State of California
The Resources Agency
Department of Water Resources

FINAL REPORT
FISH SPECIES COMPOSITION IN LAKE OROVILLE'S UPSTREAM TRIBUTARIES
SP-F3.1 TASK 1B

Oroville Facilities Relicensing
FERC Project No. 2100

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REPORT SUMMARY

The purpose of SP-F 3.1 Task 1B was to describe the fish species composition in tributaries of the Feather River upstream from Lake Oroville. A description of the life history and habitat requirements of the fish species in the upstream tributaries is available in the SP-F3.2 Task 2. The Oroville Facilities have the potential to influence fish species composition upstream from Lake Oroville due to reservoir surface elevation fluctuations caused by ongoing project operations. When the surface elevation of Lake Oroville is high (generally in the spring), fish are able to move freely between the reservoir and upstream tributaries. Conversely, when the surface elevation of Lake Oroville is low (generally in the fall), free movement of fish between the reservoir and upstream tributaries may be blocked. Fisheries management activities supporting the warmwater fishery in Lake Oroville also could potentially have influenced species composition in upstream tributaries because some introduced warmwater species have been observed upstream from Lake Oroville. Additionally, the stocking of salmonid species in Lake Oroville in support of the coldwater fishery also could influence upstream species composition because these species may migrate into upstream tributaries as conditions allow. The results of this study will provide information regarding fish species composition in the tributaries upstream from Lake Oroville and the effects of project operations on species composition. Additionally, the results of this study will be used to evaluate the potential impact of resource actions altering project operations that may affect current fish species composition and distribution in the tributaries upstream from Lake Oroville.

Fish species composition in the tributaries upstream from Lake Oroville was determined from a series of surveys conducted by DWR during 2002 and 2003 as part of the Oroville Facilities FERC relicensing process and from fish distribution data collected on the North Fork Feather River by Pacific Gas and Electric Company (PG&E) as part of the Poe Hydroelectric Project FERC relicensing process.

The game fish species observed in the upper Feather River by DWR in 2002 and 2003 include two species of salmonids; rainbow trout (*Oncorhynchus mykiss*) and brown trout (*Salmo trutta*), and three species of black bass; smallmouth bass (*Micropterus dolomieu*), redeye bass (*Micropterus coosae*), and spotted bass (*Micropterus punctulatus*). In addition, several juvenile bluegill (*Lepomis macrochirus*) were observed in the South Fork Feather River. Of those game fish observed, only rainbow trout are considered native to the drainage. Non-game fish species observed in the upper Feather River tributaries include carp (*Cyprinus carpio*), Sacramento pikeminnow (*Ptychocheilus grandis*), California roach (*Hesperoleucus symmetricus*), and at least one species each of sucker (*Catostomus* sp.) and sculpin (*Cottus* sp.). In addition to those species observed during the DWR surveys, hardhead (*Mylopharadon conocephalus*), largemouth bass (*Micropterus salmoides*), and brown bullhead (*Ameiurus nebulosus*) were reported by PG&E to be present in the North Fork Feather River prior to 2002. Of these three species, only hardhead are native to the Feather River drainage. The fish species composition upstream of Lake Oroville's high water

mark supports a typical California foothill stream-dwelling fish assemblage. No fish species of primary management concern was observed in upstream tributaries that had not been previously observed in Lake Oroville or in the downstream reaches of the Feather River.

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1.0 INTRODUCTION

1.1 BACKGROUND INFORMATION

The Oroville Facilities have the potential to influence fish species composition upstream from Lake Oroville due to surface level fluctuations of the reservoir caused by project operations. When Lake Oroville's surface elevation is high (normally in the spring), fish are able to move freely between the reservoir and the upstream tributaries. When Lake Oroville's surface elevation is low (normally in the fall), free movement of fish between the reservoir and upstream tributaries may be blocked. Additionally, fish species composition in upstream tributaries may be affected by fisheries management activities in support of Lake Oroville's warmwater and coldwater fisheries. As a component of study plan (SP)-F3.1, *Evaluation of Project Effects on Fish and Their Habitat within Lake Oroville, its Upstream Tributaries, the Thermalito Complex, and the Oroville Wildlife Area*, Task 1B, herein describes the fish species composition in Lake Oroville's upstream tributaries.

1.1.1 Statutory/Regulatory Requirements

Section 4.51(f)(3) of 18 CFR requires reporting of certain types of information in the Federal Energy Regulatory Commission (FERC) application for license of major hydropower projects, including a discussion of the fish, wildlife, and botanical resources in the vicinity of the project (FERC 2001). The discussion is required to identify the potential impacts of the project on these resources, including a description of any anticipated continuing impact from on-going and future operations. As a subtask of SP-F3.1, Task 1B fulfills a portion of the FERC application requirements by detailing potential effects of project operations on fish species composition in tributaries upstream of Lake Oroville.

1.1.2 Study Area

The study area for Task 1B of SP-F3.1 includes the four major tributaries of the Feather River extending upstream from the high water mark of Lake Oroville to the first stream channel obstructions that, under normal flow conditions, limit the upstream migration of salmonids. The tributaries include the North Fork Feather River upstream to Poe Dam, West Branch North Fork Feather River upstream to Miocene Dam, Middle Fork Feather River upstream to Curtain Falls and the South Fork Feather River upstream to Ponderosa Dam. Smaller tributaries in the study area include Berry Creek, Canyon Creek, Chino Creek, Concow Creek, Fall River, French Creek, Frey Creek, Sucker Run Creek, McCabe Creek, and Stony Creek. The study area is shown in Figure 1.1-1.

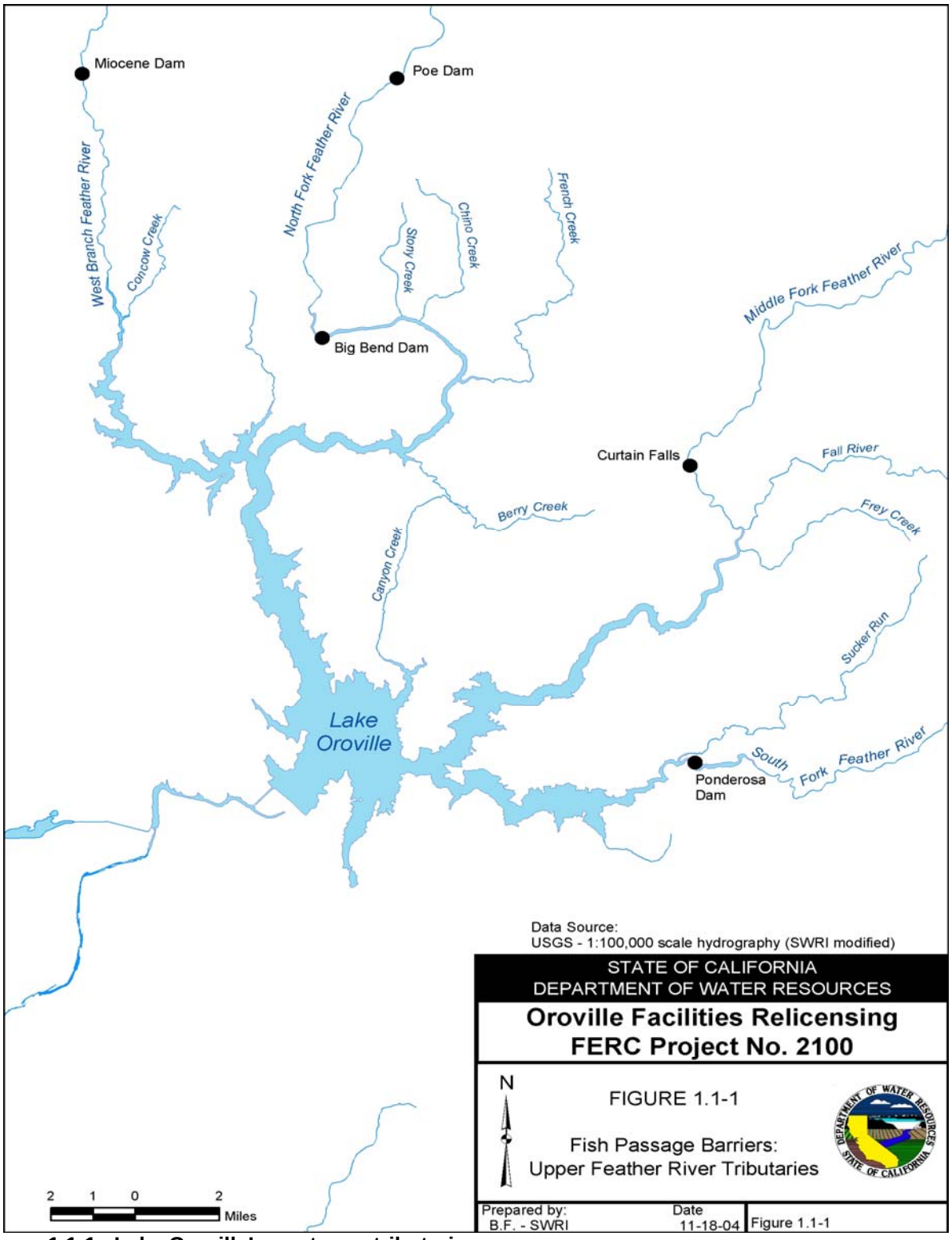

Figure 1.1-1. Lake Oroville's upstream tributaries

1.1.2.1 Description

The upper Feather River watershed (drainage area above the gauging station at Oroville) drains 3,624 square miles and encompasses about 68 percent of the Feather River basin (DWR 2001). Four major tributaries drain the upper Feather River watershed above Lake Oroville.

West Branch North Fork Feather River

The study area on the West Branch North Fork Feather River (West Branch) extends from Miocene Dam at an elevation of 1550 feet to the high pool elevation level of Lake Oroville at 900 feet msl, encompassing a distance of approximately six river miles. Miocene Dam is a concrete diversion dam located approximately 3 to 4 miles upstream from Salmon Falls. It may be possible, during extremely high flow events, that Miocene Dam would become passable allowing access to another four miles of habitat upstream to the falls below Big Kimshew Creek. The Falls below Big Kimshew Creek are located approximately ¾ mile downstream from Big Kimshew Creek and are estimated to be 5 to 6 meters in height. Another potential upstream migration barrier is Salmon Falls. Salmon Falls was evaluated as a potential upstream migration barrier during the SP 3.1 Task 1A data gathering process. Although not evaluated at all potential flow regimes, the assessment team concluded that Salmon Falls presents a likely barrier to upstream migration during all but extreme flow events (DWR 2004a). Concow Creek is a major tributary flowing into the West Branch downstream from the high pool level of Lake Oroville.

North Fork Feather River

Big Bend Dam marks the upstream extent of the study area on the North Fork Feather River (North Fork) and is at the same elevation as the high pool level of Lake Oroville. However, during high flow events when Lake Oroville is at full pool (normally in the spring) it is likely that Big Bend Dam is passable (DWR 2004a; DWR 2004b). Big Bend Dam is a concrete dam located approximately ½ mile downstream of Poe Powerhouse. The dam crosses the entire river channel and passes water over its top during high flow conditions. When Big Bend Dam is passable, the upstream extent of potentially accessible habitat would extend to Poe Dam. Therefore, the fish species observed or reported to be present in the reach below Poe Dam and above Miocene Dam were reported as present within the study area. Major tributaries of the North Fork downstream from Big Bend Dam include Stoney Creek, Chino Creek, French Creek and Berry Creek.

Middle Fork Feather River

The upstream extent of the study area on the Middle Fork Feather River (Middle Fork) is Curtain Falls, which is at an elevation of 1,220 feet msl. Curtain Falls is located approximately six miles upstream of the high pool level of Lake Oroville. Major

tributaries of the Middle Fork Feather River include Fall River, Frey Creek, and Canyon Creek. The Middle Fork Feather River has been designated a "Wild and Scenic River."

The Wild and Scenic Rivers Act of 1968 (PL-542, 16 USC 1271-1287) established the policy that certain rivers and their immediate environments, which possess outstanding scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values will be preserved and protected. Section 10 of the act requires that each component of the Wild and Scenic river system be administered in such a manner as to protect and enhance the values for which the river was designated. Under the act, federal agencies with discretionary decision-making authority (i.e., permitting authority) must review the proposed project in relation to Section 7 and Section 10 of the act to determine if the proposed project would affect the values of the Wild and Scenic river. The Middle Fork was one of the nine original rivers designated under the act in 1968. The designation includes the entire Middle Fork downstream from the confluence of its tributary streams one kilometer south of Beckwourth, California (U.S. Congress 1968). The 77.6 miles of stream included in this description are broken down according to their classification statue: 32.9 miles are designated as wild, 9.7 miles are managed as scenic, and 35 miles are managed for recreational purposes (National Park Service Website 2004). The Secretary of Agriculture administers the Middle Fork Feather River component of the National Wild and Scenic Rivers System.

The Fish and Game Commission also has designated the Middle Fork to be managed exclusively for wild trout. The Fish and Game Commission established the California Wild Trout Program in 1971, with an objective of protecting and enhancing fisheries sustained by strains of trout. The waters managed by the Fish and Game Commission include lakes and streams, which are designated as either Catch-and Release and/or Wild Trout streams. The Fish and Game Commission set forth a policy, which states: "all necessary actions, consistent with State law, shall be taken to prevent adverse impact by land or water development projects affecting designated wild trout rivers." It is the responsibility of DFG, through the Wild Trout Program, to implement the Trout and Steelhead Conservation and Management Planning Act of 1979, which requires annual statewide inventories of trout streams and lakes, evaluations of catch-and-release regulations, and recommends waters for catch-and-release angling regulations. The Middle Fork Feather River is one of the original streams included in the Wild Trout Program, and is designated as a wild trout river (DFG Website 2004). Trout for which the Middle Fork is managed include rainbow and brown trout.

South Fork Feather River

Ponderosa Dam marks the upstream extent of the study area on the South Fork Feather River (South Fork). Ponderosa Dam is a large earth-fill dam near the full-pool level of Lake Oroville. The dam has a concrete spillway on river-right, which serves as a straight, high velocity chute ending with a waterfall. Major tributaries of the South Fork downstream from Ponderosa Dam, within the high-pool extent of Lake Oroville; include Sucker Run Creek and McCabe Creek.

1.1.2.2 History

The Fish Barrier Dam was constructed as part of the Oroville Facilities between 1962 and 1964. Located upstream from the FRFH and approximately five miles downstream of Oroville Dam, it is identified as the first impassible salmonid migration barrier on the Feather River (DWR and USBR 2000; Yoshiyama et al. 1998).

Historically, the upper Feather River watershed provided habitat for anadromous and resident salmonids. Spring-run Chinook salmon and steelhead were reported to ascend the very highest streams and headwaters of the Feather River watershed, while fall-run Chinook salmon occupied the lower foothill reaches of the river (DWR and USBR 2000; Yoshiyama et al. 1998). Prior to the construction of Oroville Dam, the upstream extent of fish passage was limited by natural fish barriers and previously constructed hydroelectric projects.

DFG has been involved with fishery management activities in the Feather River watershed for over 100 years. In the 1960s, DFG narrowed its focus from the watershed level and initiated fishery management activities within the FERC-project boundary. These activities included fisheries studies, species introductions, fish stocking programs, habitat enhancement projects, and operation of the Feather River Hatchery. While habitat restoration efforts and fish stocking from the Feather River Hatchery have increased fish production and provided increased angling opportunities in Lake Oroville, management actions including the introduction of exotic species, as well as disease propagation may have affected fisheries resources in project waters.

1.2 DESCRIPTION OF FACILITIES

The Oroville Facilities were developed as part of the State Water Project (SWP), a water storage and delivery system of reservoirs, aqueducts, power plants, and pumping plants. The main purpose of the SWP is to store and distribute water to supplement the needs of urban and agricultural water users in northern California, the San Francisco Bay area, the San Joaquin Valley, and southern California. The Oroville Facilities are also operated for flood management, power generation, to improve water quality in the Delta, provide recreation, and enhance fish and wildlife.

FERC Project No. 2100 encompasses 41,100 acres and includes Oroville Dam and Reservoir, three power plants (Hyatt Pumping-Generating Plant, Thermalito Diversion Dam Power Plant, and Thermalito Pumping-Generating Plant), Thermalito Diversion Dam, the Feather River Fish Hatchery and Fish Barrier Dam, Thermalito Power Canal, Oroville Wildlife Area (OWA), Thermalito Forebay and Forebay Dam, Thermalito Afterbay and Afterbay Dam, and transmission lines, as well as a number of recreational facilities. The Oroville Dam, along with two small saddle dams, impounds Lake Oroville, a 3.5-million-acre-feet (maf) capacity storage reservoir with a surface area of 15,810 acres at its normal maximum operating level.

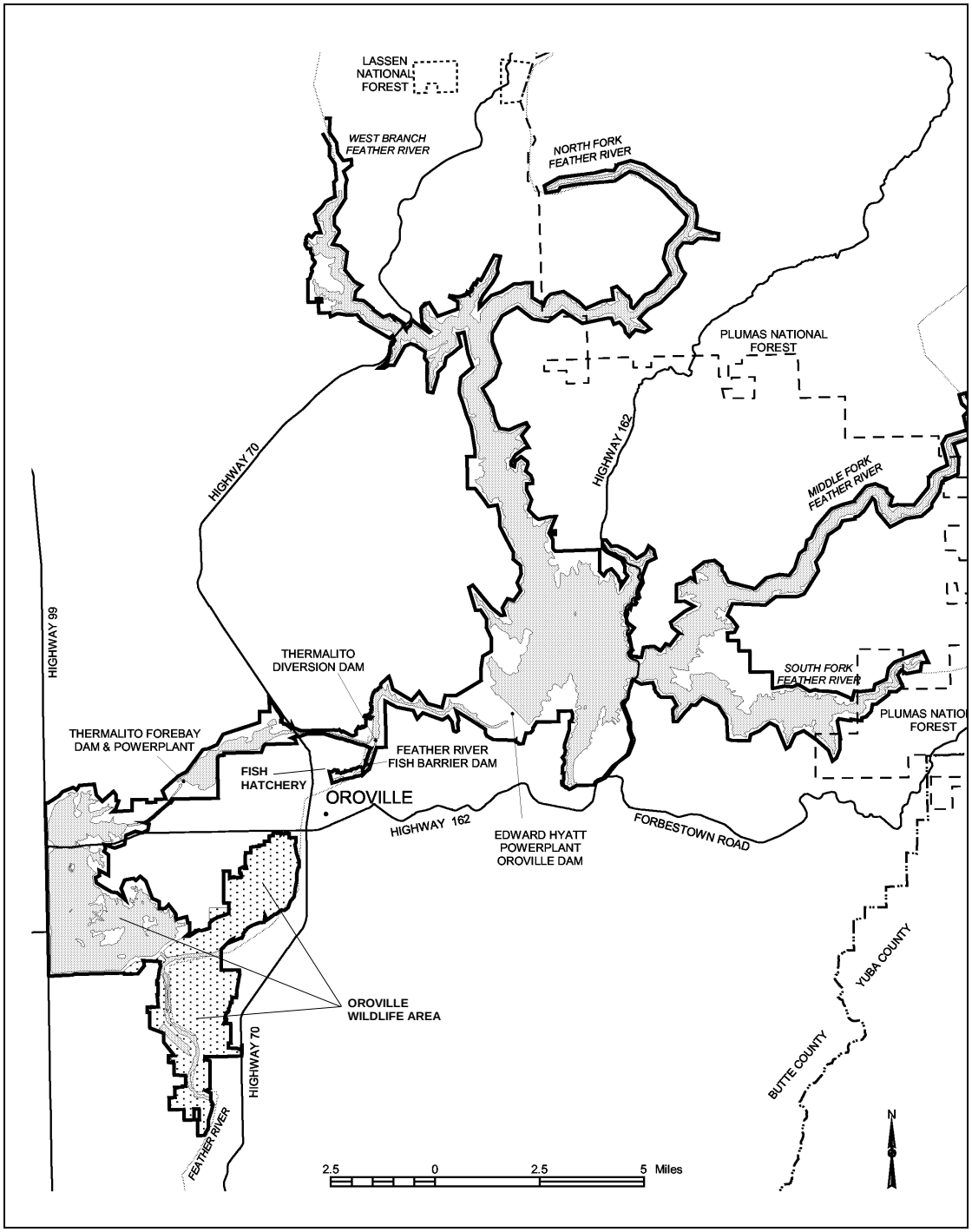

Figure 1.2-1. Oroville Facilities FERC Project Boundary.

The hydroelectric facilities have a combined licensed generating capacity of approximately 762 megawatts (MW). The Hyatt Pumping-Generating Plant is the largest of the three power plants with a capacity of 645 MW. Water from the six-unit underground power plant (three conventional generating and three pumping-generating

units) is discharged through two tunnels into the Feather River just downstream of Oroville Dam. The plant has a generating and pumping flow capacity of 16,950 cfs and 5,610 cfs, respectively. Other generation facilities include the 3-MW Thermalito Diversion Dam Power Plant and the 114-MW Thermalito Pumping-Generating Plant.

Thermalito Diversion Dam, four miles downstream of the Oroville Dam creates a tail water pool for the Hyatt Pumping-Generating Plant and is used to divert water to the Thermalito Power Canal. The Thermalito Diversion Dam Power Plant is a 3-MW power plant located on the left abutment of the Diversion Dam. The power plant releases a maximum of 615 cubic feet per second (cfs) of water into the river.

The Power Canal is a 10,000-foot-long channel designed to convey generating flows of 16,900 cfs to the Thermalito Forebay and pump-back flows to the Hyatt Pumping-Generating Plant. The Thermalito Forebay is an off-stream regulating reservoir for the 114-MW Thermalito Pumping-Generating Plant. The Thermalito Pumping-Generating Plant is designed to operate in tandem with the Hyatt Pumping-Generating Plant and has generating and pump-back flow capacities of 17,400 cfs and 9,120 cfs, respectively. When in generating mode, the Thermalito Pumping-Generating Plant discharges into the Thermalito Afterbay, which is contained by a 42,000-foot-long earth-fill dam. The Afterbay is used to release water into the Feather River downstream of the Oroville Facilities, helps regulate the power system, provides storage for pump-back operations, and provides recreational opportunities. Several local irrigation districts receive water from the Afterbay.

The Feather River Fish Barrier Dam is downstream of the Thermalito Diversion Dam and immediately upstream of the Feather River Fish Hatchery. The flow over the dam maintains fish habitat in the low-flow channel of the Feather River between the dam and the Afterbay outlet, and provides attraction flow for the hatchery. The hatchery was intended to compensate for spawning grounds lost to returning salmon and steelhead trout from the construction of Oroville Dam. The hatchery can accommodate an average of 15,000 to 20,000 adult fish annually.

The Oroville Facilities support a wide variety of recreational opportunities. They include: boating (several types), fishing (several types), fully developed and primitive camping (including boat-in and floating sites), picnicking, swimming, horseback riding, hiking, off-road bicycle riding, wildlife watching, hunting, and visitor information sites with cultural and informational displays about the developed facilities and the natural environment. There are major recreation facilities at Loafer Creek, Bidwell Canyon, the Spillway, North and South Thermalito Forebay, and Lime Saddle. Lake Oroville has two full-service marinas, five car-top boat launch ramps, ten floating campsites, and seven dispersed floating toilets. There are also recreation facilities at the Visitor Center and the OWA.

The OWA comprises approximately 11,000-acres west of Oroville that is managed for wildlife habitat and recreational activities. It includes the Thermalito Afterbay and

surrounding lands (approximately 6,000 acres) along with 5,000 acres adjoining the Feather River. The 5,000 acre area straddles 12 miles of the Feather River, which includes willow and cottonwood lined ponds, islands, and channels. Recreation areas include dispersed recreation (hunting, fishing, and bird watching), plus recreation at developed sites, including Monument Hill day use area, model airplane grounds, three boat launches on the Afterbay and two on the river, and two primitive camping areas. California Department of Fish and Game's (DFG) habitat enhancement program includes a wood duck nest-box program and dry land farming for nesting cover and improved wildlife forage. Limited gravel extraction also occurs in a number of locations.

1.3 CURRENT OPERATIONAL CONSTRAINTS

Operation of the Oroville Facilities varies seasonally, weekly and hourly, depending on hydrology and the objectives DWR is trying to meet. Typically, releases to the Feather River are managed to conserve water while meeting a variety of water delivery requirements, including flow, temperature, fisheries, recreation, diversion and water quality. Lake Oroville stores winter and spring runoff for release to the Feather River as necessary for project purposes. Meeting the water supply objectives of the SWP has always been the primary consideration for determining Oroville Facilities operation (within the regulatory constraints specified for flood control, in-stream fisheries, and downstream uses). Power production is scheduled within the boundaries specified by the water operations criteria noted above. Annual operations planning is conducted for multi-year carry over. The current methodology is to retain half of the Lake Oroville storage above a specific level for subsequent years. Currently, that level has been established at 1,000,000 acre-feet (af); however, this does not limit draw down of the reservoir below that level. If hydrology is drier than expected or requirements greater than expected, additional water would be released from Lake Oroville. The operations plan is updated regularly to reflect changes in hydrology and downstream operations. Typically, Lake Oroville is filled to its maximum annual level of up to 900 feet above mean sea level (msl) in June and then can be lowered as necessary to meet downstream requirements, to its minimum level in December or January. During drier years, the lake may be drawn down more and may not fill to the desired levels the following spring. Project operations are directly constrained by downstream operational constraints and flood management criteria as described below.

1.3.1 Downstream Operation

An August 1983 agreement between DWR and DFG entitled, "Agreement Concerning the Operation of the Oroville Division of the State Water Project for Management of Fish & Wildlife," sets criteria and objectives for flow and temperatures in the low flow channel and the reach of the Feather River between Thermalito Afterbay and Verona. This agreement: (1) establishes minimum flows between Thermalito Afterbay Outlet and Verona which vary by water year type; (2) requires flow changes under 2,500 cfs to be reduced by no more than 200 cfs during any 24-hour period, except for flood management, failures, etc.; (3) requires flow stability during the peak of the fall-run

Chinook spawning season; and (4) sets an objective of suitable temperature conditions during the fall months for salmon and during the later spring/summer for shad and striped bass.

1.3.1.1 Instream Flow Requirements

The Oroville Facilities are operated to meet minimum flows in the Lower Feather River as established by the 1983 agreement (see above). The agreement specifies that Oroville Facilities release a minimum of 600 cfs into the Feather River from the Thermalito Diversion Dam for fisheries purposes. This is the total volume of flows from the diversion dam outlet, diversion dam power plant, and the Feather River Fish Hatchery pipeline.

Generally, the instream flow requirements below Thermalito Afterbay are 1,700 cfs from October through March, and 1,000 cfs from April through September. However, if runoff for the previous April through July period is less than 1,942,000 af (i.e., the 1911-1960 mean unimpaired runoff near Oroville), the minimum flow can be reduced to 1,200 cfs from October to February, and 1,000 cfs for March. A maximum flow of 2,500 cfs is maintained from October 15 through November 30 to prevent spawning in overbank areas that might become de-watered.

1.3.1.2 Water Temperature Requirements

The Diversion Pool provides the water supply for the Feather River Fish Hatchery. The hatchery objectives are 52°F for September, 51°F for October and November, 55°F for December through March, 51°F for April through May 15, 55°F for last half of May, 56°F for June 1-15, 60°F for June 16 through August 15, and 58°F for August 16-31. A temperature range of plus or minus 4°F is allowed for objectives, April through November.

There are several temperature objectives for the Feather River downstream of the Afterbay Outlet. During the fall months, after September 15, the temperatures must be suitable for fall-run Chinook. From May through August, they must be suitable for shad, striped bass, and other warmwater fish.

The National Marine Fisheries Service has also established an explicit criterion for steelhead trout and spring-run Chinook salmon. Memorialized in a biological opinion on the effects of the Central Valley Project and SWP on Central Valley spring-run Chinook and steelhead as a reasonable and prudent measure; DWR is required to control water temperature at Feather River mile 61.6 (Robinson's Riffle in the low-flow channel) from June 1 through September 30. This measure requires water temperatures less than or equal to 65°F on a daily average. The requirement is not intended to preclude pump-back operations at the Oroville Facilities needed to assist the State of California with supplying energy during periods when the California ISO anticipates a Stage 2 or higher alert.

The hatchery and river water temperature objectives sometimes conflict with temperatures desired by agricultural diverters. Under existing agreements, DWR provides water for the Feather River Service Area (FRSA) contractors. The contractors claim a need for warmer water during spring and summer for rice germination and growth (i.e., 65°F from approximately April through mid May, and 59°F during the remainder of the growing season). There is no obligation for DWR to meet the rice water temperature goals. However, to the extent practical, DWR does use its operational flexibility to accommodate the FRSA contractor's temperature goals.

1.3.1.3 Water Diversions

Monthly irrigation diversions of up to 190,000 (July 2002) af are made from the Thermalito Complex during the May through August irrigation season. Total annual entitlement of the Butte and Sutter County agricultural users is approximately 1 maf. After meeting these local demands, flows into the lower Feather River continue into the Sacramento River and into the Sacramento-San Joaquin Delta. In the northwestern portion of the Delta, water is pumped into the North Bay Aqueduct. In the south Delta, water is diverted into Clifton Court Forebay where the water is stored until it is pumped into the California Aqueduct.

1.3.1.4 Water Quality

Flows through the Delta are maintained to meet Bay-Delta water quality standards arising from DWR's water rights permits. These standards are designed to meet several water quality objectives such as salinity, Delta outflow, river flows, and export limits. The purpose of these objectives is to attain the highest water quality, which is reasonable, considering all demands being made on the Bay-Delta waters. In particular, they protect a wide range of fish and wildlife including Chinook salmon, Delta smelt, striped bass, and the habitat of estuarine-dependent species.

1.3.2 Flood Management

The Oroville Facilities are an integral component of the flood management system for the Sacramento Valley. During the wintertime, the Oroville Facilities are operated under flood control requirements specified by the U.S. Army Corps of Engineers (USACE). Under these requirements, Lake Oroville is operated to maintain up to 750,000 af of storage space to allow for the capture of significant inflows. Flood control releases are based on the release schedule in the flood control diagram or the emergency spillway release diagram prepared by the USACE, whichever requires the greater release. Decisions regarding such releases are made in consultation with the USACE.

The flood control requirements are designed for multiple use of reservoir space. During times when flood management space is not required to accomplish flood management objectives, the reservoir space can be used for storing water. From October through

March, the maximum allowable storage limit (point at which specific flood release would have to be made) varies from about 2.8 to 3.2 maf to ensure adequate space in Lake Oroville to handle flood flows. The actual encroachment demarcation is based on a wetness index, computed from accumulated basin precipitation. This allows higher levels in the reservoir when the prevailing hydrology is dry while maintaining adequate flood protection. When the wetness index is high in the basin (i.e., wetness in the watershed above Lake Oroville), the flood management space required is at its greatest amount to provide the necessary flood protection. From April through June, the maximum allowable storage limit is increased as the flooding potential decreases, which allows capture of the higher spring flows for use later in the year. During September, the maximum allowable storage decreases again to prepare for the next flood season. During flood events, actual storage may encroach into the flood reservation zone to prevent or minimize downstream flooding along the Feather River.

2.0 NEED FOR STUDY

Task 1B is a subtask of SP-F3.1, *Evaluation of Project Effects on Fish and Their Habitat within Lake Oroville, its Upstream Tributaries, the Thermalito Complex, and the Oroville Wildlife Area*. Task 1B fulfills a portion of the FERC application requirements by evaluating fish species composition in the Feather River tributaries upstream of Lake Oroville. In addition to fulfilling statutory requirements, information collected during this task may be used in developing or evaluating potential Resource Actions.

Performing this study is necessary, in part, because operations of the Oroville Facilities may affect the ability of fish species to migrate between Lake Oroville and its upstream tributaries. Project operations have the potential to affect connectivity between upstream tributaries and the lake through the timing and range of reservoir surface elevation changes. Performing this study is additionally necessary because the study results will provide data for evaluation of potential effects of a fish passage program as evaluated in SP-F15.

3.0 STUDY OBJECTIVE

The objective of SP-F3.1 Task 1B is to describe the fish species composition in Lake Oroville's upstream tributaries and provide information relevant to evaluating the effects of project operations on those species. Fish life history and habitat requirements of the fish species of primary management concern that are present in the upstream tributaries of Lake Oroville are documented in the SP-F3.2 Task 2 report. Information obtained in this study is associated with, and will be applied to the following purposes and activities.

3.1 APPLICATION OF STUDY INFORMATION

The results of this analysis will be used to assess potential interactions between fish species in the upper Feather River tributaries and Lake Oroville, and to evaluate the effects of project operations on the fish species composition in the upstream tributaries. Additionally, this analysis will be used, in part, as a basis to evaluate some of the potential effects of re-introducing anadromous salmonids to the upper Feather River.

3.1.1 Department of Water Resources/Stakeholders

The information from this analysis will be used by DWR and the Environmental Work Group (EWG) to evaluate potential on-going effects of project operations by describing the fish species composition in tributaries upstream from Lake Oroville. Additionally, data collected in this task serves as a foundation for future evaluation and development of potential Resource Actions.

3.1.2 Other Studies

As a subtask of study plan SP-F3.1, *Evaluation of Project Effects on Fish and Their Habitat within Lake Oroville, its Upstream Tributaries, the Thermalito Complex, and the Oroville Wildlife Area,* Task 1 characterizes upstream migration barriers, fish species composition, and fish habitat in Lake Oroville's upstream tributaries. Task 1B, herein, describes the fish species composition. Task 1A Identifies barriers to upstream migration and Task 1C describes aquatic habitat in the upstream tributaries. For further description of Tasks 1A, or 1C, see SP-F3.1 and associated interim and final reports.

3.1.3 Engineering Exhibits

No modeling results from DWR's Engineering and Operations Group were necessary to complete this study plan report because the focus of SP-F3.1 Task 1B, fish species composition in Feather River tributaries upstream of Lake Oroville, is not a variable that is being modeled by DWR's Engineering and Operations Group.

3.1.4 Environmental Documentation

In addition to Section 4.51(f)(3) of 18 CFR, which requires reporting of certain types of information in the Federal Energy Regulatory Commission (FERC) application for license of major hydropower projects (FERC 2001), it may be necessary to satisfy the requirements of the National Environmental Policy Act (NEPA) as well as the Endangered Species Act (ESA). Because FERC has the authority to grant an operating license to DWR for continued operation of the Oroville Facilities, discussion is required to identify the potential impacts of the project on many types of resources, including fish, wildlife, and botanical resources. In addition, NEPA requires discussion of any anticipated continuing impact from on-going and future operations. To satisfy NEPA and ESA, DWR is preparing a Preliminary Draft Environmental Assessment (PDEA) to attach to the FERC license application, which shall include information provided by this study plan report.

3.1.5 Settlement Agreement

In addition to statutory and regulatory requirements, SP-F3.1 Task 1B provides information that may be useful in the development of potential Resource Actions to be negotiated during the collaborative process

4.0 METHODOLOGY

Fish species composition in tributaries upstream from Lake Oroville was determined through a combination of surveys conducted by DWR during 2002 and 2003 as part of the FERC relicensing process for the Oroville Facilities and on fish distribution data collected on the North Fork Feather River through surveys conducted by Pacific Gas and Electric as part of the Poe Hydroelectric Project FERC relicensing process.

4.1 FISH SPECIES COMPOSITION SURVEYS

Fish species composition in the upper Feather River was determined through snorkel surveys, backpack electrofishing, and hook-and-line sampling. The fish composition survey reaches are shown in Figure 4.1-1. Surveys were conducted on each of the four major tributaries of the upper Feather River. On Sucker Run Creek, a tributary of the South Fork Feather River, sampling occurred on five separate occasions during 2002 and 2003 (November 18, 2002, May 12, 2003, May 28, 2003, August 28, 2003, and September 2, 2003). Backpack electrofishing was the primary sampling technique used. Approximately 24,300 linear feet were sampled by electrofishing. Hook-and-line sampling occurred during the May 28, 2003 sampling effort. On the Middle Fork Feather River, snorkel surveys were conducted on two survey reaches on three separate occasions during 2002 and 2003 (December 5, 2002; July 29, 2003; August 19, 2003). The same reach was sampled on December 5, 2002 and August 19, 2003, while a second reach was sampled on July 29, 2003. The total linear extent of river sampled was approximately 2,000 linear feet. On Berry Creek, a tributary of the North Fork, an approximately 1,300 ft reach was sampled on November 12, 2002 using backpack electrofishing gear. On the West Branch, backpack electrofishing and snorkel surveys were conducted on three separate occasions during 2002 and 2003 (November 22, 2002; November 25, 2002; September 4, 2003). On November 22, 2002 and November 25, 2002, backpack electrofishing gear was used to sample two separate reaches measuring approximately 4,900 ft and approximately 6,560 ft in length, respectively. On September 4, 2003, two separate snorkel surveys were conducted along two reaches measuring approximately 1,300 ft and 2,600 ft, respectively. However, the snorkel survey reaches completely overlapped the electrofishing reaches, and did not add to the length of river sampled.

Surveys were conducted on the North Fork in 1999 and 2000 as part of the FERC relicensing process for the Poe Hydroelectric Project. Electrofishing and gill nets were used to sample the Poe Reservoir upstream from Poe Dam and snorkel surveys were conducted in the Poe Reach extending downstream from Poe Dam for a distance of approximately seven miles to the Poe Powerhouse (PG&E 2003). These surveys were used in conjunction with those conducted by DWR, described above, to determine species composition in the tributaries of the upper Feather River.

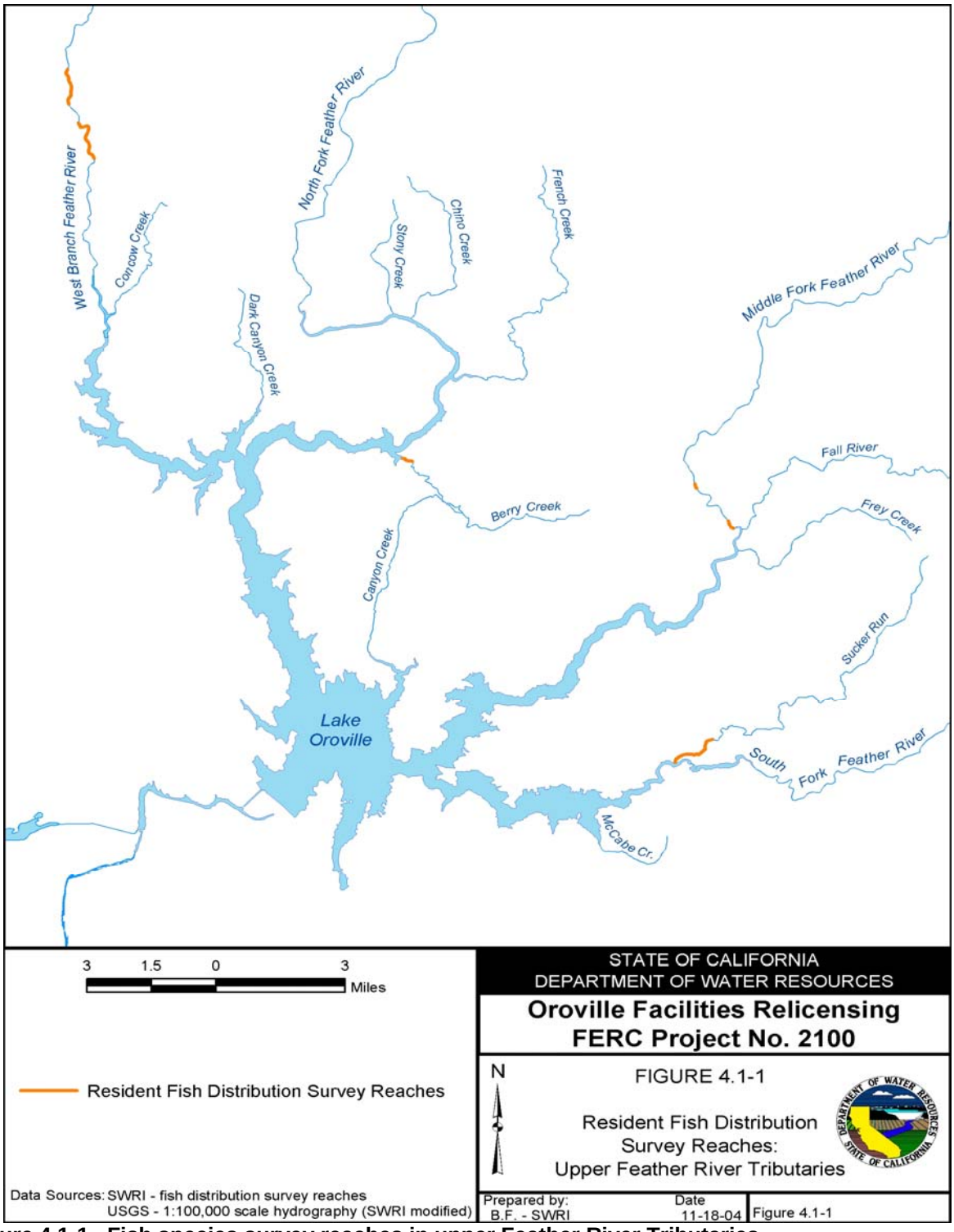

Figure 4.1-1. Fish species survey reaches in upper Feather River Tributaries

4.2 SURVEY DATA LIMITATIONS

Data containing fish species composition and distribution were collected in the four main tributaries of the upper Feather River. Fish distribution and composition data were gathered at broad scales, limiting analyses to a qualitative rather than quantitative description of species composition. Comparisons among tributaries and habitat types were not possible because survey effort and sampling methods differed. Surveyed areas represent a small proportion of the linear extent of the upper Feather River, and it is uncertain if results are applicable to the system as a whole. Surveys were not conducted year round due to access limitations and safety concerns. Due to sampling constraints, the species assemblage may not be completely reflective of the upper Feather River because: (1) fish have seasonal migrations; (2) fish have seasonal habitat preferences; and (3) selected sampling techniques have inherent bias.

4.3 LITERATURE REVIEW

A review of available literature was conducted to identify additional fish species composition data that may have resulted from additional surveys or other studies conducted in the upper Feather River watershed. Additionally, fish distribution data collected on the North Fork Feather River by government agencies and by other hydropower project operators was collected and summarized for use in supplementing survey data to describe fish species composition in Lake Oroville's upstream tributaries.

4.4 FISHERIES MANAGEMENT AND HATCHERY OPERATIONS

Fisheries management activities in Lake Oroville, specifically stocking of fish in the lake, could potentially affect the composition of fish species in the Feather River tributaries upstream from Lake Oroville. A review of current lake fishery management practices and a review of Lake Oroville stocking records were conducted to identify potential activities that may affect upstream tributary fish species composition.

5.0 STUDY RESULTS

5.1 TRIBUTARY SAMPLING

Table 5.1-1 summarizes, by tributary and length group, the numbers of individual fish captured during the 2002 and 2003 DWR sampling efforts in Lake Oroville's upstream tributaries. Results could not be compared among tributaries because sampling effort and methods differed.

Table 5.1-1 Numbers of fish captured during sampling efforts, and fish species distribution by tributary and length group in the major tributaries of the upper Feather River.

Species	Length (inches)	South Fork	Middle Fork	North Fork	West Branch	Total
Rainbow Trout	0-5.9	121	5	8	21	155
	6-11.9	32	17	3	47	99
	12≤	2	19	0	1	22
Brown Trout	0-5.9	22	0	0	0	22
	6-11.9	6	0	0	6	12
	12≤	0	0	0	8	8
Bluegill	0-5.9	9	0	0	0	9
	6-11.9	0	0	0	0	0
	12≤	0	0	0	0	0
Green Sunfish	0-5.9	0	0	0	0	0
	6-11.9	0	0	0	0	0
	12≤	0	0	0	0	0
Largemouth Bass	0-5.9	0	0	0	0	0
	6-11.9	0	0	0	0	0
	12≤	0	0	0	0	0
Redeye Bass	0-5.9	0	0	0	0	0
	6-11.9	0	25	0	0	25
	12≤	0	0	0	0	0
Smallmouth Bass	0-5.9	0	0	0	0	0
	6-11.9	0	6	0	0	6
	12≤	0	0	0	0	0
Spotted Bass	0-5.9	64	224	0	0	288
	6-11.9	0	33	0	0	33
	12≤	1	25	0	0	26
Carp	0-5.9	0	0	0	0	0
	6-11.9	0	0	0	0	0
	12≤	0	1	0	0	1
Sacramento Pikeminnow	0-5.9	1	53	0	10	64
	6-11.9	0	22	0	0	22
	12≤	0	30	0	1	31
Sucker sp.	0-5.9	34	1	0	0	35
	6-11.9	13	38	1	3	55
	12≤	0	45	0	0	45
Sculpin sp.	0-5.9	45	0	1	0	46
	6-11.9	0	0	0	0	0
	12≤	0	0	0	0	0
California Roach	0-5.9	0	100	0	1133	1233
	6-11.9	0	0	0	0	0
	12≤	0	0	0	0	0
Total		350	644	13	1230	2237

Source (DWR 2004c)

Rainbow trout were present at all sampling sites and small numbers of brown trout were observed in the South Fork and West Branch. In the Middle Fork, 19 of the rainbow trout sampled were over 12 inches in length. Sacramento pikeminnow were observed in all tributaries except the North Fork, and suckers were observed in all tributaries. California roach were observed in both the Middle Fork and South Fork. Sculpin were detected in both the South Fork and Middle Fork.

Few Centrarchids were captured during sampling efforts. Largemouth bass and green sunfish (*Lepomis cyanellus*) were not detected in the upper Feather River. Bluegill juveniles were observed in the South Fork. Redeye bass and smallmouth bass were found only in the Middle Fork, and spotted bass were detected in the South Fork and were abundant in the Middle Fork.

The Poe Reach of the North Fork extends downstream from Poe Dam, a distance of approximately seven miles to the Poe Powerhouse. The results of surveys conducted by PG&E for the Poe Hydroelectric Project FERC relicensing are shown in Table 5.1-2. Surveys reported in the table were conducted in the fall during 1992, during spring 1999, during fall 1999, and during spring 2000. Results of the surveys were reported by mesohabitat type including pools, runs, pocket water, and riffles. Three different sub-reaches of the Poe reach were sampled in each survey. Rather than reporting raw numbers of fish observed, Table 5.1-2 reports species densities in units of fish per 100 linear feet of survey reach.

Table 5.1-2 Poe Reach snorkel survey results

	Fish Density (# fish / 100 ft)			
Species	**Fall 1992**	**Spring 1999**	**Fall 1999**	**Spring 2000**
Pools				
Hardhead	0.2	1.8	1.4	0.2
Sacramento Pikeminnow	8.1	3.6	5.7	2.3
Sacramento Sucker	6.4	53.9	10.0	19.9
Rainbow trout	0.9	6.2	1.5	14.8
Smallmouth bass	8.9	1.4	0.0	0.6
Runs				
Hardhead	0.0	0.9	1.3	0.2
Sacramento Pikeminnow	0.0	1.1	1.7	1.4
Sacramento Sucker	2.9	54.9	9.1	29.4
Rainbow trout	0.8	18.0	4.1	49.8
Smallmouth bass	3.8	0.7	0.1	0.1
Pocket Water				
Hardhead	0.0	0.4	0.0	0.2
Sacramento Pikeminnow	0.0	3.6	0.0	6.0
Sacramento Sucker	4.8	77.0	6.3	27.9
Rainbow trout	4.0	13.5	5.2	30.3
Smallmouth bass	1.6	0.0	0.0	1.1
Riffles				
Hardhead	0.0	0.0	0.0	0.0
Sacramento Pikeminnow	0.0	4.3	0.6	2.8
Sacramento Sucker	2.0	24.3	2.2	3.7
Rainbow trout	3.0	12.2	3.6	46.4
Smallmouth bass	1.6	0.0	0.0	0.0

Source (PG&E 2003)

In addition to the above species identified during snorkel surveys, electrofishing surveys conducted upstream of Poe Dam in 1992 and 2000 found largemouth bass and several unidentified species of cyprinids (PG&E 2003). In the upper Feather River drainage, which includes Lake Almanor, Butt Valley Reservoir, and Bucks Lake, PG&E reported the presence of Chinook salmon (*O. tshawytscha*), lake trout (*Salvelinus namaycush*), brook trout (*S. fontinalis*), kokanee salmon (*O. nerka*), Tahoe sucker (*Catostomus tahoeenis*), tui chub (*Gila bicolor*), Lahontan redside (*Richardsonious egregious*), channel catfish (*Ictalurus punctatus*), and wakasagi (*Hypomesus nipponensis*) (PG&E 2003). Although many of these fish were stocked in Lake Almanor, they could potentially appear in Feather River tributaries within the Oroville Facilities FERC relicensing study area.

5.2 LITERATURE REVIEW

A review of available fisheries literature indicates that fish sampling on upstream tributaries of the Feather River, other than the North Fork, has been minimal. Moyle, et al. (1983) investigated the fish fauna in the North Fork downstream of Rock Creek Dam in 1977 and upstream of Rock Creek Dam in 1981. In both cases, the species assemblage was similar to that described in the DWR and PG&E surveys cited in Section 5.1. The Middle Fork is designated as a Wild and Scenic River and a Heritage Trout Water by DFG (DFG Website 2003). Although brown trout were not observed during the DWR survey efforts in 2002 and 2003, DFG reports suggest the presence of brown trout in the Middle Fork (DFG Website 2003).

Moyle and Nichols (1974) examined the fish species assemblage in streams draining into the Central Valley of California from the Sierra Nevada foothills by surveying 167 different locations during 1969, 1970, and 1971. Their findings indicate a species assemblage similar to that determined by the DWR and PG&E surveys on upper Feather River tributaries.

5.3 FISHERIES MANAGEMENT AND HATCHERY OPERATIONS

As a result of a 1994 FERC order, DWR became involved with fisheries management activities within the FERC project boundary. Since that time, DWR has stocked over 1.9 million Chinook salmon in Lake Oroville and expanded the Feather River Hatchery to accommodate Lake Oroville stocking. In 1999 alone, the Feather River Hatchery raised approximately 500,000 yearling Chinook salmon, 25,000 of which were stocked in the Thermalito Forebay, 158,000 were placed in Lake Oroville (in addition to 128,750 fingerlings), and the remainder were stocked in reservoirs outside the Oroville area.

The literature search identified a variety of different salmonid species, strains, and sizes that have been stocked in Lake Oroville since its creation in 1968 (Table 5.1.1). During Lake Oroville's first decade, rainbow trout, brown trout, and coho salmon were the primary species being stocked, with periodic plants of kokanee salmon. Catchable-sized

(10-12 inches long) fish were emphasized, which provided immediate angler returns in addition to larger trophy-sized fish if they survived over the winter and were available for a second and even third year in the lake. As is common with newly created reservoirs, fish growth was very high and Lake Oroville quickly became one of the most popular reservoir fisheries in California for all four of these species (John Hiscox pers. comm. 1993). In 1972, DFG introduced wakasagi smelt into Lake Almanor to provide a forage base for the Almanor coldwater fishery. Lake Almanor is located upstream of Lake Oroville on the North Fork of the Feather River, and by 1976 the wakasagi had passed down into Lake Oroville where they became established (Moyle 2002). They directly competed with the kokanee salmon in Lake Oroville since they both feed primarily on zooplankton in the cooler, deeper waters. This competition reduced the kokanee growth rate to a point where DFG ceased stocking kokanee after 1977 and this program has never been revived.

During Lake Oroville's second decade, rainbow trout stocking was phased out due to decreasing angler returns as a result of the presence of *Ceratomyxa shasta*, a myxosporean parasite that is lethal to most varieties of rainbows, and competition with wakasagi smelt (DWR 1993). Coho stocking was reduced due to egg supply and hatchery rearing problems (DWR 1993). The stocking of catchable-sized brown trout was increased, and Chinook salmon stocking became a regular occurrence, both at the fingerling (3-4 inches long) and yearling (6-8 inches long) size ranges. DFG experimented with lake trout, but this was abandoned due to egg supply difficulties and concerns that lake trout may compete or predate on the lake's warmwater fisheries.

By the beginning of the 1990s, brown trout and Chinook salmon had become the dominant coldwater species stocked in Lake Oroville, and except for a small group of coho salmon fingerlings stocked by a private fishing organization in 1991, this continued throughout the decade. Catchable-sized fish were phased out as the stocking management shifted toward a "put-and-grow" type of program, where smaller hatchery-produced salmonids (3-8 inches long) are stocked with the anticipation that they will increase substantially in size and survive for more than one season. DFG and DWR conducted a fishery study from 1993 through 1999, to update the fishery management plan and establish optimum stocking rates for the lake. Chinook yearlings were stocked in increasing amounts each year for several consecutive years to study the effects this would have on Chinook growth. The baseline amount of Chinook yearlings was 60,000/year, and this was increased to 350,000/year in the fifth year of the study. During this same period, the numbers of Chinook fingerlings was about 100,000/year, and brown trout averaged about 60,000/year. DFG set minimum growth criteria for the Chinook salmon of 13 inches at 18 months of age, and 16 inches at 24 months of age. This growth criteria was met until the stocking exceeded 170,000 yearlings per year, so ultimately this stocking level was recommended for Chinook salmon at Lake Oroville (DWR 2000). Although the angler catch of brown trout were very low (DWR 2000), DFG decided to continue stocking brown trout because their presence provided additional angler interest in the Lake Oroville fishery.

Prior to the involvement of DWR in the management of the fisheries within the project area, DFG had conducted several fish stocking experiments. In the 1970s and 1980s DFG stocked rainbow trout and lake trout in Lake Oroville with limited success (DWR 2001). Rainbow trout are still caught in Lake Oroville in low numbers. Private fishing clubs also stocked Florida-strain largemouth bass (*M. salmoides floridanus*), white crappie (*Pomoxis annularis)*, white sturgeon (*Acipenser transmontanus)*, and Sacramento perch (*Archoliptes interruptus*) in Lake Oroville, with limited success as well.

The current Lake Oroville stocking program goal is to annually stock approximately 170,000 coho salmon in order to provide a satisfactory coldwater fishery. This recent program developed as a result of a severe outbreak of Infectious Hematopoietic Necrosis (IHN) virus in the FRH that began in 2000, and was traced back to the presence of IHN in Lake Oroville salmonids. Lake Oroville forms the water supply for the FRH and DFG was concerned that diseased fish in the lake could infect the hatchery. Therefore, DFG issued a moratorium on stocking any salmonids in Lake Oroville until they completed testing on the IHN susceptibility of various salmonid species and varieties. DFG found that Chinook salmon and brown trout, the two species being stocked up to that time, were capable of transmitting IHN and therefore should no longer be stocked in the lake. DFG found that coho salmon were resistant to IHN and recommended that they be stocked to provide for the Lake Oroville coldwater fishery (DFG 2000). In late 2001, DWR located a private aquaculture facility in Washington State (Aquaseed Corporation) that could be used as a source for coho salmon eggs, and subsequently stocked 178,529, and 172,792 coho salmon in 2002 and 2003, respectively. Coho were scheduled for stocking during 2004, however DFG did not allow the importation of the Aquaseed coho eggs because they failed DFG's disease certification process due to a bacterial disease (*Renibacterium*) that was found in some of Aquaseed's broodstock. Subsequently, DFG advised Aquaseed on better procedures to address the *Renibacterium* problem, and it is anticipated that coho stocking will resume in 2005. The coho stocking levels have loosely been based upon those for Chinook salmon, however this may be adjusted somewhat as this new program is being implemented and more information becomes available.

6.0 ANALYSES

6.1 EXISTING CONDITIONS/ENVIRONMENTAL SETTING

As a subtask of SP-F3.1, *Evaluation of Project Effects on Fish and Their Habitat within Lake Oroville, its Upstream Tributaries, the Thermalito Complex, and the Oroville Wildlife Area*, the assessment of fish species composition in the upstream tributaries of the Feather River in Task 1B fulfills a portion of the FERC application requirements by detailing the effects of project operations on fish species composition. Additionally, the results of Task 1B provide information on the ability of fish occurring in Lake Oroville to access habitat upstream of Lake Oroville and potentially interact with resident fish communities in the upstream tributaries. In addition to fulfilling these requirements, information collected during this task may be used in developing or evaluating potential Resource Actions.

Ongoing operation of the Oroville Facilities has the potential to influence accessibility to upstream tributary habitat creating the opportunity for interactions between tributary and Lake Oroville fishes. Operations of the Oroville Facilities affect water surface elevation of Lake Oroville, and the water surface elevation of Lake Oroville influences the ability of fish residing in Lake Oroville to migrate into upstream tributaries. The results of this study provide information regarding the ability of the fish occurring within Lake Oroville to access habitat upstream from the lake to the first upstream migration barrier and evidence supporting the occasional migration of fish residing in Lake Oroville to migrate into upstream tributaries

A fish species list for the study area is presented in Table 6.1-1. The first section of the table includes species that were confirmed to be present by surveys conducted downstream from the first migration barrier. This portion of the table is consistent with a normal fish assemblage for California Central Valley foothill streams as described by Moyle and Nichols (1974), and includes both native and introduced species. The second section of the table lists those species that have been confirmed in the upper portion of the watershed including Lake Almanor, Butt Valley Reservoir, and Bucks Lake. It is possible that these species may occasionally migrate downstream as far as Lake Oroville. For example, wakasagi have been observed in Lake Oroville. These fish most likely migrated down the North Fork Feather River after being intentionally planted in Lake Almanor (Aasen et al. 1998).

Table 6.1-1. Fish Species present in tributaries upstream of Lake Oroville.

Species confirmed present downstream of first migration barrier		
Species	**Native (N)/Introduced (I)**	**Frequency[a]**
Rainbow trout (*Oncorhynchus mykiss*)	N	P
Brown trout (*Salmo trutta*)	I	O
Bluegill (*Lepomis macrochirus*)	I	R
Green sunfish (*Lepomis cyanellus*)	I	R
Largemouth Bass (*Micropterus salmoides*)	I	R
Redeye bass (*Micropterus coosae*)	I	O

Smallmouth bass (*Micropterus dolomieui*)	I	O
Spotted bass (*Micropterus punctulatus*)	I	P
Carp (*Cyprinus carpio*)	I	R
Sacramento pikeminnow (*Ptychocheilus grandis*)	N	P
California roach (*Hesperoleucus symmetricus*)	N	P
Hardhead (*Mylopharadon conocephalus)*	N	P
Sacramento sucker (*Catostomas occidentalis*)	N	P
Sculpin (*Cottus sp*.)	N	P
Species confirmed present upstream of first migration barrier but not present in survey data		
Species	**Native (N)/Introduced (I)**	**Frequency[b]**
Chinook salmon (*Oncorhynchus tshawytscha*)	I[c]	R
Lake trout (*Salvelinus namaycush*)	I	R
Brook trout (*Salvelinus fontinalis*)	I	R
Kokanee salmon (*Oncorhynchus nerka*)	I	R
Tahoe sucker (*Catostomus tahoensis*)	I	R
Tui chub (*Gila bicolor*)	I	R
Lahontan redside (*Richardsonius egregious*)	I	R
Channel catfish (*Ictalurus punctatus*)	I	R
Wakasagi (*Hypomesus nipponensis*)	I	R

a. P = plentiful, O = Occasionally observed, R = Rare or not observed but suspected present
b. These species would all be considered rare in tributary reaches extending from Lake Oroville upstream to the first impassable fish barrier
c. Inland Chinook salmon have been stocked in Lake Almanor

Based on survey results, the native fish species assemblage appears to be the most plentiful in tributaries upstream from Lake Oroville in reaches extending to the first impassable fish barrier. Of the native species, rainbow trout and Sacramento sucker appear to be the most plentiful. The most common introduced species appears to be spotted bass, particularly in the Middle Fork. However, the accuracy of the relative abundance measures reported for each species is limited by the differences in sampling methods and sampling effort among sample reaches.

6.2 PROJECT RELATED EFFECTS

Project operations associated with the Oroville Facilities do not control flows and/or temperatures within tributaries upstream from Lake Oroville. However, operations of the Oroville Facilities do potentially influence other aquatic resources in the upper Feather River up to the first impassable fish barriers. Project operations determine water surface elevations in Lake Oroville that may either block or allow passage of fish species from the lake into upstream tributaries.

In addition to project operations affecting surface elevations in Lake Oroville, Feather River Fish Hatchery operations and fisheries management activities may affect species composition in the upstream tributaries. The presence of black bass species in the upstream tributaries could be a result of warmwater fisheries management practices in Lake Oroville. It also is possible that stocked coho salmon may occasionally stray into upstream tributaries although neither Chinook salmon nor coho have been reported in surveys or the literature.

The habitat available to fish species in tributaries upstream from Lake Oroville is primarily suited to salmonids and other coldwater resident species. Most of the introduced species observed in upstream tributaries, such as black bass species, prefer lacustrine habitat and are only occasional or seasonal users of coldwater riverine habitat. The only introduced salmonid species that seems to have adapted well to upstream tributary habitat are brown trout, which are now an important component of the recreational trout fishery.

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