Gradient-transition points (i.e., head-cuts or knick-points) are evident in all five of the main tributaries at approximately 1000 feet elevation, forming notable waterfalls. These erosional deposits are the source of rich, well-draining soils that support lush forests and agricultural development (USFWS 2000).

The Cow Creek watershed is a dendritic system and can be divided into five main tributary subbasins, including Little Cow Creek, Oak Run Creek, Clover Creek, Old Cow Creek and South Cow Creek (USFWS 2000) (Table 1). The following subbasin descriptions come from USFWS (2000).

Table 1. Summary Data for Tributaries of the Cow Creek Basin

Stream Name	Basin Area (square miles)	Stream Length
Little Cow Creek	148	36
Oak Run Creek	42	23.5
Clover Creek	54	27.5
Old Cow Creek	80	32.9
South Cow Creek	78	28.5
Main Stem Cow Creek	29	15
Total to Sacramento River	**430**	**47.8**

Source: (USFWS 2000)

Little Cow Creek

Also known as North Cow Creek, this subbasin drains 148 square miles. The headwaters (Cedar Creek, North Fork, and Mill Creek) originate at an elevation of roughly 5900 feet on the west slopes of Tolladay Peak, Snow Mountain and Clover Mountain. Little Cow Creek flows for 36 miles southwesterly, and then southerly prior to joining the Cow Creek mainstem at Hwy 44.

Oak Run Creek

Oak Run Creek is the smallest of the five main tributaries, draining 42 square miles. Oak Run Creek originates at an elevation of approximately 3200 feet. Oak Run Creek flows 23.5 miles southwesterly to its confluence with the Cow Creek mainstem in Palo Cedro.

Clover Creek

Clover Creek drains 54 square miles and originates at approximately 5500 feet on the south slope of Clover Mountain. Clover creek flows 27.5 miles from its headwaters to its confluence with the mainstem of Cow Creek.

Old Cow Creek

Old Cow Creek drains 80 square miles and originates at an elevation of 6500 feet in the Latour Demonstration State Forest. Old Cow Creek flows 32 miles and joins with Hunt Creek, Glendenning Creek, Canyon Creek and Coal Gulch prior to entering South Cow Creek three miles east of Millville.

South Cow Creek

South Cow Creek drains a 78 square mile basin and originates at an elevation of 5800 feet in the Latour Demonstration State Forest. South Cow Creek flows 28.5 miles to its confluence with Old Cow Creek near Hwy 44. Its larger tributaries include Atkins Creek, Beal Creek, Hamp Creek, and Mill Creek.

Cow Creek is a tributary to the upper Sacramento River and is one of the only watersheds of significant size remaining in the Cascade region of California that is accessible to anadromous salmonids. It also has habitat types similar to those in which the now scarce runs of winter- and spring-run Chinook salmon evolved (USFWS 1995a). Prior to the hydroelectric development in Battle Creek watershed more than a century ago, prime habitat for Chinook salmon and steelhead extended from the confluence with the Sacramento River upstream to natural barrier waterfalls on North Fork and South Fork Battle Creek.

Settlers were initially drawn to the Cow Creek watershed for its agricultural potential, due to its fertile floodplains (Corps 1971). Irrigation in the Cow Creek basin began soon after its settlement and continues today with a complex series of diversions and lift-pumps in all of the main tributaries. Diversions and pumps carry water to fields, pasturelands and residences in the upper and lower elevation areas. The lowland area primarily supports livestock ranches. Private and public timberlands dominate the eastern upland parts of the basin (above 2000 ft). Mining activity was limited to the northern portion of the basin along Little Cow Creek, where the Afterthought Mine near Ingot (Hwy 299) was a source for gold and copper ore from 1862 to 1952 (Albers and Robertson 1961 *as cited in* USFWS 2000). Hydro-power plants were established on Old Cow Creek (Kilarc Reservoir and Powerplant) and South Cow Creek (Olsen Diversion) in the early 1900s to provide electricity for copper smelting, businesses and residents (Allen 1979 *as cited in* USFWS 2000). There are also multiple small individual hydropower setups throughout the watershed, including on Clover Creek (P. Bratcher pers. comm. 2009).

As reported by USFWS (1995), primary limiting factors for anadromous salmonids include low fall and summer flows, caused in part by irrigation diversions. Irrigation diversions also affect steelhead by delaying or blocking adult immigration and entraining juveniles. Loss of habitat and water diversions in the Cow Creek watershed are largely due to activities associated with livestock production (USFWS 1995).

As reported by USFWS (1995), agricultural diversions in the Cow Creek watershed are unscreened, and ditches are unlined and poorly maintained. Habitat surveys conducted by CDFG in 1992 identified several permanent and temporary irrigation diversions in the various tributary streams, including 13 diversions in South Cow Creek, 10 diversions on Old Cow Creek, one on Clover Creek, and two on North Cow Creek (USFWS 1995). No surveys were conducted on Oak Run Creek. According to CDFG, no summary data readily exist for information on diversion rights (i.e., ownership, magnitude, and duration). Steelhead are directly affected by water diversions because they impede upstream migration of adults and entrain downstream migrating juveniles. Agricultural diversions and Pacific Gas and Electric Company's hydropower diversions on South Cow Creek also reduce summer flows important for juvenile steelhead rearing (USFWS 1995).

As reported by USFWS (1995), livestock grazing has reduced riparian vegetation and eroded streambanks in the various tributary streams and in the mainstem Cow Creek, degrading the quality of spawning gravel in Cow Creek. Habitat surveys conducted by CDFG in 1992 identified stream sections within the various tributaries where excessive erosion has occurred. Fencing these stream sections to protect the riparian corridor has been recommended for approximately 42,600 feet of stream on South Cow Creek, 45,600 feet on Old Cow Creek, 39,120 feet on Clover Creek, and 19,500 feet on North Cow Creek (Harvey pers. comm., as cited in USFWS 1995). Population growth in the towns of Palo Cedro, Bella Vista, Oak Run, and Millville is resulting in increased demand for domestic water and is affecting riparian habitat within the Cow Creek watershed (Reynolds et al. 1993 *as cited in* USFWS 1995).

According to data collected during 2002 and 2003, water temperatures appear to be suitable for salmonids year-round in the upper reaches of Old Cow and South Cow creeks. Stressful and lethal water temperatures were observed in the lower reaches, but may not affect steelhead adult immigration or emigrating steelhead smolts because water temperatures are relatively cool between October and June (Moore 2003).

Cow Creek Development

South Cow Creek

South Cow Creek is managed for anadromous and resident fish, with a focus on anadromous salmonids. In the 1980s and 1990s mostly steelhead were planted with some rainbow trout (SHN 2001), while prior to that rainbow trout were planted in the greatest numbers, with smaller plantings of eastern brook trout (*Salvelinus fontinalis*) and Chinook salmon. CDFG has adopted a policy of not stocking in waters supporting anadromous fish, and no stocking currently occurs in the vicinity of South Cow Creek (Baumgartner pers. comm. 2008; Myers pers. comm. 2009). Data collected in 2002 to 2003 indicate that habitat in South Cow Creek was predominately pool (65 to 70 percent) in all reaches, with the remaining habitat divided equally between riffles and runs (PG&E 2007a). The proportions of shallow and deep pools (with 3 feet being the dividing point) were similar. Below Wagoner Canyon the level of confinement of the stream channel decreased and the stream was wider and shallower. Within and upstream of Wagoner Canyon, the stream was narrower and deeper. Cover was generally abundant throughout the bypass reach, but more limited below Wagoner Canyon. Substrate in the bypass reach was dominated by boulders, with cobble and gravel. Spawning gravel tended to be concentrated toward the top of Wagoner Canyon. Spawning gravel was located primarily within pool habitat, especially shallow pool habitat. Run habitat also provided a high proportion of good to excellent spawning gravel for each species.

Water quality data collected in 2003 documented mean daily temperatures in South Cow Creek that were warmer than optimal for steelhead from June through September both above and throughout the bypass reach. Maximum daily temperature exceeded 24°C (75°F) about the half the time in July, but generally remained less than this the rest of the year. These temperatures could result in sub-lethal effects, and potentially some mortality to rearing steelhead. This is based on the very conservative use of instantaneous maximum daily temperatures, whereas most of the laboratory studies used in defining this limit are based on exposures of one to seven days. The summer water temperatures observed in South Cow Creek would not provide optimal growing conditions for rearing steelhead and rainbow trout (PG&E 2009).

Passage within the bypass reach is impeded at low flows by several natural barriers, mostly located near the upstream end of Wagoner Canyon (PG&E 2007a). A total of nine barriers to fish migration were noted within the bypass reach, including the South Cow Creek Diversion Dam, which is made passable by a fish ladder. The remaining barriers were natural falls that are 3 to 6 feet tall or cascades that could present difficulties under low flow conditions, but likely would be passable at higher flows. Flows of 20 to 25 cfs would likely allow passage at all of these barriers.

The South Cow Creek Diversion Dam is equipped with fish screens to prevent entrainment of young fish to the canal and a ladder to pass adult fish upstream (although these facilities do not meet NMFS' fish passage and screen guidelines). Adult steelhead have been observed using the ladder to access upstream habitat (Moock and Steitz 1984).

South Cow Creek supported various species of fish (PG&E 2007a, TRPA 1985). The fish community structure changed substantially at the downstream end of Wagoner Canyon (PG&E

2007a). In the sites within and upstream of Wagoner Canyon, the fish community consisted of California roach (*Hesperoleucus symmetricus*) and steelhead/rainbow trout, with roach being more numerous than steelhead/rainbow trout. Lamprey were also observed in the South Cow Creek Main Canal and so presumably are present in South Cow Creek, although none were observed there. In the area downstream of Wagoner Canyon, the fish community consisted of seven to nine species (several of which are introduced) typical of the pikeminnow-hardhead-sucker assemblage (previously referred to as the transition zone community - Moyle 2002). The fish community below Wagoner Canyon consisted of (in order of numerical abundance) California roach, speckled dace (*Rhinichthys osculus*), rainbow trout, Sacramento pikeminnow, Sacramento sucker (*Catostomus occidentalis*), riffle sculpin (*Cottus gulosus*), and smallmouth bass (*Micropterus dolomieu*). Low numbers of Chinook salmon and largemouth bass (*M. salmoides*) were also observed. Different studies have reported Chinook salmon spawning between the confluence with Cow Creek and the base of Wagoner Canyon (Healey, 1974, CDFG unpublished data). Steelhead activity within the Cow Creek Development area ranges from the confluence with Hooten Gulch to the South Cow Creek campground (Moock and Steitz 1984, SHN 2001, Healey 1974, TRPA 1986), which is upstream of the Cow Creek Development.

Mill Creek

Mill Creek is generally a low-gradient stream with thick riparian growth along the banks. Substrate was predominately bedrock with a few cobbles interspersed (PG&E, 2007a). Cover in Mill Creek consisted mostly of overhanging vegetation; as well as turbidity above the Mill Creek Diversion Dam.

It is generally unknown what fish species occur in Mill Creek, with the exception of rainbow trout that are found above the Mill Creek Diversion Dam (PG&E 2007a). It is likely that the species found in South Cow Creek above Wagoner Canyon (steelhead/rainbow trout, California roach, and lamprey) could also be present in Mill Creek below the diversion, and that non-anadromous species could also be found above it.

Hooten Gulch

Hooten Gulch is a low-gradient, U-shaped stream channel with 10-foot-high banks (PG&E 2007a). This stream is ephemeral above the Cow Creek Powerhouse even early in the year. Tailrace water from the Cow Creek Powerhouse flows down Hooten Gulch. A small unscreened diversion takes water from Hooten Gulch into the Wild Oak Powerhouse (not part of the Project) just downstream of the Cow Creek Tailrace. A second diversion near the confluence of Hooten Gulch and South Cow Creek takes water from Hooten Gulch into Abbott Ditch, an irrigation canal (not part of the Project). The Abbott Diversion prevents fish from moving upstream into Hooten Gulch from South Cow Creek. The banks along Hooten Gulch are eroded. Data collected in 2002 to 2003 indicate that the primary habitat types within Hooten Gulch were pool and riffle (PG&E, 2007a). Substrate consisted mainly of cobble, with lesser components of gravel and boulder. Spawning habitat was poor due to high embeddedness of potential spawning substrates. Hooten Gulch supported California roach, riffle sculpin, and rainbow trout (PG&E 2007a).

South Cow Creek Main Canal

South Cow Creek Main Canal conveys water from the South Cow Creek Diversion Dam to Cow Creek Forebay. The canal is 2.1 miles long. Cover within the South Cow Creek Main Canal consisted primarily of aquatic macrophytes and cobbles (observations during relicensing studies). The canal had little riparian vegetation along the banks. Substrate was primarily sand with a few cobbles.

The South Cow Creek Main Canal is screened to prevent fish from being entrained into the canal. Two sampling surveys in the canal in 2003 found relatively few fish and only three species. In order of decreasing abundance these were California roach, rainbow trout, and lamprey.

Cow Creek Forebay

Cow Creek Forebay is a small forebay (1 acre) in a relatively open area (PG&E 2007b). Cover within the forebay consisted of submerged aquatic vegetation, algae, and sedges (PG&E 2007a). Cow Creek Forebay primarily supported populations of golden shiner and green sunfish (*Lepomis cyanellus*). A few Sacramento sucker and rainbow trout were also observed (PG&E, 2007a).

Other Projects

Two small privately-owned projects divert water out of Hooten Gulch below the Cow Creek Tailrace, as described in Section 2.4. The Wild Oak Development uses the water to generate electricity. An irrigation diversion known as the Abbott Ditch diverts water from Hooten Gulch. Pursuant to an adjudication of the watershed, Abbott Ditch water users are entitled to divert 13.13 cfs from the natural flow of the east channel of South Cow Creek below the confluence with Hooten Gulch (and not from Hooten Gulch itself). Upon decommissioning, the mini-hydro facility and the Abbott Ditch water users who currently divert water from the reach of Hooten Gulch augmented by Cow Creek Powerhouse releases would have a reduced ability to do so at the current point of diversion. The Abbot Diversion is located at the mouth of Hooten Gulch and prevents fish migration from South Cow Creek into Hooten Gulch.

<u>Kilarc Development</u>

Old Cow Creek

Historically, CDFG managed Old Cow Creek for resident salmonids above Whitmore Falls (including the Action Area) and for anadromous salmonids below Whitmore Falls (shown on Figure 2-1). Whitmore Falls had long been considered an impassable barrier to anadromous salmonids. CDFG and NMFS re-evaluated the barrier at Whitmore Falls in 2003 and now believe that this barrier may be passable under unspecified high flow conditions, likely during wet years (Manji pers. comm. 2002, confirmed December 17, 2008). The reclassification of the barrier at Whitmore Falls led CDFG and NMFS to revise their management objectives for the

Action Area to include anadromous salmonids. No anadromous fish have been observed above Whitmore Falls, but it may be possible for them to pass over the falls during some high flow events (Myers pers. comm. 2008). The frequency with which steelhead or Chinook salmon might pass over Whitmore Falls is unknown, as there have been no studies to assess this. CDFG identified a waterfall located 2.7 miles upstream of the Kilarc Powerhouse as a barrier to upstream migration (Manji pers. comm. 2002). Surveys conducted as part of PG&E's relicensing studies indicated that this barrier likely precludes the use of the upper portion of the Action Area by anadromous salmonids (PG&E 2007a). It was determined that this 12-foot-high falls was likely to be impassable at any flow. This opinion was shared by CDFG (Myers pers. comm. 2008), and NMFS (White pers. comm. 2008). NMFS's opinion is that the barrier is likely to be impassable under flow conditions in which salmonids typically migrate, due to a combination of height, insufficient jump pool depth, and a lack of a significant constriction point downstream that would backwater the barrier under high flow conditions. The PG&E surveys also identified a boulder cascade located 3 miles upstream of Kilarc Powerhouse (between these 12-foot falls and the Kilarc Main Canal Diversion Dam) and assessed as a barrier at most flows. Eleven other barriers were also identified within the Old Cow Creek bypass reach. These barriers were assessed as passable at some flows (PG&E 2007a).

The bypass reach generally provided suitable habitat for salmonids, with a good mix of habitats (riffle, run pool) with good structure and abundant cover (PG&E 2007a). Dominant substrate in Old Cow Creek was boulder and cobble. The spawning gravel available ranged from fair to good in quality for rainbow trout and steelhead, and ranged from poor to fair for Chinook salmon. The stream was shaded by riparian vegetation and the canyon walls. Water temperature monitoring data collected in May through September 2003 showed that mean daily temperatures were cool, generally remaining below 64°F, throughout the bypass reach, even during the warmest portion of the year (late July). The cool temperatures provide desirable conditions for rearing salmonids.

Rainbow trout and/or steelhead were the most abundant species in the Kilarc Development area during the relicensing surveys. This species made up over 90 percent of the total number of fish at all sites sampled (PG&E 2007a). Other species present included riffle sculpin and brown trout (*Salmo trutta*). Additionally, a few Sacramento pikeminnow were observed. These results were consistent with those of previous studies conducted in Old Cow Creek drainage including a CDFG study near Kilarc Powerhouse (SHN 2001), and a TRPA (2002) study completed for the Olson Power Plant located downstream of the Kilarc Development.

North and South Canyon Creeks

Limited information is available for North and South Canyon Creeks. North Canyon Creek is a small, ephemeral stream, and supports limited or no flow during the summer months, depending on water year type. South Canyon Creek is somewhat larger and perennial, although still much smaller than Old Cow Creek.

Kilarc Main Canal

Kilarc Main Canal conveys water from the Kilarc Main Canal Diversion Dam to Kilarc Forebay. The canal is approximately 3.65 miles long. Data collected in 2002 to 2003 indicate that the unlined sections of the canal provided some limited habitat for smaller fish, as these portions of the canal had some cover in the form of cobbles and smaller boulders, as well as aquatic and overhanging terrestrial vegetation (PG&E 2007a). Substrate in Kilarc Main Canal was dominated by sand and cobbles. This habitat appeared to be more favorable at the upstream end of the canal than at the downstream end. The Kilarc Main Canal is unscreened and fish can enter the canal from upstream of the diversion or from the Kilarc Forebay. Fish densities within the canal were generally low and populations consisted of rainbow and brown trout. Brown trout in the canal may be the offspring of fish from the Kilarc Forebay, given that the area upstream of the diversion supported very low densities of brown trout, whereas the forebay has relatively high densities of adult brown trout. The actual origin of these brown trout and the rainbow trout observed is unknown.

Kilarc Forebay

Kilarc Forebay has a surface area of 4 acres (PG&E 2007b) and is generally shallow with abundant rooted algae and plants (PG&E 2007a). Kilarc Forebay provides a local recreational fishing opportunity with large numbers of naturally produced brown trout. Rainbow trout were also sampled in the forebay, but only a small proportion appeared to be of wild origin. Most rainbow trout in the forebay are planted by CDFG. Golden shiners, an introduced species, are also found in Kilarc Forebay. There are no other inflows to the impoundment other than the Kilarc Main Canal.

Other Projects

The Toucher Project diverts water from South Canyon Creek and returns that water to Old Cow Creek about 0.25 miles upstream of the Kilarc Powerhouse. This diversion reduces the amount of water of South Canyon Creek and may reduce aquatic habitat.

A. Status of the Listed Species and Critical Habitat within the Action Area

1. <u>Central Valley Steelhead Status and Critical Habitat</u>

As reported in the Cow Creek Watershed Assessment (SHN 2001), steelhead populations have not been estimated in Cow Creek. No specific studies have been conducted on Cow Creek to estimate the size of the steelhead spawning run, although CDFG estimated that Cow Creek supported annual spawning runs of 500 steelhead (SHN 2001). Adult steelhead have been observed in North Cow, Old Cow and South Cow creeks; however, it is unknown what percentage of the steelhead run utilizes the other tributaries (SHN 2001). Most steelhead spawning in South Cow Creek probably occurs above South Cow Creek diversion. The best spawning habitat occurs in the 5-mile reach of stream extending from about 1.5 miles below South Cow Creek Diversion Dam to 3.5 miles above the diversion dam (Healey 1997 *as cited in* SHN 2001). Additional spawning habitat occurs upstream of this reach, but it is much less abundant. Sightings of adult steelhead have been made at the South Cow Creek Campground (approximately 8.5 miles upstream of the South Cow Creek Diversion Dam) and in Atkins Creek, located just upstream from the campground (SHN 2001).

During February – April of 2002 snorkel surveys were conducted in South Cow Creek, but no steelhead adults, carcasses or redds were identified (Moore 2003). During February – April of 2003, snorkel surveys and one walking survey in South Cow Creek, and one snorkel survey in Old Cow Creek were conducted to identify steelhead adults, carcasses and redds. Seven adult steelhead and two possible redds were identified in South Cow Creek (Moore 2003).

Critical habitat extends through the action area on South Cow Creek about 7 miles upstream of the South Cow Creek Diversion Dam to the mouth of Hagaman Gulch. Critical habitat on Old Cow Creek for steelhead extends upstream to near the Whitmore Radio Range Station and Whitmore Falls (Figure 5).

B. Factors Affecting Species and Critical Habitat Within the Action Area

Factors limiting salmonid productivity in the Cow Creek Watershed that have been identified in watershed reports include instream flow, water temperatures, adult passage, entrainment at diversions, impacts to riparian zones, and gravel mining. In addition, diversion dams have blocked the natural sediment transport process, thus limiting spawning gravel availability. Nonetheless, Cow Creek has been identified as having good habitat conditions in portions of the drainage and may be a candidate for restoration actions.

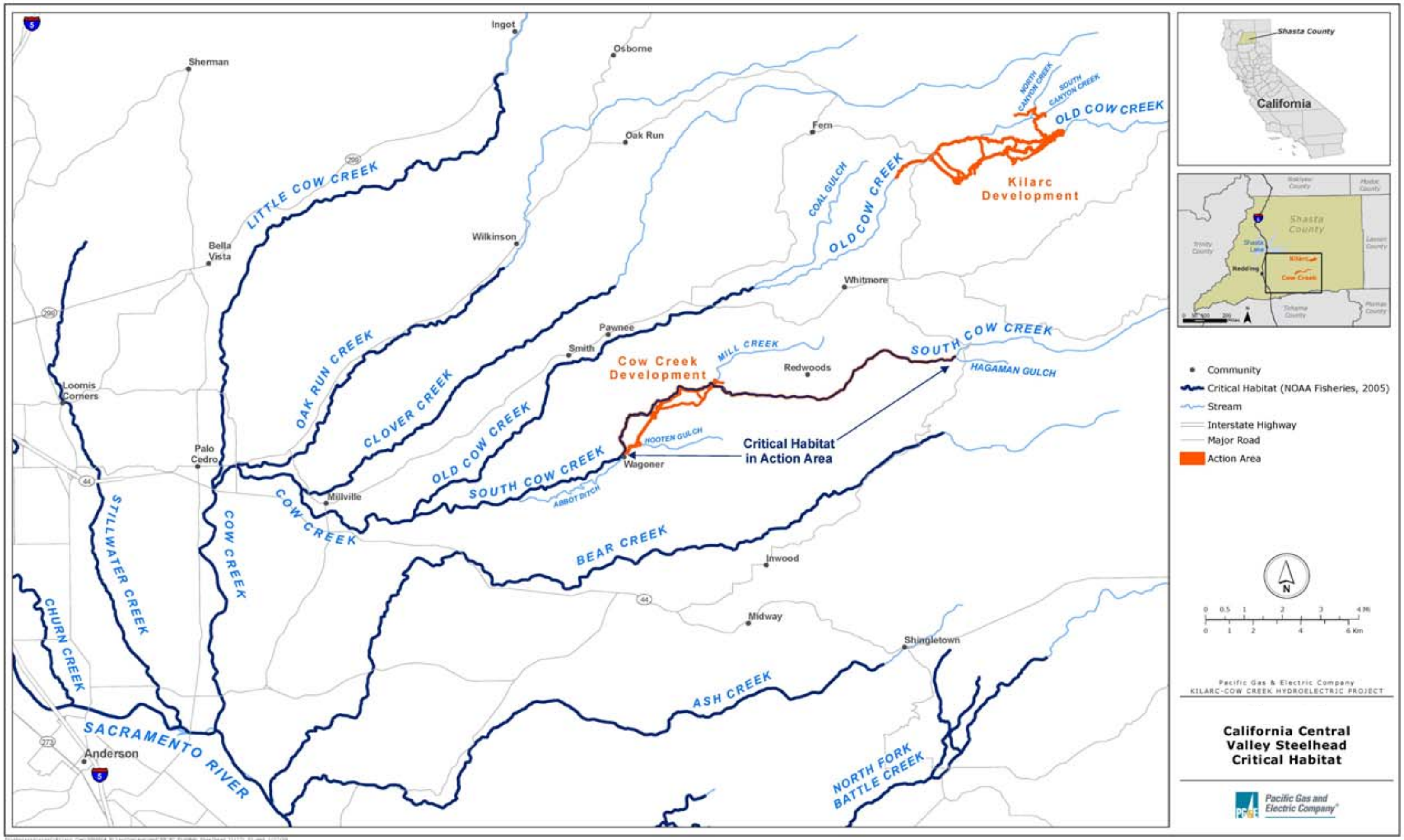

Figure 5. Designated Critical Habitat for Central Valley Steelhead in the Cow Creek Watershed.

C. Likelihood of Species Survival and Recovery in the Action Area

Under baseline conditions, without implementation of the decommissioning of the Kilarc-Cow Hydroelectric project, the likelihood of survival and recovery of naturally-reproducing steelhead in Cow Creek is very low. Naturally-reproducing steelhead still maintain remnant populations in Cow Creek, but are not well documented. Without consistent access to suitable habitat, screening of the hydropower diversions, and a return to a more natural hydrograph, it is unlikely that they would be able to maintain these remnant populations, and even less likely that they would improve to support the DPS.

V. EFFECTS OF THE ACTION

A. Approach to the Assessment

Pursuant to section 7(a)(2) of the ESA (16 U.S.C. 1536), Federal agencies are directed to ensure that their activities are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of designated critical habitat. This biological opinion does not rely on the regulatory definition of “destruction or adverse modification” of critical habitat as defined in 50 CFR 402.02. Instead, this biological opinion relies upon the statutory provisions of the ESA to complete the following analysis with respect to critical habitat. NMFS will evaluate destruction or adverse modification of critical habitat by determining if the action reduces the value of critical habitat for the conservation of the species. This biological opinion assesses the effects of the proposed decommissioning of the Kilarc-Cow Hydroelectric Project (FERC 606) on threatened Central Valley steelhead, and their designated critical habitats.

In the section II, “Description of the Proposed Action,” of this biological opinion, NMFS provided an overview of the action. In the sections III and IV, “Status of the Species and Critical Habitat” and “Environmental Baseline,” respectively, NMFS provided an overview of the threatened and endangered species and critical habitat in the action area of this consultation.

Regulations that implement section 7(a)(2) of the ESA require biological opinions to evaluate the direct and indirect effects of Federal actions and actions that are interrelated with or interdependent to the Federal action to determine if it would be reasonable to expect them to reduce appreciably listed species' likelihood of surviving and recovering in the wild by reducing their reproduction, numbers, or distribution (16 U.S.C. 1536; 50 CFR 402.02). Section 7 of the ESA and its implementing regulations also require biological opinions to determine if Federal actions would destroy or adversely modify the conservation value of designated critical habitat (16 U.S.C. 1536).

NMFS generally approaches "jeopardy" analyses in a series of steps. First, we evaluate the available evidence to identify the direct and indirect physical, chemical, and biotic effects of the proposed action on individual members of the listed species or aspects of the species' environment (these effects include direct, physical harm or injury to individual members of a species; modifications to something in the species' environment - such as reducing a species' prey base, enhancing populations of predators, altering spawning substrate, altering ambient temperature regimes; or adding something novel to a species' environment - such as introducing exotic competitors or noise disturbance). Once we have identified the effects of an action, we evaluate the available evidence to identify a species' probable exposure to those effects (the extent of temporal and spatial overlap between individuals of the species and the effects of the action). Once we have identified the exposure of the species to the effects of an action, we evaluate the available evidence to identify a species' probable response (including behavioral responses) to those effects to determine if those effects could reasonably be expected to reduce a species' reproduction, numbers, or distribution (for example, by changing birth, death, immigration, or emigration rates; increasing the age at which individuals reach sexual maturity; decreasing the age at which individuals stop reproducing; among others). We then use the evidence available to determine if these reductions, if any, could reasonably be expected to appreciably reduce a species' likelihood of surviving and recovering in the wild.

The final step in conducting the "jeopardy" analysis is to consider the additive effects of the environmental baseline, the effects of the action and any reasonably foreseeable cumulative effects to determine the potential for the action to affect the survival and recovery of the species, or the conservation value of their designated critical habitat.

To evaluate the effects of the proposed action, NMFS examined PG&E's Biological Evaluation, and application for surrender of project license, to identify likely impacts to listed anadromous salmonids within the action area, based on the best available information. In addition, there were a number of interagency meetings held to discuss the project components, and to make clarifications as needed (see "Consultation History" section above for more detail).

The primary information used in this assessment includes fishery information previously described in the "Status of the Species and Critical Habitat" and "Environmental Baseline" sections of this biological opinion; studies and accounts of the impacts of water diversions, dams, and artificial flow fluctuations on anadromous species; and documents prepared in support of the proposed action.

B. Assessment

The assessment will consider the nature, duration, and extent of the effects of the proposed action relative to the migration timing, behavior, and habitat requirements of Federally listed Central Valley steelhead, and the magnitude, timing, frequency, and duration of project impacts to these listed species. Specifically, the assessment will consider the potential impacts related to adverse effects to these species and their habitat resulting from the decommissioning of Kilarc-Cow project. The project includes avoidance and minimization measures, potential impacts.

The surrender of the Hydroelectric Project license (the proposed action) – decommissioning is expected to result in overall net benefits to migration, flow, temperature, entrainment, food availability and predation, in the Cow Creek watershed.

1. Decommissioning Cow Creek and Kilarc Developments

In the case of smaller hydroelectric projects, the Energy Commission has found that "the loss of hydroelectricity would not have a significant effect on electric resource adequacy at the state and regional level." (Terrence O'Brien, pers. comm. 2004). At 4.6 MW nameplate capacity, 1.5 MW dependable capacity and 31.1 GWh of production, Kilarc-Cow Project is the smallest hydropower project reviewed to date by Energy Commission staff (compare to Battle Creek at 36.3 MW nameplate capacity, and 245 GWh of production). The energy potential from Kilarc-Cow project cannot be stored or counted upon for use during peak summer demand periods. Therefore, its energy resource values are low. Loss of the project's power would have limited effect on electricity resource adequacy. In the view of the Energy Commission staff, decommissioning small energy facilities like Kilarc-Cow project would create no measurable difference in air emissions in California, but can significantly contribute to increases in wild salmonid habitats. In addition, should measures to develop renewable resources state-wide be insufficient, it is most likely that the incremental unit used to replace the lost capacity and energy will be a modern natural gas-fired power plant, which means that global climate change gas emissions will be minimized. Finally, the Energy Commission concluded that the environmental benefits of removing this small facility outweigh its electricity generation benefits (Terrence O'Brien, pers. comm. 2004).

a. South Cow Creek and Mill Creek Diversion Dams

Juvenile steelhead would likely be present at the dams during deconstruction, and may be affected by the Proposed Action. Breaking down the dam structures could create shockwaves that could harm fish, heavy equipment in the stream could crush fish, and sedimentation effects could result from removal of dam material, gates, and other structures. Avoidance and minimization measures include avoiding sensitive periods for steelhead and Chinook salmon, isolating the construction area and conducting fish rescues. In addition there may be some short-term displacement of fish to other habitats associated with the construction activities, but this is not expected to substantially affect the health of the individuals.

Equipment operation in the streambed and streambanks has the potential to affect water quality and result in erosion and sedimentation of stream habitat. Implementation of soil erosion and sedimentation control BMPs and stormwater pollution prevention BMPs will minimize soil erosion and water quality effects to fish downstream of work area.

Temporary loss of vegetation may occur during decommissioning. This loss is not expected to be substantial, and will include mitigation areas, and preserving riparian during deconstruction.

Adult steelhead are not expected to be present due to the timing of deconstruction. In addition, redds would not be present during the construction period.

b. Cow Creek Powerhouse Tailrace and Kilarc Tailrace

Juvenile steelhead and Chinook salmon are not expected to be present at the Cow Creek Powerhouse Tailrace. Downstream water quality and sedimentation effects will be avoided and minimized using BMPs. Steelhead and Chinook salmon could be present near the Kilarc Tailrace. Whitmore Falls is downstream and has thought to be a complete barrier, but recent observations of salmonids above indicate it may only be a partial barrier under certain flows. Kilarc will be filled during decommissioning and could release sediments into the stream. In addition, fish could be buried by fill material. To minimize potential adverse effects, sensitive time periods will be avoided, isolation of the construction area, as well as conducting a fish relocation.

c. South Cow Creek Main Canal/Mill Creek Canal and Cow Creek Forebay

Although the canal is equipped with a fish screen, there have been some observations of *O. mykiss* present. Access for Chinook salmon is thought to be blocked due to a natural barrier downstream. Dewatering and filling the canal and forebay could result in fish mortality. Resident fish will be relocated to suitable areas.

d. Kilarc Main Canal and North and South Canyon Creek Diversion Dams and Kilarc Forebay

Chinook salmon and steelhead cannot access the area near the diversion dams on Old Cow, North Canyon and South Canyon Creek, and would therefore not be directly affected by the decommissioning. PG&E will relocate any desirable native fish on the Kilarc Main Canal and Forebay during decommissioning to suitable areas determined by CDFG and NMFS.

e. Roads and Staging Areas

Potential erosion from access roads and staging areas will be minimized by soil erosion and sedimentation BMPs. A paved low-water crossing over South Cow Creek to access the work area is expected to be used several times a day. Although juvenile steelhead are likely to be present in the vicinity of the stream crossing, they are unlikely to use the area immediately over the crossing. The Proposed Action may require improvement of existing roads, and potentially 13 new, short road segments to allow access for equipment to canal segments. BMPs will minimize water quality effects. No channel crossing on Old Cow Creek will be needed for decommissioning activities.

f. Habitat on South Cow Creek, Mill Creek, Old Cow Creek, North and South Canyon Creeks, Hooten Gulch

During removal of the South Cow Creek Diversion Dam, approximately 400 feet of stream will be dewatered. The sediment wedge behind the dam will be reshaped to an appropriate angle and with a pilot thalweg to ensure fish passage until sediments have been transported by flow. The streambed at these areas is expected to return to its natural state after the first winter following decommissioning. The plunge pool immediately downstream of the dam would likely fill as a result. These pools are the only ones that would not be expected to reform since they were maintained by the high-head associated with the dam itself.

g. Increased sedimentation

Sediments behind the diversions will be allowed to naturally transport downstream. The release of sediments during high flow events may result in turbidity increases. However, natural turbidity peaks would occur during this type of high flow event. Movement of the stored sediments is not anticipated to result in a substantial increase in the natural turbidity pulse. Passage conditions will be monitored after the first big flow event after decommissioning as well as for two years after.

2. Long Term Effects

Long term effects of the decommissioning are expected to be beneficial. As the streams will no longer have the diversions from the project, flows will be allowed to return to a more nature hydrology downstream. This will affect flow magnitude, especially during the summer months. In addition, water temperatures may improve slightly in the project area. Spawning sediments that have been trapped behind the dams would be redistributed downstream, and the normal sediment transport process will be restored. Finally, several miles of designated critical habitat to steelhead would become more easily accessible to salmonids.

VI. CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

A. Timber Harvesting and Cattle Grazing

In general, the primary land use activities in the two watersheds that encompass the Project are privately owned grazing lands and private and state-owned timberlands. Several small ranches are located in the vicinity of the Project. Land uses in the lower South Cow Creek Watershed consist primarily of grazing and rural residential, with some timber, wildlife habitat, and recreation resource management. Land in the upper South Cow Creek Watershed is primarily state-owned forest that is managed for timber harvest. Land in the immediate vicinity of the Cow Creek Powerhouse and associated facilities is primarily used for cattle grazing, with some smaller portions in private timber, and rural residential. An agricultural diversion known as the Abbott Diversion operates throughout the year in Hooten Gulch, providing water for domestic, livestock and irrigation use on the South Cow Creek bottomlands. The diversion is located a short distance upstream of the confluence of Hooten Gulch with South Cow Creek. Water is conveyed approximately 1 mile down valley from the Abbott Diversion by gravity flow in an unlined ditch. The main canal laterals and turnouts irrigate approximately 315 acres by flood irrigation. The Old Cow Creek Watershed consists of lands utilized for cattle grazing (private), management of wildlife habitat and recreation resources (state), and timber harvest (state and private). Lands in the immediate vicinity of the Kilarc Powerhouse and associated facilities are primarily managed for timber harvest, with some smaller portions used for cattle grazing. Continued grazing and timber harvest operations can degrade or reduce suitable habitat for listed salmonids by increasing erosion and sedimentation, as well as introducing nitrogen, ammonia, and other nutrients into the watershed, and have likely reduced the quality of salmonid habitat in the Cow Creek Watershed.

B. Hydroelectric and Agricultural Diversions

Two non-PG&E hydropower diversions are present in the Action Area. A mini-hydro project, the Wild Oak Development, obtains water from the reach of Hooten Gulch that is augmented with flow from PG&E's Cow Creek Powerhouse Tailrace. This mini-hydro project does not require a FERC license. Water is discharged from the Wild Oak Powerhouse back into Hooten Gulch. Water diversion rates at the Wild Oak Diversion vary throughout the year in response to seasonal hydrology and outflow from PG&E's Cow Creek Powerhouse. The Toucher Project is another mini-hydro project that diverts water from South Canyon Creek at the same location as PG&E, but with a senior water right. This project does not require a FERC license. Unscreened or improperly screened diversions may result in entrainment of fish, including juvenile salmonids.

C. Fish Planting

CDFG has had a number of programs that planted fish in the Cow Creek Watershed to support various management activities. Fish planting programs were usually associated with management of resident trout fisheries. Species planted in the last 30 years include predominately catchable rainbow trout. Isolated or infrequent plantings were made of largemouth bass (1974 in Buckhorn Lake) and brown trout until the 1980s (SHN 2001).

In the Project vicinity, CDFG has been stocking rainbow trout since 1951 for sport recreational fishing purposes (SHN 2001). Most of the stocking for catchable rainbow trout in South Cow Creek is upstream of the South Cow Diversion Dam near the Cow Creek Campgrounds (River Mile [RM] 19). Coleman National Fish Hatchery (CNFH) planted steelhead fingerlings in South Cow Creek in the 1980s and 1990s.

The species planted in Old Cow Creek were similar to those in South Cow Creek. However, fewer fish have been planted in Old Cow Creek in recent years. Catchable rainbow trout have been planted near the Kilarc Powerhouse and fingerling steelhead were planted further downstream.

Currently, Kilarc Forebay is stocked twice a year with catchable rainbow trout to support recreational fishing. Anglers report catching large brown trout in the forebay even though no brown trout have been planted since the 1980s (PG&E 2007a). Surveys in 2003 also found golden shiner in the forebay, although they comprised less than 5 percent of the total number of fish caught (PG&E 2007a). Stocking will be discontinued before the decommissioning of Kilarc Forebay, and any non-native fish will be relocated outside of anadromous habitat.

VII. INTEGRATION AND SYNTHESIS OF EFFECTS

The purpose of this section is to summarize the effects of the action and add those effects to the impacts described in the “Environmental Baseline” and “Cumulative Effects” sections of this biological opinion in order to inform the conclusion of whether or not the proposed action is likely to jeopardize the continued existence of the listed salmonids, or destroy or adversely modify designated critical habitat.

Populations of steelhead in California have declined drastically over the last century, and some subpopulations have been extirpated. The current status of listed salmonids within the action area, based upon their risk of extinction, has not significantly improved since the species were listed (Good *et al*. 2005). This severe decline in population over many years, and in consideration of the degraded environmental baseline, demonstrates the need for actions which will assist in the recovery of all of the ESA-listed species in the action area, and that if measures are not taken to reverse these trends, the continued existence of steelhead could be at risk.

A. Impacts of the Proposed Action on ESU/DPS Survival and Potential for Recovery

The Effects of the Action section acknowledges and analyzes the effect of decommissioning the Project. Some potential effects of the decommissioning are expected to result take of listed anadromous fish in the action area. However, the most significant long-term effect of surrendering the FERC license and decommissioning the project will be to improve overall conditions for listed salmonids by improving habitat. This improvement of habitat will be achieved through removing barriers, increasing instream flows (and returning flows to a natural hydrograph), and thereby reducing temperatures during critical periods.

The adverse effects that are anticipated to result from the construction are not the type or magnitude that would be expected to appreciably reduce the likelihood of survival and recovery of the affected species within the action area. NMFS expects that any adverse effects of this project will be outweighed by the long-term benefits to species survival produced by the improvement in habitat for steelhead.

B. Impacts of the Proposed Action on Critical Habitat

The long-term effects of decommissioning the Kilarc-Cow Project are anticipated to be beneficial to these species and are expected to enhance the conservation value of designated critical habitat in the Cow Creek watershed.

VIII. CONCLUSION

After reviewing the best scientific and commercial data available, including the current status of the listed salmonid species, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is NMFS' biological opinion that the FERC license surrender of the Kilarc-Cow Project is not likely to jeopardize the continued existence of Central Valley steelhead.

In addition, NMFS has determined that the FERC action, as proposed, is not likely to destroy or adversely modify the designated critical habitat for Central Valley steelhead.

IX. INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by NMFS as an act which kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by FERC so that they become binding conditions of any licenses issued, as appropriate, for the exemption in section

7(o)(2) to apply. FERC has a continuing duty to regulate the activities covered by this Incidental Take Statement. If FERC: (1) fails to assume and implement the terms and conditions; or (2) fails to require the licensees to adhere to the terms and conditions of the Incidental Take Statement through enforceable terms that are added to the license, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, FERC must report the progress of the action and its impact on the species to NMFS as specified in this Incidental Take Statement (50 CFR §402.14(I)(3)).

A. Amount or Extent of Take

NMFS anticipates incidental take of Central Valley steelhead through the decommissioning of the Kilarc-Cow project. Specifically, NMFS anticipates that incubating eggs, fry, juvenile, and adult steelhead may be killed, injured, or harassed during the decommissioning activities.

Often, NMFS cannot, using the best available information, specifically quantify the anticipated amount of incidental take of individual listed fish because of the variability and uncertainty associated with the response of listed species to the effects of the project, the varying population size of each species, annual variations in the timing of spawning and migration, and individual habitat use within the project area. However, in some cases actual numbers of fish to be taken can be determined, due to the nature of the take. NMFS anticipates take associated with:

1. <u>Entrapment or stranding of juveniles in isolated pools resulting from dewatering of instream construction areas</u>

Fish relocation operations will occur during decommissioning at Kilarc Tailrace, South Cow Creek Diversion, Mill Creek Diversion, South Cow Creek Main Canal, and Cow Creek Forebay. Numbers of steelhead to be captured and relocated from each site have been estimated (by PGE), and range from 331 to 671 juveniles. A maximum of 10 percent of steelhead handled and relocated are expected to be lost during the operation. Take will be exceeded if more than 10 percent or more than 67 steelhead are killed in the process of relocation, and will trigger the need to reinitiate consultation on the project.

B. Effect of the Take

In the accompanying biological opinion, NMFS determined that this level of anticipated take is not likely to result in jeopardy to Central Valley steelhead. In addition, NMFS determined that this level of anticipated take is not likely to result in the destruction or adverse modification of designated critical habitat for Central Valley steelhead.

C. Reasonable and Prudent Measures

Pursuant to section 7(b)(4) of the ESA, the following reasonable and prudent measures are necessary and appropriate to minimize take of Central Valley steelhead:

1. Due to close cooperation between PG&E and NMFS throughout the planning and development of the project and Biological Evaluation, NMFS believes that all measures which are necessary and appropriate to minimize take of Central Valley steelhead have already been incorporated into the project plan. Therefore, the only requirement will be for thorough monitoring and reporting to NMFS on the efficacy of the proposed conservation measures and any documented take that results from construction of the project.

D. Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, FERC must require that PG&E comply with the following terms and conditions, which implement the reasonable and prudent measures, described above, and outline reporting/monitoring requirements. These terms and conditions are non-discretionary.

1. Due to close cooperation between PG&E and NMFS throughout the planning and development of the project and Biological Evaluation, NMFS believes that all measures which are necessary and appropriate to minimize take of Central Valley steelhead have already been incorporated into the project plan. Therefore, the only requirement will be for thorough monitoring and reporting to NMFS on the efficacy of the proposed conservation measures and any documented take that results from construction of the project.

   a. FERC shall require PG&E to closely monitor all construction activities and report any incidences of take of listed salmonids within 48 hours to NMFS at the contact information below.

   b. FERC shall require PG&E to provide annual reports to NMFS within six months of the close of each instream/near-stream construction season. These reports shall include: a summary of total numbers of listed salmonids encountered, captured, or killed during construction and relocation operations; progress on construction elements and updated timelines for project completion; and efficacy of erosion control and other conservation measures and descriptions of any unforeseen problems or incidents that may have affected listed salmonids.

Updates and reports required by these terms and conditions shall be submitted to:

Supervisor
Central Valley Office
National Marine Fisheries Service
650 Capitol Mall, Suite 8-300
Sacramento CA 95814
FAX: (916) 930-3629
Phone: (916) 930-3600

X. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. "Conservation" is defined in the ESA as those measures necessary to delist a species. These conservation recommendations include discretionary measures that FERC can take to minimize or avoid adverse effects of a proposed action on a listed species or designated critical habitat or regarding the development of information. In addition to the terms and conditions of the

Incidental Take Statement, NMFS provides the following conservation recommendation that will reduce or avoid adverse impacts on the listed species:

1. FERC should encourage PG&E to minimize any potential take whenever possible.

XI. REINITIATION OF CONSULTATION

This concludes formal consultation on the proposed Kilarc-Cow Decommissioning project. As provided in 50 CFR §402.16, reinitiation of formal consultation is required if: (1) the amount or extent of taking specified in the incidental take statement is exceeded; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) the action is subsequently modified in a manner that causes an effect to the listed species that was not considered in the biological opinion; or (4) a new species is listed or critical habitat is designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, formal consultation shall be reinitiated immediately.

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Enclosure 2

<u>Magnuson-Stevens Fishery Conservation and Management Act</u>

ESSENTIAL FISH HABITAT CONSERVATION RECOMMENDATIONS[1]
FERC Kilarc-Cow Decommissioning Project (Project)

I. IDENTIFICATION OF ESSENTIAL FISH HABITAT

The Magnuson-Stevens Fishery Conservation and Management Act (MSA), as amended (U.S.C. 180 *et seq.*), requires that Essential Fish Habitat (EFH) be identified and described in Federal fishery management plans (FMPs). Federal action agencies must consult with NOAA's National Marine Fisheries Service (NMFS) on any activity which they fund, permit, or carry out that may adversely affect EFH. NMFS is required to provide EFH conservation and enhancement recommendations to the Federal action agencies.

EFH is defined as those waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity. For the purposes of interpreting the definition of EFH, "waters" includes aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include areas historically used by fish where appropriate; "substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities; "necessary" means habitat required to support a sustainable fishery and a healthy ecosystem; and, "spawning, breeding, feeding, or growth to maturity" covers all habitat types used by a species throughout its life cycle. The proposed project site is within the region identified as EFH for Pacific salmon in Amendment 14 of the Pacific Salmon FMPs.

The Pacific Fishery Management Council (PFMC) has identified and described EFH, Adverse Impacts and Recommended Conservation Measures for salmon in Amendment 14 to the Pacific Coast Salmon FMP (PFMC 1999). Freshwater EFH for Pacific salmon in the California Central Valley includes waters currently or historically accessible to salmon within the Central Valley ecosystem as described in Myers *et al.* (1998). Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*), Central Valley spring-run Chinook salmon (*O. tshawytscha*), and Central Valley fall-/late fall-run Chinook salmon (*O. tshawytscha*) are species managed under the Pacific Coast Salmon FMP that occur in the Central Valley. Fall-run Chinook salmon comprise the largest population of Chinook salmon in the Cow Creek watershed.

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[1] The 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) set forth new mandates for NOAA's National Marine Fisheries Service (NMFS) and Federal action agencies to protect important marine and anadromous fish habitat. Federal action agencies which fund, permit, or carry out activities that may adversely impact EFH are required to consult with NMFS regarding potential adverse effects of their actions on EFH, and respond in writing to NMFS "EFH Conservation Recommendations." The Pacific Fisheries Management Council has identified essential fish habitat (EFH) for the Pacific salmon fishery in Amendment 14 to the Pacific Coast Salmon Fishery Management Plan.

Factors limiting salmon populations in the Cow Creek Watershed include multiple unscreened diversions, low flows with an unnatural hydrograph, high water temperatures, and lack of spawning habitat due to sediment transport process being blocked by dams.

A. Life History and Habitat Requirements

1. <u>Pacific Salmon</u>

General life history information for Central Valley fall-run Chinook salmon is summarized below. Further detailed information on the other Central Valley Chinook salmon Evolutionarily Significant Units (ESUs) are available in the enclosed biological opinion, the NMFS status review of Chinook salmon from Washington, Idaho, Oregon, and California (Myers *et al.* 1998), and the NMFS proposed rule for listing several ESUs of Chinook salmon (63 FR 11482).

Adult Central Valley fall-run Chinook salmon enter the Sacramento and San Joaquin Rivers from July through December and spawn from October through December while adult Central Valley late fall-run Chinook salmon enter the Sacramento and San Joaquin Rivers from October to April and spawn from January to April (U.S. Fish and Wildlife Service [USFWS] 1998). Chinook salmon spawning generally occurs in clean loose gravel in swift, relatively shallow riffles, or along the edges of fast runs (NMFS 1997).

Egg incubation occurs from October through March (Reynolds *et al.* 1993). Shortly after emergence from their gravel nests, most fry disperse downstream towards the Delta and into the San Francisco Bay and its estuarine waters (Kjelson *et al.* 1982). The remaining fry hide in the gravel or station in calm, shallow waters with bank cover such as tree roots, logs, and submerged or overhead vegetation. These juveniles feed and grow from January through mid-May, and emigrate to the Delta and estuary from mid-March through mid-June (Lister and Genoe 1970). As they grow, the juveniles associate with coarser substrates along the stream margin or farther from shore (Healey 1991). Along the emigration route, submerged and overhead cover in the form of rocks, aquatic and riparian vegetation, logs, and undercut banks provide habitat for food organisms, shade, and protect juveniles and smolts from predation. These smolts generally spend a very short time in the Delta and estuary before entry into the ocean. Whether entering the Delta or estuary as fry or larger juveniles, Central Valley Chinook salmon depend on passage through the Delta for access to the ocean.

II. PROPOSED ACTION

The proposed action is described in section II (*Description of the Proposed Action*) of the preceding biological opinion for threatened Central Valley steelhead (*Oncorhynchus mykiss*), and designated critical habitat for Central Valley steelhead (Enclosure 1).

III. EFFECTS OF THE PROPOSED ACTION

The effects of the proposed action on salmonid habitat (*i.e.*, Central Valley steelhead) are described at length in section V (*Effects of the Action*) of the preceding biological opinion, and generally are expected to apply to Pacific salmon EFH.

Potential negative effects to EFH are expected to be minimal and temporary stemming from construction activities that may contribute sediment and increased turbidity and will be avoided or minimized by meeting Regional Water Quality Board objectives, implementing applicable BMPs, staging equipment outside of the riparian corridor, limiting the amount of riparian vegetation removal, and replacing lost riparian vegetation at the project site. Monitoring of all construction areas will occur for one to two years (as agreed upon by agencies).

Implementation of the proposed project would result in a permanent net increase of riverine habitat since this project would result in an increase in flows, decreased water temperatures, increased water quality, restoration of natural sediment transport process, and redistribution of sediments stored behind the dams.

The adverse effects that are anticipated to result from the proposed project are not of the type, duration, or magnitude that would be expected to adversely modify EFH to the extent that it could lead to an appreciable reduction in the function and conservation role of the affected habitat. NMFS expects that nearly all of the adverse effects to EFH from this project will be of a short term nature and will not affect future generations of Pacific salmon beyond the deconstruction of the project.

IV. CONCLUSION

Based on the best available information, and upon review of the effects of the proposed FERC license surrender and decommissioning of the Kilarc-Cow Hydroelectric Project, NMFS believes that the proposed actions will have negligible effects on EFH of Pacific salmon protected under MSA.

V. EFH CONSERVATION RECOMMENDATIONS

As the adverse effects to EFH associated with the proposed project will generally occur in the critical habitat utilized by the federally listed species addressed in the enclosed biological opinion, NMFS recommends that reasonable and prudent measure number 1 and the respective implementing terms and conditions as well as conservation recommendation number 1 described in the enclosed biological opinion, be adopted as EFH conservation recommendations. Those terms and conditions which require the submittal of reports and status updates can be disregarded for the purposes of this EFH consultation as there is no need to duplicate those submittals.

VI. STATUTORY REQUIREMENTS

Section 305 (b) 4(B) of the MSA requires that the Federal lead agency provide NMFS with a detailed written response within 30 days, and 10 days in advance of any action, to the EFH conservation recommendations, including a description of measures adopted by the lead agency for avoiding, minimizing, or mitigating the impact of the project on EFH (50 CFR 600.920[j]). In the case of a response that is inconsistent with our recommendations, the lead agency must explain its reasons for not following the recommendations, including the scientific justification for any disagreement with NMFS over the anticipated effects of the proposed action and the measures needed to avoid, minimize, or mitigate such effects.

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